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Title of Study: A PROPOSED METHOD FOR CHANGING A UNIT WOODWORK SHOP TO A GENERAL SHOP

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Major Field: Department of Industrial Arts Education

Scope of Study: This study deals with the problem of converting a unit woodworking shop to a general shop. The general shop will offer the student work in wood, metal, drawing and electricity. A review of the history of junior high school and the history of the development of electricity are included as background for the proposed change. The objectives of general education and of industrial arts education were reviewed and a course of study planned to meet these objectives. A list of tools, books, and supplies needed, based on the projects selected, were used as the basis for the cost estimate. The projects selected are electrical projects requiring the arts of wood, metal, and drawing in construction.

Findings and Conclusions: At a cost of approximately $425.00 a unit woodworking shop equipped for twenty students can be converted to a general shop. This, however, would be the bare essentials and a more desirable program could be had with an additional expenditure of $1200.00 for tools and equipment. This estimate is based on a class of twenty students of junior high grade level using projects from the proposed list.

Adviser's Approval: ____________________

A PROPOSED METHOD FOR CHANGING A UNIT WOODWORK SHOP TO A GENERAL SHOP

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By

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A PROPOSED METHOD FOR CHANGING A UNIT
WOODWORK SHOP TO A GENERAL SHOP

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CHAPTER I

A PROBLEM OF PROGRESS

Today is said to be the age of automation. The inner workings of industrial machines are being controlled and operated by the forces of electricity. There is said to be a revolution going on in regard to the methods of industrial production. A new industrial art is becoming prominent in the American industrial world. This art is the art of electronics. When the machines of industry are controlled by the forces of electricity, the control is called automation. Automation is not new. Early samples are the windmills of Holland and the Jacquard loom. James Watt's fly-ball governor and the slide valve on his steam engine are perhaps the best known examples of automation. (51, page 37) Men must learn to accept automation and work with it. Automation is a part of the American way of life. The heart of automation, as used today in industry, is electricity and electronics. If industrial arts are to be taught, both electricity and electronics must be a part of these arts.

There was a time when wood was the most common item of everyday living. Man cooked by wood, ate on wooden tables, and lived in wood houses containing wood furniture. Wood was the common denominator of life. Time has marched on, and now electricity is the most common item in everyday life. Man has learned to cook, light, warm the home, travel, and even be entertained by electricity. (44, page 3)

Need for Study. The need for a change in the industrial arts program is evidenced by the change from wood to electricity. There are many small woodworking shops in the schools which need to be changed to general shops, with emphasis on electricity, to meet the changing demands of industrial arts teaching. This study will show a method for bringing about the change.

Method and Restrictions of Investigation. The materials for the recommended change will be obtained from a review of books, theses, reports, and magazine articles by writers in the field of industrial arts education, general education and industry. The study will be limited to those books, theses, reports, and articles found in the library at Oklahoma State University and will by no means include all the material available. Only those the writer feel pertinent will be used.

The Problem. Many of the junior high schools in the state of Oklahoma have well-equipped woodworking shops. The need to convert these shops to general shops offering work in wood, metal, drawing, and electricity is known, but the materials and know-how to do this appear to be lacking. (52, page 63) A problem of finding a method for doing this therefore exists. This study will assume that a school three presents the change. The change will be in the form of objectives for the junior high shop and materials to be covered in meeting the objectives, together with the supplies, tools, and equipment needed in addition to those normally found in a woodwork shop. Chapter four will be a summary together with recommendations for further study.

The leading industrialists and educators of today are saying that this is the age of automation and that it is the responsibility of the school to keep pace. The trend of the day is toward greater use of electricity and electronics. This trend indicates change. A method for this change must be found. The succeeding chapters of this study are an attempt to find a method.

CHAPTER II

HISTORY AND PHILOSOPHY OF THE JUNIOR HIGH SCHOOL AND A HISTORY OF ELECTRICITY AND ELECTRONICS

Part A

History and Philosophy of the Junior High School

In a lecture given in 1949, at Oklahoma State University, Mr. E. P. Chandler, then an instructor in trade and industrial education, stated that no teacher could be sure that his students would learn; at best the teacher could only set up a situation by which learning might take place.

The junior high age group is thought to be a transition period in the development of the adolescent. The junior high is neither high school nor elementary school in nature. The junior high school is something in between the two. The youth is growing from a baby into an adolescent and this growth brings factors common to no other period of life's cycle. Every phase of the child's existence is undergoing drastic change. The body, the moral and mental outlook, and the home and community responsibilities of the child take on a new appearance. The child is at the age of searching, wishing to cut loose from the ways of a baby and take up the ways of an adult. The child trys; but, being inexperienced, many times fails. The failure may be felt deeply or may be felt only on the surface. Much counseling and guidance is needed. At no other time will the child be called upon to make so many changes and at no other time will be so ill-equipped to make them. (40, page 40)

Definitions. The field of education, like all other fields, has its special terms. These terms may have special meaning in the field of education and may or may not have the same meaning for others. In order to avoid confusion, the following definitions are offered:

Adolescent. Person from 13 to 21 years of age.

Curriculum. Set of courses of study for a school.

Drop-Outs. Those who leave before completion.

General Education. Common experiences of all educated men and women.

General Shop. Shop planned for two or more distinct activities. (32, page 14)

Junior High System. An intermediate school between elementary and high school.

Manual Training. Training in work done with the hands.

Prussian System. Education system imported from Prussia about 1840 by Horace Mann.

Secondary Education. That obtained in junior and senior high school.

Youth. The time between childhood and manhood.

6-3-3 Plan. School plan having six years of elementary, three years of junior high and three years of high school. (40, page 24)

6-2-4 Plan. School plan having six years of elementary, two years of junior high and four years in high school.

8-4 Plan. School plan having eight years of elementary and four years in high school. (40, page 1)

The Junior High System. The changing condition within the child has been recognized by educators for many years, and through experimentation with various educational programs, the junior high system has been developed. The junior high system is a part of an overall program most commonly known as the 6-3-3 plan. It comprises the years 7, 8, and 9 of a 12-year program. It is a period of both mental and physical activity on the part of the student. In the first six years much of the activity of the student is physical and during the last three it is mental; the junior high period is one of mixed physical and mental activity. The youth wants to try out this muscle and brain which he is discovering to possess. The student's first few trys often end in failure and he then seeks guidance and counsel. The junior high system is designed to provide him with a chance to try new things and give him guidance to combat his failures. The junior high school is the experimentally proven answer to finding a situation whereby learning, between the ages of eleven and fourteen will take place. No claim is made as to whether the junior high system is the best answer, only that it appears to be.

Historical Development of Junior High School. Historians by nature are fond of tracing every situation back to the beginning of time; but with the junior high school this cannot be done. Certain phases of the junior high curriculum can be traced back to Comenius (1592-1610) and to Rousseau (1712-1778), but the junior high system as a system of education can only be traced back to 1840. There were experimental attempts between 1840 and 1890 to improve the Prussian system which was then in use in American schools and which later led to the establishment of the junior high system. These experiments were mainly curriculum enrichment to help prevent drop-outs. The adding of such subjects as foreign language, algebra, geometry, shop work and household arts was tried with some success.

In 1872-73 and again in 1885-86, President Elliot of Harvard University proposed a study of the school system to try to eliminate wasted time. It was his wish to have the students ready for college work before their eighteenth birthday as was then the practice. The outgrowth of this was a "Committee of Ten" set up to study the educational system of the day and recommend changes. One of the changes this committee recommended was the establishment of the junior high system. The year 1893 saw a "Committee of Fifteen" set up for much the same purpose, and they too, recommended that the junior high system be used. This committee recommended a curriculum which included "Manual Training".

The period from 1900 to 1910 saw many schools experimenting with and establishing junior high schools. Among these Columbus, Ohio, and Berkley, California, were the most successful. Emphasis was being placed on the growth and development of the student both mentally and physically. An attempt was made to stimulate a desire for self-improvement. The student was encouraged to try to find ways to solve his problems in school and not to drop out. In the period from 1910 to 1930, the junior high system grew rapidly and gained much favor with school planners. It was generally accepted as a part of the American education system and as rapidly as possible the 8-4 plan gave way to it. Since that time its use has grown steadily, and today it is found in almost every community. The shift has not been without its problems, but today it is a generally accepted system in American education. (40, pages 1-31)

Part B

A History of Electricity and Electronics

For many centuries man has been interested in electricity and the things he could make it do. Many men have devoted a lifetime to the study of the habits and methods of harnessing these habits to make the electricity do useful work. For many years it was a curious plaything but it has now become a very powerful force. Electricity, when properly harnessed, wakes man in the morning, cooks his breakfast for him, shaves his face, causes his auto to start and run him to his job, drives the machines he works with, lights and ventilates his work area, pumps his water, warms his lunch, tells him when it is time to go home, cooks his dinner, entertains him until bedtime, and then warms his bed or cools it while he sleeps. These are just a few of the many jobs that man has been able to make electricity do. The contributions that electricity makes to everyday life of man are endless.

Definitions. When the topic of electricity is discussed it is often necessary to give the reader some information concerning the meaning of words and terms used in that field. Each field of study has its own vocabulary of words. These words may be found only in that field or they may have special meaning in that field. Electricity is a field of study having many words special to its vocabulary. The definitions used were taken from "The Dictionary of Technical Terms", by F. S. Crispin.

Amber. A brown translucent fossil resin which will become electrified through friction.

Amplifier. A device for increasing the strength of weak currents or sounds.

Battery. A number of primary or storage cells grouped together.

Coherer. Early detector used in radio work.

Coil. Successive turns of insulated wire which create a magnetic field when an electric current passes through them.

Communication. An exchange of messages.

Compass. A permanent magnetic needle balanced about its center used to tell directions on the surface of the earth.

Detector. A device for converting radio frequency signals to audio frequency signals.

Edison Effect. The effect on current when a plate is placed near the filament of a radio tube.

Electricity. Electrons in motion.

Generator. A term applied to machines which transform mechanical energy to electrical energy.

Magnetism. The properties of iron, steel, and certain other metals, by virtue of which they exert certain properties of attraction and repulsion.

Microphone. A device by which sound waves are made to produce a fluctuation of current in an electrical circuit.

Negative. A charge of electricity having an excess of electrons.

Photo-Electric Tube. A device for changing light energy to electrical energy.

Positive. A charge of electricity having an excess of protons.

Radio. A preferred name for wireless.

Static Electricity. Electricity at rest.

Telegraph. A means of transmitting and receiving messages by a series of electrically transmitted signals.

Telephone. An instrument for the electrical transmission of the voice.

Television. An instrument for transmitting and receiving both sound and vision by a series of electrically transmitted signals.

Transformer. An instrument for changing voltage and amperage of an electrical circuit.

Transmission. The sending of electrical signals.

Wireless. A device for sending electrical signals without the use of wires.

Magnetism. The history of electricity starts with the history of magnetism. The date of the discovery of magnetism is lost and the location is known only in legends and stories. It is believed to have been discovered by a shepherd named Magnes near the City of Magnesia in Asia. He found rocks clinging to his shoes that had a metallic look and feeling. The magnet was said to have been used as a direction-finding device by Hoang-Ti, founder of the Chinese Empire, in the year 2637 B.C. He had a figure of a woman mounted on his chariot, the outstretched hand of which always pointed south. Columbus is said to have used a compass in his voyage to the new world. Natural magnet or loadstone is found throughout the world. It has been sought after and kept for centuries for its supposed medical and magic properties. Its most valuable property is its ability to generate a current of electricity in copper wire. (41, page 6)

Static Electricity. The first kind of electricity that man learned to make was called static electricity. A Greek philosopher named Thales (640-546 B.C.) observed that a stone called amber would attract straw, leaves and other light weight objects if rubbed with the hand and placed near them. About A. D. 1600, Sir William Gilbert found other substances that would do this; glass, ivory, and similar substances could be made to attract light weight items. (41, page 8)

Static Electricity Generation. The first man to make a generator for static electricity was Otto Van Guericke. His invention is said to have taken place about 1660. It consisted of a globe of sulphur about the size of a man's head mounted on an axle and turned by a wheel and pulley arrangement. By holding his hand on the ball while it was being turned, he was able to generate a charge of electricity. (41, page 9)

Early Transmission. The credit for being the first to transmit electricity over a distance is given to Stephen Gray and is dated, 1729. He, at the suggestion of Granville Wheeler, transmitted a charge of electricity over a distance of 765 feet using a silk thread and 886 feet of wire. Gray is also credited with discovering that hair and rosin were insulators and that copper was a conductor. (41, page 9)

Kinds of Electricity. A Frenchman, Charles Francis De Cisternay Du Fayin, in 1733, found there were two kinds of electricity. He classed them as Vitreous and Resinous. He observed that items of same materials repel each other. This was the first observance of what is known as positive and negative electricity. (41, page 10)

Electricity at Work. The first man to make electricity work was a Scottsman named Andreas Gordon. In the year A.D. 1742, he made electricity ring a bell and turn a wheel. The credit for the discovery of how to magnetize a piece of steel goes to Hans Christian Oersted, a Danish physicist. In 1820 he discovered that a compass placed near a wire connected to a battery would line up with the wire, and that a needle left near that wire would take on the properties of a magnet. Michael Faraday is given the credit of being the first man to generate electricity, using a coil and a magnet. He is also credited with the invention of the transformer. Samuel Morse and Alexander Bell are not the inventors of the telegraphy and the telephone. The credit should go to Joseph Henry. He demonstrated the method over a mile of wire in 1831, but it was Bell and Morse who made the method commercially possible. Thomas Edison is due the credit for creating the electrical industry. With his invention of the light bulb and the building of his powerplant in New York City, he is said to have created the first practical electrical industry.

Electricity in Communications. The story of the use of electricity to send a message is the story of electricity itself. The use of electricity to cook, heat, and light have been side developments of experiments to develop methods of communications. The first attempt to send a message by electricity was in 1774 by George Louis LeSage, but it remained for Volta to make a dependable battery before the real value of the device could be seen. The first single wire telegraph was built by Joseph Henry in 1831 using an electromagnet developed by William Storgeon in 1825. The system developed by William Cooke and Charles Wheatstone in 1837 was the first commercial usage of electricity to send messages. In 1845 Samuel Morse, using a refined model of the Cooke-Wheatstone device, built the first commercial message service. This service had been extended from coast to coast across the United States by 1851, and across the Atlantic Ocean by 1866. The telephone was first designed and constructed by Phillip Reis, a German, in 1861. In 1867 Alexander Bell, while trying to build a visual aid for his classroom, built the first working model. Bell built the first long-distance line in 1876. The telephone of today was conceived by Edison when he built the carbon microphone in 1878. (5, pages 53-74)

Radio and Television. The last chapter of man's struggle for better communications is the "wireless". It is called wireless since it does not depend on a wire to carry the electricity. Some of the early experimenters in the development of radio and television were James Clark Maxwell --- electromagnets, in 1864; Heinrich Hertz --- transmission of waves, in 1864; Edouard Branly --- a 'Coherer', in 1890; and Thomas Edison --- the 'Edison effect' in tubes in 1883. These ideas and devices were welded in radio as it is known today by Gulielmo Marconi, in 1896.

He made his first trans-Atlantic broadcast in 1903. The development of the Edison tube was taken up by Ambrose Fleming and Doctor Lee DeForest and it is they, who are responsible for its widespread use as a detector and amplifier. The development of television was started by P. Nipkow with the design of his 'scanner' in 1884, but needed the photoelectric tube developed in 1907 to make it work. The electric scanner was developed by V. K. Zworkin in 1933. The first television station came into being in England in 1936 under the direction of J. D. McGeen. (5, pages 75-88)

<u>Summary</u>. Legends are the names of the men who have made great discoveries in electricity. They have created one of the greatest industries in the world. They have made a force so great that, if properly harnessed, can be made to move mountains. There is no task too small or too large for it to do. The names of Edison, Bell, Morse, Henry, Faraday, Orested, Gordon, Grey, Fay, and Guericke are just a few of the great names in the history of the development of this force. These are a few of the men who have performed the experiments and made the discoveries that have made this force useful. This energy is a powerful force and must be handled with care and respect. Great amounts of experimentation have made it possible and great amounts of education are needed to make it do its work. Its history has just begun and there are many chapters left to be written.

CHAPTER III

A COURSE OF STUDY

Part A

Goals and Objectives

The development of any course, be it a course of study or a course of travel, must take into consideration not only where the developer was, but where the developer is. The developer must make recognition of the present and analyze the situation. The traveler must take up a map or a compass and plot a course to arrive at the desired place. The course planner must know the goals of the school to make a course to satisfy those goals.

The Objectives of General Education. Different authors interpret the goals of general education in different ways. Some use many words and some use only a few. Perhaps the fewer the number of words which are used, the more easily these words are understood. Wilber says that, stripped of extra words, the objectives should read as follows:

The purposes of general education are:

1. To transmit a way of life.
2. To improve and reconstruct that way of life
3. To meet the needs of the individual.

Wilber feels that all the goals that might be proposed could be classified under one of the above. (49, page 3)

If the process of transmitting the way of life from one generation to the next were to stop, then all learning would stop. If this were to continue for two generations, then all knowledge would be lost. When civilization was young and life was simple, each parent taught the child the customs of the people and the ways of livelihood; but as the society has developed in complexity, it has been found necessary to establish some central agency to carry out this work, thus the need for schools. Man, due to the complexity of the world, can no longer depend upon himself to educate the children. Man has become a specialist and must depend on other specialists to supply many of the every day needs. The job of education is delegated to the schools.

If society were to do nothing but pass on the way of life, there would be no progress. If there is to be progress, then society must improve the way of life. Man must throw out some of the old ideas and take on new ones. This can only be done by thinking. To improve the way of life, students must be taught to think. Progress is not easy and the student must be taught to look for a better way of life. It is not enough to learn the way of life, students must be taught to improve that way of life.

The needs of the individual are many and complex. The individual needs to learn to take care of the physical and mental health. Man needs to learn to be a part of the group, to learn to be a part of society and to reach the goal of that society. This need becomes greater and more difficult for the student as society becomes more complex. Meeting the purposes of education becomes increasingly more difficult with each new development. Evaluation and reconstruction of the methods become more important. The increased speed of change makes the transmitting of the way of life more difficult.

The purpose of industrial arts education is to assist general education in meeting the goals. If industrial arts shop work cannot assist general education in meeting the goals, then there is no reason for existence. Industrial arts is important only to the degree to which this is done. Industrial arts' only justification for being is to help meet the goals of general education.

<u>Industrial Arts Defined</u>. What is industrial arts? What is industrial arts about? What does industrial arts propose to do? Wilber says it is

> Those parts of general education which deal with industry - its organization, materials, processes, occupations and products - and with the problems resulting from the industrial and technological nature of society. (49, page 2)

By definition industrial arts is a part of general education and must have goals or purposes which will satisfy the goals or purposes of general education as a whole or in part.

<u>Objectives of Industrial Arts</u>: Industrial arts is the outgrowth of changes in educational ideas. Industrial arts had its early conception, as a school subject, as handicraft

work. Industrial arts developed into the "hand and eye" coordination classes of manual training, and, by broadening the field into manual arts. Industrial arts deals with the building of understanding of industrial processes and the problems caused by these processes, with industrial organizations and the functions of these organizations, with raw materials and finished products, and the effects of these upon society. Industrial arts deals with the why and the how of industry.

In order to meet the purposes of general education, Wilber recommends the following objectives for industrial arts:

1. To explore industry and American civilization in terms of its organization, raw materials, processes and operations, products and occupations.
2. To develop recreational and avocational activities in the areas of constructive work.
3. To increase appreciation for good craftsmanship and design, ---
4. To increase consumer knowledge to a point where students can select, buy, use and maintain the products of industry.
5. To provide information about, and-insofar as possible, experience in the basic processes of many 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 industrial processes. (49, page 43)

Industrial arts teaching is valuable only as it meets the goals of general education, and a specific shop or course is valuable only to the degree that it meets the goals of industrial arts. Any shop or course must meet the goals of industrial arts if there is to be value. Things other than the goals may be presented but these will have no value if the goals are not met.

Proposed Goals for General Shop. The general shop as a specific kind of industrial arts shop is one having two or more areas of work. The areas should be related only to the degree that they are related in industry. To give the student as wide a range of experiences as possible, the activities should be as varied as the teacher can successfully make them. The proposal of this study is to have a varied general shop program yet relate the work around a common purpose. Electricity has been chosen as the central theme of the course of study with drawing, woodwork and metal work in sufficient amounts to satisfy the goals.

Objectives for Drawing. The study of the methods and techniques of drawing is common to all forms of industry and should be given its full share of attention in any shop course. The shop drawing and the blueprint are the language of industry and they must be understood if communication is to take place. Essentials among the things the student should know are:

1. drawing tools and materials
2. types of drawings
3. lines and symbols
4. geometric construction
5. pattern development

6. project design
7. procedure planning
8. billing and cost calculation

The student should also be able to:

1. select and use tools and materials
2. produce drawings
3. apply rules of good design
4. apply geometric construction
5. plan a project
6. prepare bill and figure cost
7. discuss drafting as a possible vocation

<u>Objectives for Woodwork</u>: Wood is the most abundant of all materials and should be used wherever practical. Wood gives great satisfaction per unit cost in industrial arts work. The amount of satisfaction to be gained depends upon the amount of knowledge the student has at his disposal. The student should know:

1. shop safety
2. characteristics of common woods
3. measuring and layout
4. tools and their usage
5. fastening devices
6. sanding and finishing

In addition, the student should be able to:

1. select materials
2. select, use, and maintain tools
3. plan a procedure to accomplish a job

4. produce a project from drawings
5. finish a project from drawing specifications
6. discuss woodwork as a possible vocation

Objectives for Metalwork. The American way of life is dependent upon the metalworking industry. Over seven million people are employed either directly or indirectly in the steel industry. Metal is a large industry and deserves consideration in every industrial arts program. The American way of life is dependent upon what is known about metalwork. The student should know:

1. shop safety
2. common metals
3. measuring and layout
4. drilling, punching, and cutting
5. forming
6. jointing
7. finishing

The student should be able to:

1. select materials
2. select, use and maintain tools
3. plan the procedure to accomplish a job
4. produce a project to drawing specifications
5. finish a project to drawing specifications
6. discuss metalwork as a possible vocation

Objectives for Electricity. Electricity is a cheap and obedient servant. It would be very difficult to visualize what life today would be like without this force, yet seventy-five years ago it was in the experimental stage. As a servant, it is available at a moment's call, but the method of call must be known. The language of electricity must be known. The student should know:

1. electrical safety
2. forms and effects of electricity
3. conductors and insulators
4. measurements
5. wiring techniques
6. communications devices

The student should be able to:

1. select materials
2. select, use and maintain tools
3. plan procedure for accomplishing a job
4. produce a project from a drawing
5. finish a project to drawing specifications
6. discuss electricity as a possible vocation

Part B

Outline of Course of Study

To insure that the objectives of the course will be attained, it is necessary to plan the lessons around these objectives. It is necessary to plan a set of exercises, activities and explanations for the student that will cause him to learn what he should know. A set of goals and objectives do not provide a learning situation, they only state what the outcome should be, and the instructor must take these goals and objectives and provide the situation wherein they will be met by the student. Learning experiences take many forms, but the two which the teacher will most likely be using are the theory lesson and the skill lesson. There is no sharp line of distinction between these two. The lessons will often overlap and be related so closely as to be combined. Presented here is an outline of lessons, both theory and skill, which will satisfy the goals and objectives set down in the first part of this study. It should be understood, however, that a lesson does not mean the work for one class period, rather it is a division of subject matter to be covered. It may require more than one class period or it may take only a small part of a period. The work presented here is for the general shop and it may be necessary to present lessons from more than one area at a class meeting. As an example, if an object is to be made requiring holes to be made in both wood and steel, it may be desirable to present them together rather than separately as they are listed in the outline. Part of the projects to be used will necessitate finishing both wood and metal on the same project, and it may be desirable to present a part of the lesson on finishing both materials at the same time. The course outline presented here is designed for the general shop and should provide enough flexibility to accomplish the objectives of general education as well as the objectives of industrial arts education.

I. The lessons for drawing:

A. Theory

1. Language of drawing

   a. basic lines
   b. basic symbols
   c. paper layout
   d. title block
   e. notations

2. Drawing materials

   a. paper
   b. pencils

3. Drawing equipment

   a. T-square
   b. triangles
   c. scale
   d. protractor
   e. pencil compass

4. Symbols

   a. electrical
   b. architectural
   c. mechanical

5. Design fundamentals

   a. mass and proportion
   b. curves
   c. harmony with surroundings

6. Geometric principles

   a. parallels
   b. perpendicular
   c. angles
   d. circles and arcs

7. Area calculations

   a. rectangles
   b. triangles
   c. circles

8. Cost calculations

   a. square footage
   b. board footage
   c. weights
   d. volumes

9. Drawing as a vocation

    a. pay
    b. working conditions
    c. working responsibilities
    d. civic responsibilities

B. Skill

1. Freehand drawing

2. 3-view drawing

    a. side or main
    b. top
    c. end
    d. auxiliary
    e. detail

3. Lettering

    a. alphabet
    b. lining

4. Dimensioning

    a. extension lines
    b. dimension lines
    c. arrow heads
    d. leader lines

5. Isometric drawing

6. Pattern layout

7. Schematic layout

    a. symbols
    b. lines

II. <u>The outline of lessons for woodworking</u>:

A. Theory

1. Common woods

    a. hard woods
    b. soft woods
    c. wood structure and grain
    d. cutting, drying, and milling
    e. uses

2. Measuring and layout

    a. measuring tools

        1. bench rule
        2. combination squares
        3. try square
        4. steel square
        5. folding rules

    b. layout tools

        1. steel square
        2. combination square
        3. compass
        4. dividers
        5. straight edge

3. Cutting stock

    a. hand saws

        1. rip
        2. crosscut

    b. back saw
    c. miter saw
    d. compass saw
    e. coping saw

4. Cutting to size

    a. planes

        1. block
        2. junior jack
        3. jack
        4. jointer

    b. chisels
    c. gouges
    d. draw knife
    e. spoke shave

5. Boring holes

    a. auger bits
    b. drill bits

6. Fastening devices

    a. nails
    b. screws
    c. glue
    d. bolts

7. Holding devices

    a. screw clamps
    b. bar clamps
    c. c-clamps
    d. vises
    e. wedge clamp

8. Preparing to finish

    a. scraper
    b. sandpaper

9. Finishing

    a. staining
    b. filling
    c. sealing
    d. shellacing
    e. varnishing
    f. painting

10. Woodwork as a vocation

    a. cabinetmaker

        1. pay
        2. working conditions
        3. working responsibilities
        4. civic responsibilities

    b. carpenter

        1. pay
        2. working conditions
        3. working responsibilities
        4. civic responsibilities

B. Skill

1. Laying out

    a. length
    b. width
    c. thickness
    d. straight lines
    e. curves
    f. angles
    g. bevels
    h. chamfers
    i. radii

2. Using saws

    a. ripping
    b. crosscutting
    c. curves
    d. dados

3. Using edged tools

    a. planes

        1. flat faces
        2. edge grain
        3. end grain
        4. bevels
        5. chamfers
        6. radii

    b. chisels

        1. flat surfaces
        2. curves
        3. dados
        4. mortises

    c. gouges

        1. mortises
        2. curves
        3. coves

    d. drawknife

    e. spokeshave

4. Using nails, screws and glue

    a. screws

        1. selecting and fitting screwdriver
        2. pilot holes
        3. countersinking

    b. nails

        1. selecting and fitting hammer
        2. driving
        3. clinching
        4. pulling

    c. glue

        1. spreading
        2. clamping

a) hand clamp
b) bar clamp
c) clamp
d) sand bag

5. Scraping and sanding

a. scraper

1. selecting and fitting
2. scraping

b. sanding

1. face and edge grain
2. end grain
3. chamfers
4. radii

6. Applying finish

a. with rag
b. with brush
c. with sprayer

III. <u>The outline of lessons for metal work</u>

A. Theory

1. Kinds and guages of metal

a. steel

1. bright
2. galvanized
3. black
4. tinplate

b. copper
c. aluminum
d. zinc
e. brass

2. Measuring and layout

a. measuring tools

1. steel square
2. barrel rule
3. combination square
4. protractor

b. layout tools

1. barrel rule
2. steel square
3. combination square
4. compass
5. center punch
6. scratch awl

3. Cutting out

a. squaring shears
b. tin snips
c. punches
d. hack saw
e. coping saw
f. cold chisel

4. Files

5. Forming tools

a. hammers

1. ball-peen
2. setting down
3. plastic
4. wood mallet

b. vises
c. anvil
d. form blocks

1. wood
2. metal

e. slip roll
f. box and pan brake
g. stakes

1. square
2. double seaming
3. hatchet
4. conductor
5. beak horn
6. blow horn
7. candle-mold

6. Making holes

a. punches
b. drills

7. Soldering tools and solder

    a. coppers

        1. electric
        2. gas
        3. guns
        4. pencil

    b. solder

        1. sheet metal

            a) cored
            b) pastes and flux

        2. electrical

            a) cored
            b) pastes and flux

8. Riveting tools and rivets

    a. tools

        1. hammers
        2. sets

    b. rivets

        1. iron
        2. copper
        3. aluminum
        4. tinners

9. Bolts and bolting

    a. bolts and washers

        1. metal to metal
        2. metal to wood
        3. Wood to wood

    b. wrenches

        1. adjustable
        2. open end
        3. box end
        4. socket

10. Joints, kinds and uses

    a. lap
    b. soldered

c. riveted
d. pittsburgh

11. Metalwork as a vocation

a. sheet metal

1. pay
2. working conditions
3. working responsibilities
4. civic responsibilities

b. machine shop

1. pay
2. working conditions
3. working responsibilities
4. civic responsibilities

c. body and fender

1. pay
2. working conditions
3. working responsibilities
4. civic responsibilities

d. welding

1. pay
2. working conditions
3. working responsibilities
4. civic responsibilities

B. Skill

1. Layout

a. straight lines
b. parallel lines
c. perpendicular lines
d. angles
e. curves

2. Using metal cutting tools

a. squaring shears
b. tin snips
c. cold chisel
d. saws

1. hack
2. coping

e. punches
f. drills
g. files

3. Using forming tools

a. rolls
b. bending on brake
c. bending on stake
d. beating down
e. bending in vise

1. hammer
2. adjustable wrench

4. Soldering

a. soldering copper

1. heavy metal
2. sheet metal
3. wire

b. soldering gun

1. sheet metal
2. wire

5. Riveting

a. steel
b. copper
c. aluminum

6. Finishing

a. filing
b. polishing
c. shellacing
d. lacquering

IV. <u>The outline of lessons for electricity</u>:

A. Theory

1. Uses

a. heat
b. light
c. magnetism

2. Production

a. friction

b. chemical action
c. mechanical

1. permanent magnets
2. electromagnets

3. Conductors

a. metals
b. non-metals

4. Insulators

5. Circuits, basic

a. continuous
b. series
c. parallel

6. Fuses

7. Transformers

8. Lighting

9. Heating

10. Motors

11. Automotive system

12. Communications

a. telegraph
b. telephone
c. radio
d. television

13. Electricity as a vocation

a. job opportunities
b. pay
c. working conditions
c. working responsibilities
d. civic responsibilities

B. Skill

1. Bell wiring

a. series
b. parallel
c. combinations

2. Measuring

   a. voltage
   b. current
   c. resistance

3. Splicing wire

   a. western union
   b. bellhanger
   c. tap
   d. pigtail
   e. turnback
   f. duplex tap

4. Winding transformers

5. Light wiring and switches

6. Wiring heating units

7. Building motor

   a. winding fields
   b. winding rotors
   c. commutator

8. Building the carbon microphone

9. Building the crystal receiver

10. Building the radio receiver

11. Building the power supply

    a. selenium rectifier
    b. tube rectifier

12. Building the transmitter

    a. F. C. C. regulations
    b. construction techniques

With this outline in mind, the next logical step is to select a group of projects to fit this outline. The student, after being shown some new skill or has been presented with some new information, needs an opportunity to test this information or skill. This is the function of the project.

Part C

Projects

<u>Projects for the General Shop</u>. The purpose of the project in the shop is to serve as a vehicle of learning. The project is to provide a work situation compelling the student to solve certain problems and to have certain experiences. By solving these problems and having experiences, the student will learn the needed knowledge and skill to satisfy the objectives of the course. The amount of learning on the part of the student is said to be a factor of the motivation of the subject for the student. The student will learn in proportion to the personal motivation for the subject. This selection of projects is offered as one which will satisfy the goals of general education and industrial arts, and carry enough motivation to insure the interest of the student.

<u>Selection of Projects</u>. A project for the general shop should contain operations from as many different areas of the shop as possible. The project should give the student an opportunity to work with as many different materials as is practical within the limits of the shop and the school. The electrical project offers this type of experience. Using a simple radio as an example, the student in building such a set would be required to make a drawing, list of materials and supplies, and make a bill of cost. A wood base or cabinet would be required in which to mount the radio and

finishing would be required to make the set harmonious with the furnishings of his room or home. A metal chassis with holes and mounting brackets would be needed. The student would be required to assemble the parts and solder the wiring. On this one project the student would meet many areas of shop work. The completion of such a project gives a more complete picture of the methods of industry than does the unit shop and would make for a more normal picture than does the plan of rotating students on a time basis.

Project List. The following list of projects are found in most of the books on electricity for the junior high shop. The ones selected are found in Electricity and Electronics-Basic by William C. Steinberg and Walter B. Ford. For the most part similar projects will be found in General Shop Electricity by A. W. Dragoo and C. B. Porter, and in Industrial Arts Electricity by C. K. Lush and E. C. Engle. The projects selected were those which contained enough different areas of work to make desirable projects for the general shop. The projects included in this list are not all that may be made by the student nor will the average student be able to make the complete list. These projects are offered as a suggestion of the type of project suited to the general shop and the goals outlined in part B of this report. The projects are as follows:

Name of project	Page number from Electricity and Electronic-Basic by Steinberg and Ford
1. Compass	24

2.	Coil	30
3.	Primary Cell	33
4.	Galvinometer	49
5.	Ammeter	69
6.	Soldering Iron	93
7.	Push Button	101
8.	Buzzer	103
9.	Transformer	121
10.	Shock Coil	123
11.	Circuit Breaker	131
12.	Switch and Light Hookup	139, 140, 141
13.	Table Lamp	147
14.	Continuity Tester	150
15.	Coffee Heater	155
16.	Motor	163
17.	Carbon Microphone	182
18.	Crystal Radio	201
19.	One Tube Radio	204
20.	Two Tube Radio	216
21.	Transistor Radio	216
22.	Solenium Rectifier	223
23.	Full Wave Rectifier	224
24.	Code-Practice Oscillator	235

Part D

Books for Library

The contention of the writer is that no one book is best for the general shop and that a selection of reference books would better fit the current philosophy of education. The shop library should contain many different books, each dealing with a different field of work. For the junior high school shop, the books should be of a general nature and should not be restricted to the areas covered by the course outline or the projects being built in the shop. These books should cover many different fields and provide information that may be used to satisfy the personal needs of learning of the student. While drawing, woodwork, metalwork and electricity may be considered to be the "big four" of industrial arts, there are many other fields that interest the student and, insofar as possible, information on these subjects should be available. As example of this would be plastics. It is difficult to think of a project of recent manufacture that does not contain plastics in some form. The electronics industry is dependent upon plastics as much as it is upon metals in the manufacture of electrical equipment. Other examples are paper, glass, leather, textiles; the list is endless.

The Shop Library. The shop library should include books by several authors on the areas of work being covered and should include other books on as many different fields of industry as the budget will permit. If possible, the library should include books on design, mathematics, tables and formulas, and hobbies. Tool and supply catalogues should be included as well as magazines of industry. It is impossible to list all that should be available. Listed herein are a few as examples.

General Shop

Chris H. Groneman and John L. Ferier
<u>General Shop</u>
McGraw-Hill Book Co. New York, New York
1956 342 pages

Louis V. Newkirk
<u>General Shop for Everyone</u>
Heath Boston, Massachusetts
1952 261 pages

George A. Willoughby
<u>General Shop Handbook</u>
C. A. Bennett Co. Peoria, Illinois
1958 160 pages

Woodworking

J. H. Douglass and R. H. Roberts
<u>Units in Hand Woodworking</u>
McCormick-Mathers Publishing Co. Wichita, Kansas
1955 160 pages

DeWitt T. Hunt and John B. Tate
<u>Hand Woodworking</u>
Harlow Publishing Co. Oklahoma City, Oklahoma
1956 418 pages

Chris H. Groneman
<u>General Woodworking</u>
McGraw-Hill Book Co. New York, New York
1952 220 pages

Ross C. Cramlet
<u>Woodworking Visualized</u>
The Bruce Publishing Co. Milwaukee, Wisconsin
1950 158 pages

Drawing

Shriver L. Coover
<u>Drawing, Sketching, and Blueprint Reading</u>
McGraw-Hill Book Co. New York, New York
1954 377 pages

J. W. Giachina and H. J. Beukens
<u>Drafting</u>
American Technical Society Chicago, Illinois
1955 255 pages

E. M. Hale, Harry McGinnis, and C. L. Hill
<u>Introduction to Applied Drawing</u>
McKnight and McKnight Bloomington, Illinois
1952 79 pages

Metalwork

John L. Feirer
<u>General Metals</u>
McGraw-Hill Book Co. New York, New York
1952 257 pages

John C. Miller

Metal Art Craft

D. Van Nostrand Co. New York, New York

1948 165 pages

Leon C. Smith and Dewey F. Barich

Metalwork for Industrial Arts

American Technical Society Chicago, Illinois

1952 96 pages

Finishing

Harry R. Jeffery

Wood Finishing

Chas. A. Bennett Co. Peoria, Illinois

1957 112 pages

A. B. Pattou

Practical Furniture Finishing

Craftsman Wood Service Co. Chicago, Illinois

1940 112 pages

George A. Soderberg

Finishing Materials and Methods

McKnight and McKnight Bloomington, Illinois

1959 382 pages

Leathercraft

Raymond Cherry
<u>General Leatherwork</u>
McKnight and McKnight   Bloomington, Illinois
1940   79 pages

Chris H. Groneman
<u>Leather Tooling and Carving</u>
International Text Book Co.   Scranton, Pennsylvania
1951   111 pages

Robert L. Thompson
<u>Leathercraft</u>
D. Van Nostrand Co.   New York, New York
1948   147 pages

Plastics

John V. Adams
<u>Plastic Arts Crafts</u>
D. Van Nostrand Co.   New York, New York
1948   147 pages

Raymond Cherry
<u>General Plastics</u>
McKnight and McKnight   Bloomington, Illinois
1941   128 pages

Dwight Cope
Cope's Plastics Book
Goodheart-Willcox Co. Chicago, Illinois
1957 128 pages

Electricity

A. W. Dragoo and C. B. Porter
General Shop Electricity
McKnight and McKnight Bloomington, Illinois
1952 119 pages

C. K. Lush and G. E. Engle
Industrial Arts Electricity
C. A. Bennett Co. Peoria, Illinois
1956 152 pages

W. B. Steinburg and W. B. Ford
Electricity and Electronics - Basic
American Technical Society Chicago, Illinois
1957 246 pages

Radio

American Radio Relay League
The Radio Amateur's Handbook
Rumford Press Concord, New Hampshire
1959 608 pages

R. L. Oldford
Radio-Television and Basic Electronics
American Technical Society Chicago, Illinois
1957 341 pages

H. M. Watson and H. E. Walch
Understanding Radio
McGraw-Hill Book Co. New York, New York
1940 603 pages

Home Mechanics

William H. Johnson and Louis V. Newkirk
Home Mechanics
Macmillan Co. New York, New York
1947 302 pages

Stacey Maney
The Practical Home Handyman
Halcyon House Garden City, New York
1948 331 pages

Douglas Tuomey
Home Maintenance Handbook
Funk and Wagnell Co. New York, New York
1948 331 pages

Magazines

Boys Life
Boy Scouts of America
New Brunswick, New Jersey
$3.00 per year

Industrial Arts and Vocational Education
Bruce Publishing Co.
400 N. Broadway
Milwaukee, Wisconsin
$3.75 per year

Popular Electronics

Ziff-Davis Publishing Co.

Circulation Department

434 So. Wabash Avenue

Chicago, Illinois

$3.50 per year

Popular Mechanics

Popular Mechanics Press

200 E. Ontario Street

Chicago, Illinois

$3.50 per year

Popular Science

Ziff-Davis Publishing Co.

Circulation Department

434 So. Wabash Avenue

Chicago, Illinois

$3.50 per year

School Shop

Lawrence W. Prakken, publisher

330 Thompson Street

Ann Arbor, Michigan

$3.00 per year

Catalogues and Brochures. Tool and supply catalogues can supply a vast amount of information to the industrial arts student in the form of descriptions of tools and processes. Catalogues generally contain many good pictures of industrial products being made and how the products are used. Examples of quality and of cost can also be found in catalogues. Company brochures contain many examples of design and form as well as showing methods of determining quality in design. Generally catalogues and brochures can be obtained free for the asking by writing to the company having the material. The advertisements of the shop magazines will provide many company names and ideas of the materials to be had.

Part E

Tools and Equipment

The plan for any conversion must include a list of tools and equipment that will be needed, in addition to that which is found in the existing facility. The writer assumed that a woodwork shop is to be converted and that it is equipped with the necessary tools. The tools listed will be those needed in addition to the woodwork tools.

The woodwork shop will have benches with vises and the necessary tools for hand woodworking. The shop will not have powered tools other than the wood lathe and the scroll or jig saw. Since twenty is the maximum number of students for a class, the assumption is made that the shop will be equipped for that number, and the recommended tools will be based on that number. This is a recommended list and may or may not include all that might be needed. Instructors differ widely in methods of teaching and therefore differ in the amount and nature of tools and equipment needed. This list may include items that some instructors feel are not needed and may not include some that he might feel are essential.

Tool List. There is great difficulty in trying to make an exact list of every item needed without knowing exactly who the students will be and exactly what they will want to do. The junior high school shop should be equipped to allow the student to explore, and therefore, the shop should contain tools to accomplish these objectives. As many of the tools as possible should be made in the shop by the students and not purchased. Buying such items as soldering coppers for the general shop robs the student of an opportunity to make his own, while buying heating elements; wire, pipe, and wood gives him an opportunity to make his own and learn by doing. These items listed are those which will be needed to make the projects listed.

Prices. The prices included with the list are taken from Brodhead and Garrett Company's 1959 catalog. While prices of different suppliers may vary on individual items, this company's prices give a fair index for cost estimating. The tools and supplies needed should be, so far as possible, put out on bid and purchased from the best bid. The prices quoted are for estimating the cost of the conversion and are not necessarily the exact cost of each item.

Necessary Tools. Listed here are the additional minimum basic tools the writer feels will be needed to provide training in the areas of woodwork, metalwork, drawing and electricity.

Metalwork Area

Tool Name	Cost
4 tinners snips, 10" @4.60	$ 18.40
8 hammers, ball-peen 2 12 oz. @2.30 4 16 oz. @2.50 2 32 oz. @3.05	20.30
1 set of three rivet sets	3.70
1 set of three hand grovers	7.15
1 sheet metal guage	5.50
1 circumference rule, three foot	7.45
1 set of 5 cold chisels	2.15
1 set of 4 punches	2.65
4 hack saw frames @2.55	10.10
1 set of eight drills	2.24
12 files, assorted @1.50	18.00
1 anvil, 30 pound	26.50
1 adjustable end wrench, 12"	3.90
2 adjustable end wrenches, 6" @1.75	3.50
1 set, tap and die, 6-32 to 1/2-13	28.55
6 vises, machinist, 4" @23.80	142.80
6 pliers, slip joint, 6" @.75	4.50
2 pipewrenches, 10" @3.05	6.10
4 dividers, 6" @1.70	6.80

Drawing Area

24 tee squares, 18" @.66	16.04
24 rulers, desk, 12" @1.90 per dozen	3.80
24 pencil compasses @2.15 per dozen	4.30
24 triangles, 60-30, 6" @2.86 per dozen	5.72
24 triangles, 45-90, 6" @3.85 per dozen	7.90
24 protractors, 4" @1.10 per dozen	2.20

Electricity Area

6 pliers, long nose, 6" @2.35	14.10
6 pliers, side cutting, 6", @3.05	18.30
2 soldering guns @6.95	13.90
1 soldering pencil	4.75
1 set nut drivers	7.85
	$ 418.95

Desirable Tools. Listed here are tools which are very desirable for the general shop. While many of these tools are expensive, an industrial atmosphere will be brought to the shop because these are the tools used in industrial shops. Many of the operations can be done by other methods but these tools will provide a workmanlike quality for the shop projects.

Metalworking Area

Tool Name	Cost
1 slip form roller, 24", 20 guage capacity	155.00
1 brake, box and pan, 24", 16 guage capacity	320.00
1 shear, squaring, 24", 16 guage capacity	440.00

1 set of seven stakes	
1 beakhorn @63.00	
1 double seaming @41.00	
1 blowhorn @35.00	
1 hatchet @20.00	
1 creasing @36.00	
1 candle mould @32.00	
1 square @12.00	239.00
1 set of seven allen wrenches	2.00
1 set of six open end wrenches	7.79
1 set of six box end wrenches	8.25
1 set of socket wrenches, 1/2" drive	33.64
1 set of 15 drills	6.97
1 tinners snips, circular, 10"	3.05
1 calliper, outside, 8"	3.20
1 calliper, inside, 8"	3.20
1 anvil, 50 pound	31.25
4 setting hammers, 12 oz. @3.15	12.60
1 furnace, soldering, gas	12.00
2 protractors, 6", metal @7.75	15.50
Drawing Area	
1 set of drawing instruments	6.45
1 tee square, 30"	3.50
1 blackboard protractor	2.40
1 blackboard compass	1.25
Electrical Area	
1 volt-ohm meter	14.90
1 fuse puller	.80
	$ 1,183.26

Having listed the tools and equipment, the listing of supplies is next in order. There are at least five things needed for a learning situation in the shop. These are a student, a teacher, a project, some tools to make the project with and some supplies to make the project from.

Part F

Supplies

At best, the list of supplies for a year can only be a guess. Much will depend upon the number of students in the shop and upon the desires of the students. The ordering of supplies for a shop that has been long established is somewhat easier, in that the instructor can look at the orders of previous years and judge accordingly. In ordering for a new shop with a new program this is impossible, since no past record is available. The only method is to analyze the projects to be built and order accordingly. After analysis of the suggested projects, the following list is offered as a guide. This list is based on one class of twenty students. To obtain the purchasing list for the shop, the list should be multiplied by the number of classes the shop is to serve.

Supply List

Wood, 1" S2S, F.A.S.

Sugar pine	100 bd. ft.	@38.10 per 100	$ 38.10
Mahogany	100 bd. ft.	@58.90 per 100	58.90
Gum, red	100 bd. ft.	@39.70 per 100	39.70
Walnut	100 bd. ft.	@44.70 per 100	44.70

Plywood	
1/2" A-D Fir 32 sq. ft. @.18 sq. ft.	5.76
1/4" A-D Fir 32 sq. ft. @.11 sq. ft.	3.52
Masonite	
1/8" 96 sq. ft. @.07	6.72
Wire	
Heater, Nicrome, 29 guage 1000 ft. @.89 per 100	8.90
Magnet	
10 1/2 lb. spools @.65 20 guage	6.50
10 1/2 lb. spools @.68 22 guage	6.80
12 1/2 lb. spools @.71 24 guage	8.52
1 1 lb. spool @1.49 26 guage	1.49
12 1/2 lb. spools @.84 28 guage	10.08
2 1/2 lb. spools @.93 30 guage	1.86
Heater cord, 18 guage 240 ft. @.44	9.60
Lamp cord, 16 guage 600 ft. @4.47 per hundred	26.82
Hook up, 22 guage	
Solid, 5 100 ft. spools @.76	3.80
Stranded, 5 100 ft. spools @.88	4.40
6 guage, solid, 40 ft. @.20	8.00
Steel	
Flat sheet, 20 guage, 48 sq. ft. @.30	14.40
Rod, mild	
1/8 O.D. 8 ft. @.02 1/2	.20
3/16 O.D. 6 ft. @.02 1/2	.15
1/4 O.D. 8 ft. @.04	.32

3/8 O.D. 4 ft. @.08	.32
1/2 O.D. 4 ft. @.13	.52
Bar, mild	
1/8 x 3/4, 24 ft. @.08	1.92
Pipe, black	
1/8 I.D. 21 ft. @.07 per ft.	1.47
3/8 I.D. 21 ft. @.12 per ft.	2.52
Brass, sheet, 26 guage, 16 sq. ft. @1.25	20.00
Copper, sheet, 20 guage, 2 sq. ft. @1.51	3.02
Lead, sheet, 1/16", 2 sq. ft. @1.50	3.00
Zinc, sheet, 20 guage, 2 sq. ft. @.45	.90
Transite, asbestos sheet, 1/4", 28 sq. ft.	8.40
Battery, dry cell	
# 6 12 @1.10	13.20
Size D 40 @.12	4.80
Size C 20 @.12	2.40
Penlight 80 @.10	8.00
Sal-ammoniac, brick, 4 @.60	2.40
Copper Sulphate Powder, 3 lbs. @.45	1.35
Bulbs	
Neon, NE 2 60 @.08	4.80
105 volt 2 @1.90	3.80
Flashlight, 1 1/2 volts 20 @.14	2.80
Light, standard, 115 volt	
25 watt 20 @.14	2.80
50 watt 20 @.15	3.00

Switch		
Bat handle SP-ST	40 @.42	16.80
Flush, sp-st	20 @.20	4.00
3 way	40 @.30	12.00
4 way	20 @1.75	35.00
Double pole, fused	20 @.90	18.00
Receptacle		
Cleat, porcelain	60 @.15	9.00
Pull-chain	20 @.40	8.00
Fuse plug, 5 amp, 6 doz. @.80 per dozen		4.80
Plug cap, 120 @.10		12.00
Heating element, soldering iron 100 watt 20 @.97		19.40
Clip		
Battery, 5/8 opening 20 @.10		2.00
Alligator @.80 per doz., 10 doz.		8.00
Fahnstock 1000 @.01		10.00
Solder, acid core		
1/8 OD 10 lbs. @1.04		10.40
Solder, rosin core		
3/64 OD 5 lbs. @1.04		5.20
Transformer		
Stancor PA 8421	20 @3.09	61.80
Stancor PM 8401	20 @3.97	79.40
Tube, receiving		
6 J 5	60 @1.12	67.20
80	20 @1.43	28.60

Solenium rectifier		
50 ma	20 @.59	11.80
Filter choke, 6 henry, 50 ma.		
Stancor C1707	20 @1.27	25.40
Socket, Tube		
4 pin	20 @.09	1.80
7 pin	60 @.12	9.60
Head phones		
Single	10 @1.15	11.50
Double	10 @2.00	20.00
Resistors		
4.7 meg. ohm, 1/2 watt	20 @.12	2.40
2000000 ohm, 1/2 watt	40 @.12	4.80
250000 ohm, 1/2 watt	20 @.12	2.40
500000 ohm, 1/2 watt	20 @.12	2.40
3330 ohm, 1/2 watt	20@.12	2.40
1000000 ohm, 1/2 watt	20 @.12	2.40
33 ohm, 1 watt	20 @.18	3.60
10000 ohm, 5 watt	20 @.47	9.40
20000 ohm, 1/2 watt	40 @.53	21.20
Potentiometers, 100000 ohm	40 @.91	36.40
Capacitors		
Electrolitics		
20-20 mf., 150 volt	20 @.97	19.40
20-20 mf., 450 volt	20 @1.47	29.40
4 mf. 450 volt	20 @.68	13.60
Variables, 365 mmf.	40 @.66	26.40

Mica		
.00025 mf.	40 @.15	3.00
.001 mf.	20 @.18	3.60
Paper		
.01 mf.	20 @.18	3.60
.02 mf.	20 @.15	3.00
1 mf.	20 @.53	10.60
Gromets, rubber		
1/4 inch	32 @.02	.64
3/8 inch	144 @.02	2.88
1/2 inch	20 @.10 for 32¢	.64
Rivets, Tinners, Tinned		
2 pound per 1000	3 boxes @1.62	4.80
Screws, machine		
Round head		
6-32 x 1"	1 gross @.80	.80
8-32 x 1"	1 gross @.94	.94
10-24 x 1"	1 gross @1.16	1.16
12-24 x 1"	1 gross @1.48	1.48
1/4-20 x 2"	1 gross @3.02	3.02
Flat head		
6-32 x 1"	1 gross @.80	.80
8-32 x 1"	1 gross @.94	.94
10-24 x 1"	1 gross @1.16	1.16
12-24 x 1"	1 gross @1.48	1.48
1/4-20 x 2"	1 gross @3.02	3.02

Screws, Wood, Bright

Flat head

1/2" - #5	1 gross @.51	.51
5/8" - #5	1 gross @.54	.54
3/4" - # 6	1 gross @.58	.58
7/8" - #6	1 gross @.63	.63
1" - #6	1 gross @.68	.68
3/4" - #8	1 gross @.65	.65
7/8" - #8	1 gross @.72	.72
1" - #9	1 gross @.79	.79

Round head

1/2" - #5	1 gross @.58	.58
5/8" - #5	1 gross @.61	.61
3/4" - #6	1 gross @.65	.65
1" - #6	1 gross @.77	.77
3/4" - #8	1 gross @.74	.74
2" - #9	1 gross @1.57	1.57

Nails

Box

4 D	5 pounds @.16	.80
6 D	5 pounds @.16	.80
8 D	5 pounds @.16	.80

Finish

2 D	5 pounds @.16	.80
4 D	5 pounds @.16	.80
6 D	5 pounds @.16	.80

Brads

1/2" x #18	1 pound @.66	.66
3/4" x #16	3 pounds @.44	1.23
1" x #16	3 pounds @.39	1.17
1 1/2" x #16	3 pounds @.32	.96
Glue, polyvinyl resin		
1 pt. plastic applicators	6 @1.35	8.10
Shellac, white, 1 qt. cans	5 @1.16	5.80
Varnish, flat, 1 qt. cans	5 @1.75	8.75
Thinner, shellac, 1 gal. cans	2 @2.25	4.50
Thinner, varnish, 1 gal. cans	2 @1.44	2.88
	Total	$ 1,164.66

Financing of Supplies. The supplies consumed by the student in any shop course must be paid for. Many different methods can be used but the most popular in Oklahoma seems to be for the student to pay for what he uses. From a survey conducted by Cal Johnson in 1957 on Oklahoma school shop financing methods, the following four methods were found.

1. Student pays shop fee, school furnishes supplies.
2. Student buys materials from school before project is started.
3. Student pays school for supplies used at end of semester.
4. Student furnishes own supplies from outside of school. (58, page 36)

The exact method to use should be left up to the individual school, but it appears that a combination of methods one and four or methods three and four are best for the general shop. The shop will not be able to stock all the items needed by the student for every project and these should be provided from outside of school. Part of the supplies may be obtained in the student's home and this source should not be overlooked. Some supplies may be salvaged for reuse in the shop and the student should be allowed to do so if he wishes. This is particularly true of the radio parts. Their value is diminished little, if any, if care is used in salvaging. The student should be made aware of the purchasing power of his money and should be required to transact some business in the building of his project. It is suggested that the student be required to account for all supplies used in some manner of good business practices. The making of a drawing and a bill of materials to accompany this drawing would satisfy this requirement.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The study of the processes of industry is very important to an industrial nation. The United States is considered by many to be the most highly industrialized nation in the world. Every phase of life in the United States has been industrialized. The teaching of industrial processes is a part of the school program.

Summary. The need for modernizing the school program is pointed out by every newspaper, radio, television program, and magazine that brings the news of the day. This study was initiated to provide information on a method for changing a unit woodworking shop into a general shop offering work in many different areas. A discussion of the place of general shop in the general education program and a study of electricity are given to provide a setting for the change. Objectives for the shopwork have been determined and a course outline with work projects has been selected to meet the objectives. The necessary equipment and supplies have been recommended along with books for the shop library.

The changing condition of world society must be brought into the education system, if the system is to meet the goals of general education. Every boy and girl in school should know the basic concepts of electricity, for electricity in its forms, is responsible for a part of the rapid rate of change in the society.

Conclusions. There is one major conclusion that can be made from this study. It is possible to convert the unit woodworking shop to a general shop within the bounds of the present shop, giving a wider scope of training to the student without changing the general school program. At a cost of approximately $425.00 a shop can be changed from a unit woodwork shop to a general shop offering work in drawing, woodwork, metalwork, and electricity. This is not an easy change for many details found only in the individual shop will have to worked out. The change needs to be made is a foregone conclusion. Time alone will tell if the change is made. After a critical look at the American way of life, the writer feels that electricity must be taught in the school and the shop program should include this area of industrial arts. It is too important to be overlooked. This study has presented a way to bring electricity as well as other areas to enrich the shop program of the junior high school.

Recommendations. Even as this is being written, new developments are taking place in industry and in education. The examining and revising of the shop program must be a continuous process if the program is to meet the needs of the individual student. In an interview with Dr. Paul Arthur, Professor of Chemistry at Oklahoma State University, he said that an understanding of electricity and electronics would go a long way toward starting boys and girls on the way to a successful career in science and physics. The President of the United States has said that this nation is in short supply of scientists and physicists. To train personnel for these positions the schools must start the students at an early age. A means of starting young boys and girls in the study of science is in order. The writer believes that the shop is an excellent place to start these students, and that a survey is needed to determine if this is true. If this is true, a study will need to be made to determine at what age the training should begin and how this training might be done.

This study was initiated to consolidate the thoughts of the writer; but, while the study has given a solution to one problem, it has brought to mind many others. This study has pointed a way and it has reached a destination, but there is still much work to be done. The general shop has come a long way but there is much room for improvement. The general shop plan has attained a high degree of efficiency, however, with the rapid advances being made in industry much research and planning is needed to bring the advances into the classroom.

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MASTER OF SCIENCE

Report: A PROPOSED METHOD FOR CHANGING A UNIT WOODWORK SHOP TO A GENERAL SHOP

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