FUNDAMENTAL FACTORS IN THE EVOLUTION OF NON-VOCATIONAL AUTO-MECHANICS

by

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INTRODUCTION

Statement of the problem

This study was undertaken in an attempt to discover what should be included in a course of non-vocational auto-mechanics in order to make it richer in content and functional to those who elect to take it.

The conventional method of teaching auto-mechanics is to have the students working on cars or working parts of cars for the greater part of the time, calling them together occasionally to give the necessary information and instructions that are deemed opportune. In some situations, teachers set aside a certain portion of the week for a definite study of the automobile, following some accepted textbook as a guide to study. In nearly all situations the emphasis is definitely on the manipulative processes of repair.

The writer has felt a dissatisfaction with this conventional method of teaching auto-mechanics because of the stress on the manipulative processes and the failure to take advantage of the opportunity for the introduction of a wealth of related material. The textbooks available are not suited to non-vocational auto-mechanics meeting industrial arts objectives for they reflect almost entire-

ly the vocational aspect, emphasizing trade knowledge and applications. Related contacts with other branches of learning have been omitted, much to the detriment of industrial arts objectives in auto-mechanics as a medium of secondary education. For these reasons existing textbooks are of value only as reference material.

Method of procedure

The study includes a resume of developments of the past decade, in the automotive industry and in schools, as follows:

1. Manufacturing field
   - (a) Trends in engineering design
   - (b) Improvement in fuels and lubricants
2. Servicing field
   - (a) Mechanical repairs
3. Education field
   - (a) Training for vocational apprentices
   - (b) Training for general education (non-vocational)
4. Expert opinion
5. External influences
6. Probable future developments

SECTION II

DEVELOPMENTAL FACTORS

Development in the manufacturing field

During the past decade the automobile industry has undergone a tremendous change. From the time of its obscure beginning in the early 1890's when Charles and Frank Duryea placed upon the market their "horseless buggy," to the present time when its size and scope place it among the most outstanding industries of the world, no period has been so revolutionary as that from 1928 to 1938. During that period many of the most outstanding changes in design, refinement, and efficiency have taken place.

The improvement in the materials available -- alloy steels, synthetic substances for accessories, interior decoration, etc. -- has been a challenge to the designers of cars. Ten years ago it seemed that the peak of car perfection had been reached. Engines seemed to have reached a suitable standard in regard to stroke and bore. The maximum power seemed to have been developed in the various models. Many of the difficulties of cooling and lubrication had been met. Four wheel brakes had been introduced and were nearly universally used with such success that they seemed to be nearly perfect. Bodies had so changed their lines that they no longer resembled

carriages and wagons. Major overhauls were not needed as often as previously, and the life of the car in general had been definitely lengthened. It was hard for the public to see how improvements could be made.

Possibly the anxiety with which the world awaited Ford's Model A car was the spark that caused the industry to start research and experimentation. It was about that time that engineers realized automotive design had gone as far as it could with the compression ratios then in use and without major changes in conventional motor car construction. Experiments were then begun with engines of higher compression ratios. Many were the obstacles to be overcome; chief among these were cooling, combustion chamber design, better lubrication, and the development of anti-knock fuel. By extending water jackets to the bottom of cylinder walls and to the areas surrounding valves, and by the adoption of thermostats to control the circulation of the water, and other refinements to the cooling system, cooling problems were cared for. Combustion chambers were so changed that there was no place for burned gas to lurk and so the full force of the expended gas could be used for power purposes.

Lubrication was improved by adoption of the full forced lubrication system, insuring an oil film between moving parts and eliminating all metal to metal contacts,

still further reducing the frequency of major overhaul and repair work. Many innovations have been introduced, such as the vacuum controlled distributor, thermostatically controlled choke, voltage regulators, automatic starters, down-draft carburetors, oil cooling and purifying.

Not alone has the engine been the subject of this wave of improvement, but bodies have been streamlined to cut down wind resistance; lowered to give lower center of gravity which makes for comfort and better roadability; widened to give more roominess and comfort to the traveler; and equipped with radios, glove compartments, clocks, ash trays and other items promoting safety, ease, and enjoyment. Body construction has been changed to eliminate wood as a constructional material. All-steel tops are now universally accepted as a standard practice. Interiors have been soundproofed and insulated..

The development of the synchromesh transmission, with its silent, constant-mesh gears, has eliminated a great amount of objectionable noise, and has reduced failure to a minimum. The lowering of bodies has caused the adoption of hypoid gears in the rear end of most cars, giving a lowered drive shaft and eliminating the tunnel in the floor of the car.

Gasoline, as it was produced in 1928, was found to be unsuitable for use in the high compression motors, thus causing research and experimentation in the field of

petroleum engineering for suitable fuel. Kuns (9:165-166) tells us that the General Motors Research Laboratory tested some 33,000 chemical compounds before they perfected Ethyl fluid. And yet, without that improvement, the high powered, high speed cars of today would not be practical because of great cost and high upkeep.

Development in the servicing field

When an industry as gigantic and far-reaching as the automobile industry undergoes such revolutionary change as has been described, we are not surprised to find that all fields of endeavor connected with it have also undergone major changes. New machines had to be devised to produce these new type cars, and workers had to be trained to manipulate these new machines. Likewise, it has been necessary to make radical changes in the method of furnishing service for these redesigned cars.

Prior to this period of advanced automotive design, the independent garage was able to give as good service in all branches of repair and upkeep as were the car agencies. The service station was limited in most cases to the dispensing of oil and gas and to the minor repair of tires. Now all this has been changed. The new type of car has brought about an era of specialization, requiring new modern, and expensive equipment. Above all, there must be training in the use of this new equipment, which of

course is definitely a problem of the vocational school. A. C. Goodrich (7:39)* reports the result of a study of the equipment and service methods of a number of garages and service stations around Waukesha, Wisconsin. The study, made to determine what service men were doing to keep abreast of modern developments, states definitely that

> "the old type of heavy repair work is a thing of the past and in its place has arisen a new type of automotive maintenance service. Recent improvements in construction and materials enable the owner to drive his car a greater number of miles without having to make any major repairs. In fact, there was a marked absence of honing, reboring, rear end, transmission and other types of heavy repair work in all of the shops that were visited. However, on the other hand, there seemed to be a large volume of electrical motor tuneup, lubrication, brake, fender, washing, and polishing work done. Shops which were equipped to render this new type of service were doing good business."

Much of the heavier type of repair work that remains is done in the car agencies where they are equipped with jigs, gauges and other special devices for the maintenance of the particular make of car for which they are sales and service representatives. A collection of these special tools in an independent garage, sufficient to service all makes of cars, would be financially impractical. Thus we see that the independent garage man has had to turn to specialized service in order to remain in business.

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* Refers to the numbered bibliography and page, respectively. See pages 29-30.

An example of the specialization may be seen in the matter of lubrication. The great variety of lubricants required, together with the equipment necessary to dispense these lubricants, takes lubrication out of the hands of the amateur. The "grease monkey" of the old type garage, who was generally the shop flunky, has been superseded by the lubrication specialist, a man trained to know the various types of lubricants, and the correct places to use them in all the various makes and models of automobiles.

Wheel aligning has become a highly specialized business. The new steering gears, larger tires, and the need for the perfect balance of wheels, makes the work one that requires accurate adjustment of caster, toein, camber, and turning radius. This work can no longer be performed by a mechanic with improvised apparatus. It requires careful check with accurate instruments, and the service of a skilled operator. Frequently this work is coupled with brake service called "safety service." Relining of brakes and brake adjustment has become highly specialized. It, too, requires expensive equipment and the service of a highly trained man.

Electrical and motor tuneup is a highly specialized and technical business. It requires the use of motor naalyzer, gas analyzers, vaca-meter, distributor synchro-

nizer. These pieces of apparatus have taken the "guess" out of "trouble shooting," enabling the expert to locate trouble and remedy it with speed and certainty.

Body and fender repairing, and refinishing now require the employment of men who specialize in this work. The massiveness of modern fenders and the all-steel bodies have made this branch of the service work an important one. No longer are we satisfied to have fenders "bumped out" by a mechanic. They must now be returned to us with all traces of the accident removed, and the finish so restored there is no evidence of the former damage.

Valve grinding, once a frequently performed operation on a car and a source of considerable income to the garage owner, has been eliminated largely by the improvement of materials constituting valves, and by the installation of hardened valve seat inserts. The cost of the equipment and the infrequency of performance of the operation has made it unprofitable for those who do little of this work. This is likewise true of many other service operations.

The future of the independent service man then, points toward this new type of service. He cannot be oblivious to the changes that have taken place in his field and remain in business.

All of which -- the specialization of service work and equipment-- points to a necessary change in the educational phase of auto-mechanics as now conducted in

the non-vocational or industrial arts program of secondary education

Development in the educational field

Another phase in the great change in the automotive industry is that dealing with the training of workers and the teaching of automobile mechanics. It can be seen readily that the relatively small number of persons required as general all-around mechanics will, of necessity, limit this type of training. The need, however, is for a training of a different nature. It requires the teaching of these specialized branches of an industry, most phases of which have completely changed in the past ten years. That is a challenge to the vocational schools of the nation. They must equip themselves with the latest improved devices and train the prospective worker to use them with intelligence.

A. C. Goodrich (7:42) deduces from an examination of the courses of study of a great number of large and small high schools that

"1. The school has failed to change its automotive course so as to provide training for many of the newer and more demanded service occupations.

2. It has failed to take into consideration many of the latest developments and improvements in the automobile engine and chassis.

3. It has failed to train the student to use scientific motor testing equipment found in the modern service setup.

4. It has spent too much time and effort on training for manipulative skills and not enough on training the student to make the necessary social adjustments which he will have to make when working for an employer.

Again Goodrich (7:42) says,

> Perhaps great advancements have been made in the automotive-service field during the past three years than in any other occupation. Being responsible for the training of young men to enter this occupation, means to modernize courses, methods, shops, and equipment to harmonize with the progress that the occupation has made.

John Claude (4:331) states the problem in this fashion:

> The high school, too, seems to have difficulty in deciding just what is to be done in its auto-mechanics courses. In some high schools the subject is treated from the industrial arts viewpoint. In others it is looked upon from the technical and trade angle. In still others, a happy medium seems to have been struck and the subject is taught from both an industrial-arts and a vocational-educational standpoint. In the past few years the subject has been taken out of a number of high schools in small towns. The reason for this probably may be assigned to the fact that the instructor thought it was his business the run a repair and servicing garage in the school.

Again Claude (4:331) says,

> The auto-mechanics departments that seem to have the greatest difficulties are usually those having instructors who believe that the only worth-while thing to teach is automobile repairing. Probably there is no other subject in which there is such diversity of opinion as to the proper course content. This may be attributed to the lack of effort on the part of many teachers

> to determine just what should be included in an auto-mechanics course having the industrial-arts objective, and what to put into the course when trade training is the end in view. In most cases, where difficulties exist, no course of study has ever been prepared and many teachers of auto-mechanics seem to think that the use of a textbook is an expression of weakness. Some of the tragedies that have been observed are where the high school auto shop exists purely as a service garage for faculty cars. In other cases, the teaching equipment in the shop dates back to 1925 and earlier.

Both of the writers quoted above have placed the problem squarely up to the teacher and the school. They probably are right in scathingly denouncing the teacher who has followed the path of least resistance, and who has not sought to improve the course of study to the best of his ability. Quite often a deciding factor, aside from the lazy teacher, is the financial support, Homer D. Sayre (13:45E) says,

> Public school programs, which had been developed for the purpose of assisting industry in the training of apprentices and other workmen, in many cases were almost destroyed by elimination of classes to meet reduced revenue because of failure to collect taxes.

Not only has the lack of funds limited the program of the trade school and apprentice training, but it has affected all branches of industrial arts work as well. Now that the emphasis has been directed away from the repair end of the training, schools have introduced courses of the industrial arts type that do not require

the expensive equipment found to be a necessity in trade schools.

John Claude (4:331) describes a situation in which the first year work in auto-mechanics of a pseudo trade nature was removed from a basement repair shop, to a second floor room and reorganized according to industrial arts objectives. There modern automobile units were studied. The room was hung with instructional charts and the laboratory work consisted of taking down and reassembling the selected units of the motor car. Thereafter, the second year, work consisted of repair on "live" equipment in the basement shop.

H. W. Paine, (12:287) in his article entitled, "Auto-mechanics in the School," says,

> First of all, the status of one- and two-period Auto-mechanics courses in a cosmopolitan or technical high school, in relation to other aspects of auto-mechanics teaching, should be made clear. These industrial arts courses are not and should not be made vocational in character. Any attempt to disguise their true field by labeling them, misguidedly or otherwise, as "vocational" and carrying them on with vocational objectives only, in mind, detracts from their value and importance.

In stating the objectives of an industrial arts course, Paine briefly outlines seven, making no attempt to arrive at an order of importance.

1. Avocational and leisure time.
2. Intelligent consumer.
3. Work habits and safety.

4. Motivation and tieup.
5. Personality trait and ethical development.
6. Citizenship and social adjustment.
7. Guidance and exploration."

It is significant that no mention of perfection in skills is made in the foregoing list of objectives. An elaboration of this point of view is carried in the statement of the committee of the American Vocational Association (1:43-44) concerning auto-mechanics. It follows:

> "There appear to be very wide differences of opinions as to what unitsof instruction should be included in a course of automechanics for high school boys. Some hold that it should cover only the minor adjustments and care, while others would have the work cover major repairs. These differences of opinion arise out of a lack of a common understanding as to the purposes of the work.
>
> "The primary purpose of a course in automechanics in the high school is not to teach boys to repair automobiles, as a vocation, but to teach them the fundamental mechanical principles involved in other machines as well as in the automobile. In addition, we wish to teach them how it operates, how to care for it, and how to make minor adjustments. When the instruction material is selected and organized on this basis, it will be seen that it offers an opportunity far beyond the mere making of repairs and adjustments; and pupils may study with profit the construction and operation of mechanical parts which it would be unwise for them to attempt to repair or adjust on a car, as a matter of service.
>
> "In some of our schools much time has been wasted in tinkering and making minor repairs when the time should have been used for a study of the fundamental principles of the machine. If we are to train one to use and care for the car intelligently, the instruction must be

specific and systematic. In order to illustrate the fundamental things we wish to teach, the equipment must be sufficient and of the proper character. It should be permanent, and so arranged that it is available for instructional purposes with the least possible delay and without any unnecessary, non-instructive labor. We cannot depend upon friends or faculty members with obsolete models to furnish us with the kind of material needed for instruction, and to furnish it when it is needed. If we rely upon chance or accident to bring us our instructional material, the supply will be irregular, time will be wasted, and the boys will be required to do a vast amount of work from which they receive no educational returns.

We maintain schools for instructional purposes, and there is no virtue in doing a production job unless it contains the elements we wish to teach in some proportion to our needs. Production jobs are highly desirable under certain conditions, but it is better to give time to experimental and practical work, which is known to contain the things we wish to teach, than to spend time in repetitive work in production jobs after the processes have been thoroughly learned. A "clinic" is highly desirable at times, but it should not be permitted to monopolize the time allotted for instruction in fundamental principles.

We must not overlook the fact that in the study of this machine a boy will have an opportunity to learn a number of things of value which are not confined to the automobile in their application. This will justify far more extensive work on the automobile than would be justified on the basis of the care and operation of such a machine. There are many fundamental mechanical principles involved, the applications of which are found in other machines, and the automobile offers an interesting opportunity for their study.

A. H. Vance, (15:209) says,

There are certain fundamentals used in the construction of automobiles. These must be considered in the school, for they are definite facts, which remain unchanged over long periods

of time. Summing them up briefly we can say that they are simply common-sense mechanical principles, which are consistently applied to automobile construction. An entire semester can be devoted to teaching these principles."

Vance (15:209) installs the guidance factor by saying that industrial methods of building, repairing and distributing automobiles should be discussed in class, together with the chances for success in the field.

Bonser, in discussing objectives of industrial arts subjects, (2:1-2), says,

> "The school study called industrial arts derives its purposes, content, and methods from the problems that confront us in supplying our material needs. As consumers of products, we can select and use the products of industry intelligently and satisfyingly only in so far as we know their qualities and values in relation to their purposes. By studying the materials and the changes made in them to increase their values we can learn these qualities -- appropriateness to purpose, durability of materials and construction, beauty, economy, and the proper basis for use and care. As citizens, such studies provide us with that knowledge of sources, production and distribution that helps us to contribute intelligently to such regulations and cooperative practices as will help to secure just and fair treatment of both producers and consumers. As educated men and women, these studies give us a knowledge and intelligent appreciation of how man has made the world-wide resources of the earth contribute to his satisfactions."

Again Bonser (2:5) says,

> "The work in the beginning was literally 'manual training.' Now it is far more 'mental' and 'social' than 'manual,' as any legitimate educational work must be."

Drew W. Castle (3:109) offers,

> . . . a short course for all high school boys as a part of a general shop course, designed to made them safe and intelligent consumers of automotive transportation.

Max Drucker (5:143) offers for his course in auto-mechanics, these objectives:

1. To dreate interest in the sciances.
2. To help the student learn something about the principles that underlie the successful operation of the automobile.
3. To make the student realize the importance of extreme accuracy.
4. To inculcate respect for labor, skill and honest effort.

Another course, offered in Central High School, Binghamton, New York, by Carlton E. Dwight (6:214-215) is called Auto Economics, and lists as divisions of the course these titles:

1. History of Land Transportation.
2. Social Changes Caused by the Automobile.
3. Construction of the Automobile.
4. Mechanics of the Automobile.
5. Engineering Methods in the Automobile Field.
6. Industries Allied to the Automobile.
7. Occupational Opportunities and Requirements.
8. Ownership of an Automobile.
9. Driving an Automobile.
10. Traffic Control.
11. Touring by Automobile.

William A. Smith, (14:143-144) says of objectives,

> Such an age demands above everything else a citizenry that has a realistic first-hand acquaintance with the modern man-made world; a citizenry that understands the factors that condition the productions and distribution of the basic means of livelihood so well that it can vote intelligently on all issues; a citizenry that understands and appreciates the contribu-

tions and the rights of the many diverse elements that comprise it; a citizenry that consumes discriminatingly in keeping with tried and tested values; a citizenry that is schooled in the practice as well as in the theory of democracy. To the development of such a citizenry the practical arts, properly conceived and soundly articulated with the social studies, should make a major contribution.

SECTION III

OBJECTIVES, COMPARED

Objectives for non-vocational auto-mechanics

A summation of the objectives for non-vocational auto-mechanics projected by the writers previously quoted gives us these:

1. Avocational and leisure time.
2. Intelligent consumer; knowledge of sources, production and distribution.
3. Work habits and safety.
4. Motivation and tieup.
5. Personality trait and ethical development.
6. Citizenship and social adjustment.
7. Guidance and exploration.
8. Teach fundamental principles, including operation, care and minor adjustments.
9. To create interest in the sciences.
10. Inculcate respect for labor, skill, and honest effort.

In a list of objectives projected in the form of these preceding, much room is left for speculation as to what is the intended meaning of some of the items. We may have our own ideas about motivation and tieup, but what is the idea that the writer considered important enough to include in his objectives? The item of

personality trait and ethical development is also one that depends largely on the personality and influence of the teacher rather than on the course of study. It can be imagined that if a study of the traffic laws and responsibilities imposed on drivers is taken to heart, that the ethics of the individual might be improved; however, much depends on the influence of the teacher. Personality traits and ethical development are as hard to teach as are attitudes; and all are problems of great importance. The writer feels that these are more a matter of influence by the personality of the teacher than a matter of education.

Avocational and leisure time is an objective to which we can contribute in a definite way. There are certain things that people can do toward the upkeep of their cars that are not too technical, or out of their reach because of the equipment necessary. Some of these operations are washing, polishing, cleaning of the interiorsof cars, cleaning and adjusting spark plugs, flushing radiators, draining oil pans and refilling, repairing minor tire troubles, cleaning air filters, etc.

Making an intelligent consumer is one way that we can serve with a proper course. A thorough understanding of the materials going into a car, and what is necessary to keep them functioning in the most economical way, will do much to make satisfied owners. Only with this knowledge

are consumers able to appreciate values and advantages that the modern motor car affords.

The objective, work habits and safety, may be used in two ways, first, a study of the way to perform work to one's advantage and the safety in theperformance of that work; second, a study of the work habits and safety methods of those using and servicing the automobile. This latter could better be classed under the heads of guidance and exploration, citizenship and social adjustment. It is from this meaning of the term that we will deal with the objective, work habitsand safety.

Citizenship and social adjustment can be furthered by a course in auto-mechanics by showing the relationships of one person with another in ownership and operation of a motor car. The responsibility of the individual to society in maintaining the car in good mechanical condition, and in operating it with caution for the welfare of others, is one that can be pointed out while studying the car.

In the field of guidance and exploration, a study of the industries related to the automobile will give the youth an insight into the manufacture, maintenance and operation of the automobile, and will show him wherein his interest might lead to future employment in one of these fields. The laboratory experience afforded will give an opportunity to try out his selected field to a certain

degree, which might help to prove to himself whether or not he really wants to do that type of work.

Teaching the fundamental principles and linking them up with the sciences and other school subjects should stimulate a broader interest in all school work. Often the lack of interest in science of any kind is due largely to lack of adaptations based on the interest of the learner. If a learner chooses to take auto-mechanics, there is reason to believe he has an interest in the work. If it can be shown that the sciences are fundamental to the construction and operation of the automobile, then interest in the sciences should be increased.

The objectives for the course are these:

1. To give training that will make for a pleasant, interesting and worth-while avocational or leisure time activity.

2. To produce consumers informed about an important product, from its source to its final distribution; who know the value of proper upkeep of the automobile both for safety and economy.

3. To teach citizenship and social adjustment.

4. To give guidance by presenting the various opportunities and exploration to a limited degree in the laboratory.

5. To teach the fundamental principles with their

relation to the underlying sciences.

6. To emphasize safe driving practices.

Objectives for vocational courses

A contrast to these objectives for industrial arts auto-mechanics are those presented by Ambrose R. Nichols, (11:82) for trade and industrial training (vocational training). He says,

> The objectives of a trade and industrial program in any field may be stated thus: First, to train the boy for productive employment in the trade of his selection on the various levels; second, to offer opportunities for boys in their commercial courses to receive training in school in the trade they wish to enter; third, to develop boys to become independent workers in their chosen trades; fourth, to instill in the minds of boys habits of good citizenship; fifth, to attempt, through co-operative work, to satisfy the demand in the community for skilled workers; sixth, to attempt to place graduates in occupations for which they are trained; seventh, to educate the community to understand the meaning and value of trained workers.

From this list of objectives it can be seen that there is no contention between the non-vocation, industrial arts type of training and the vocational or trade and industrial program. Each has its own function in secondary education. Our concern in this study is for a functional program of auto-mechanics that will meet the general objectives common to all industrial arts subjects; that will function in the lives of all who partake, in

respect to both the "consumer values" and "safe driving practices."

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to attempt to discover what should be included in a course of non-vocational auto-mechanics to make it richer in content and more functional.

A study of the developments of the automobile industry during the past ten years shows first, that the methods employed by industry have changed radically; and second, the product turned out by industry has been vastly improved, bringing a different emphasis upon automotive service work that can be performed by the layman.

A study of the servicing industry shows that it has become highly specialized and that it requires a different type of training than has formerly been given. The improvement in materials and methods of repair have necessitated new and costly equipment which is out of the reach of the amateur.

The educational program of the secondary schools has not been able to keep pace with developments in the manufacturing and servicing fields. The curtailment of financial support of schools has prevented the installation of the necessary equipment and has therefore prevented instruction in many of the operations necessary to the repair of the car. The need is for the vocational schools

to install the latest equipment and methods in order to give vocational training to workers for specialized service jobs. The objectives of the non-vocational type of auto-mechanics should be shifted from that of manipulative work and pseudo trade-training to give a richer background in the fundamental principles of operating the motor car that will contribute both to "consumer values" and "safe driving."

The objectives chosen for this course of study are,

1. To train for a pleasant and interesting avocational or leisure time activity.

2. To enable the student to become an intelligent consumer.

3. To teach citizenship and social adjustment.

4. To give vocational guidance and furnish an opportunity for exploration.

5. To teach the fundamental principles with their relation to the underlying sciences.

6. To emphasize safe driving practices.

The units of the course and the references for study have been chosen with these objectives in mind. These will not bring the desired results, however, unless the teacher makes a constant effort to realize the objectives in directing the study of the student.

No attempt has been made to assign time limits to the various units. This would be futile until the course has been used and experience gained in actual practice. Actual interest on the part of the students should be one of the deciding factors on the length of time to be spent.

It is recommended that a laboratory type of shop be used in place of the usual pseudo service garage type. The laboratory should be equipped with selected units of the automobile that can be taken apart and reassembled for study rather than for repair. Equipment should also be on hand to make visual demonstrations of the lessons to be taught.

While the tests submitted as a part of the course of study for the various units might not fit the local conditions of other teachers, they are suggestive of the points emphasized by the units. It is reasonable to say that in a course of study of such scope, no two teachers will emphasize the same points. Possibly a good way to discover the important points of a unit is to watch student reactions which should of course be reinforced by adult judgment of the teacher and of trades people.

There are several reasons for the use of the "pre-test" or "exploratory form."

1. It shows the student that there is more to the subject than is evident on first thought.

2. It gives the teacher a knowledge as to the information, attitudes and understanding that the student may have about that particular unit.

3. It assists in orienting the teacher and gives ground for intelligent approach.

In this course of study no unit has been prepared on "Traffic Safety" as such. The teaching of safety has however been placed in the unit on "Automobile Economics." The reason is that the average high school student is prone to take chances and show a bravado. Anything that smirks of safety is a show of weakness. It is hoped that the safety idea, then, can be worked in with better results under the "economics" heading.

The outcomes of such a course, successfully completed, should be understanding of traffic laws, knowledge of safe driving principles as applied to normal driving and to emergencies, better knowledge of consumers' values as related to the automobile and to mechanical merchandise generally, a broader respect for work skillfully executed, a broadened view of the curriculum of the school through applications of the sciences and the social studies, a better perspective of life with its various interlacing activities, and prima faciae evidence of qualification for a drivers' license.

SECTION V

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11. Morrison, Henry C. The practice of teaching in the secondary school. Chicago, Ill. The University of Chicago Press, 1926.

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16. Trillingham, C. C. The unit of instruction in the organismic approach to curriculum revision. California Journal of Secondary Education, 11: 467-470, 1936.

17. Vance, A. H. The modern auto shop. Industrial Arts and Vocational Education, 23: June 1934.

APPENDIX I

UNIT I

TRANSPORTATION DEVELOPMENT

Unit Outline

A. Early History of Transportation

1. Prehistoric
2. At the time of the earliest history
3. First real roads
4. First opening of the Suez Canal
5. Roman transportation
   - Triremes
   - Development of roads
6. Venetian transportation
7. Development of guilds
   - Road, bridge and canal development
8. Crusades
   - Caravan
   - Sea transportation extended
   - Closing of ancient trade routes by Turks
9. Seventeenth century transportation
   - Development of canals
   - Local maintenance of highways
   - Appearance of mail coaches

B. Development of Transportation in America

1. Boats and rafts on natural waterways
2. Sea transportation powered by sail
3. Pack horses, pony express
4. Stage coach
5. Development of pike roads
6. Erie Canal, 1825

7. Development of coachcraft
8. Steam
    a. Railroads
    b. Shipping
    c. Communication

C. <u>Change in Transportation Caused by the Automobile</u>

1. Steam automobiles
2. Electric automobiles
3. Gasoline automobiles
4. Diesel-driven automobiles
5. Air transportation
6. Road development

D. <u>Change in Industry Caused by the Development of the Automobile</u>

UNIT I

TRANSPORTATION DEVELOPMENT

Unit Introduction

The high school student of today has lived entirely within that period which has had gasoline engines as power for automobiles. Possibly some have not stopped to think that the development of the gasoline engine and the automobile, as we know it, was a long process. Few students, probably, can see much change in the aeroplane, but progress has definitely taken place during our lifetime. The aeroplane is relatively young compared to the automobile. In like manner there were other forms of transportation before the automobile was developed.

It is the purpose of this unit to trace transportation from its earliest sources to the present time, with special emphasis on that portion dealing with the development of the automobile.

UNIT I

TRANSPORTATION DEVELOPMENT

Unit Test--Exploratory Form

Name_____Class Hour_____Date_____

Directions: Fill in the above blanks. Write your answers on a separate piece of paper, and return both papers at the close of the class period. Be sure to write your name on the answer sheet.

1. What were the earliest known means of transportation?

2. How extensive was commerce at the beginning of history?

3. What were the dangers that had to be faced by early carriers?

4. In which direction was the greatest progress in commerce, prior to the 17th century?

5. Knowledge of what mechanical device gave the early American settlers a transportation advantage over the Indian?

6. What changes in transportation did the development of the steam engine make?

7. What influence did the steam railway have on highway transportation?

8. What is the earliest record of a self-propelled vehicle?

9. Why is the gasoline engine preferable to the steam engine for automobile use?

10. Why is electrical power impractical for automobile use?

11. Make a list of all the transportation carriers that you can. (This list may be made from those with which you are familiar, have read about, or have seen in the moving pictures.)

UNIT I

TRANSPORTATION DEVELOPMENT

Guide for Study

A. Early History of Transportation

1. Prehistoric
2. At the beginning of history
3. The first real roads
4. First opening of the Suez Canal
5. Influence of the Romans on transportation
6. Influence of the Venetians on transportation
7. Influence of the development of guilds on transportation.
8. Influence of the Crusades
9. Development during the 17th century.

References:

Pound: "Transportation Progress"

Bouton: "An Outline History of Transportation".

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*Note: Complete reference bibliography is found in APPENDIX II.

UNIT I

TRANSPORTATION DEVELOPMENT

Guide for Study

B. Development of Transportation in America

1. Boats and rafts on natural waterways
2. Sea transportation powered by sail
3. Pack horses
4. Pony express
5. Stage coaches
6. Development of pike roads
7. Building of the Erie Canal in 1825
8. Development of coachcraft
9. Steam as power for boats
10. Development of steam railroads
11. Change in transportation caused by steam

References:

Pound: "Transportation Progress"

Bouton: "An Outline History of Transportation"

Lapp, John A.: "Practical Social Science," 154-176, 156

Bogardus, E. S., "Sociology," 145

Exercise 1. Develop a list of books and stories that you have read about these eleven stages of transportation development in America.

UNIT I

TRANSPORTATION DEVELOPMENT

Guide for Study

B. Development of Transportation in America - 2

Exercise 2. Develop a list of moving picture plays that used these eleven stages of transportation for their theme or used them as a part of the play.

UNIT I

TRANSPORTATION DEVELOPMENT

Guide for Study

C. Change in Transportation Caused by the Automobile

1. Steam automobiles
2. Electric automobiles
3. Gasoline automobiles
4. Diesel engine powered automobiles and trains
5. Air transportation
6. Highway development
7. Development of truck transportation.

References:

Pound: "Transportation Progress"

Bouton: "An Outline History of Transportation"

Calif. State Automobile Association: "The Driver of Tomorrow" Series, Lesson 14

UNIT I

TRANSPORTATION DEVELOPMENT

Unit Test--Form A

Name_____Class Hour_____Date_____

Instructions: Fill in the above spaces, and return this paper with your answers, which are to be written on a separate piece of paper.

A. 1. What was the incentive for the early people to try to improve transportation?

2. What was the cause of the development of inland waterways and highways during the 17th century?

B. 3. What is the great difference in the cargoes of ancient and modern carriers?

4. What factors have made this change possible?

5. What was the drawback at first to using coal as a fuel for ships?

C. 6. Why are steam automobiles not practical at the present time?

7. Who was Gottlieb Daimler, and for what invention was he famous?

8. What were the Selden patents, and how did they affect the development of the automobile?

9. What was the date of the first American gasoline automobile, and who were the inventors?

10. What did the Times-Herald race in 1895 prove to the American people?

UNIT II

INDUSTRIAL DEVELOPMENT

Unit Outline

A. Trades Nearly Eliminated by the Development of the Automobile.

1. Horseshoer
2. Wagon maker
3. Harness maker
4. Blacksmith
5. Livery stable
6. Horse-drawn stage business
7. Teamsters
8. Street sprinklers
9. Horse trader

B. Industries Contributing to the Automobile

1. Automobile manufacture
2. Metal trades
3. Agriculture
4. Petroleum industry
5. Transportation
6. Rubber industry
7. Servicing industry
8. Mining industry
9. Research
10. Chemical industry

UNIT II

INDUSTRIAL DEVELOPMENT

Unit Outline - 2

11. Engineering
12. Designing and art
13. Salesmanship
    a. Automobile
    b. Parts and accessories
    c. Service
    d. Insurance
    e. Machinery
14. Advertising
15. Radio
    a. Car radios
    b. Broadcasts
16. Highway building
17. Hotels, auto campus and tourist homes
18. Tourist recreation
19. Trailer manufacturing
    a. Commercial
    b. House
20. Machinery manufacturing
    a. Production
    b. Servicing
    c. Agricultural
    d. Road building

UNIT II

INDUSTRIAL DEVELOPMENT

Unit Outline - 2

21. Glass manufacturing
22. Lacquer and enamel manufacturing
23. Parts and accessories manufacture
24. Operators
    a. Chauffeurs
    b. Truck drivers
    c. Tractor operators
    d. Shovel operators

UNIT II

INDUSTRIAL DEVELOPMENT

Unit Introduction

A few years ago there was much discussion about machines supplanting men in the manufacture of commodities. We were told that the reason for the wave of unemployment was that one man with a modern machine could do the work formerly done by many men. The statement was true as far as it went, but it did not tell us that it required many more men to keep the machine repaired, adjusted, furnished with raw materials, etc.

In this unit it will be seen that some industries have been eliminated entirely, or in part, but that the automobile has furnished for workers a great many more opportunities than it displaced.

UNIT II

INDUSTRIAL DEVELOPMENT

Unit Test--Exploratory Form

Name_____Class Hour_____Date_____

Instructions: Fill in the above blanks. Answer the questions in the blanks provided below. If more space is needed, use the opposite side of this paper.

I. Name as many industries as you can that the automobile has displaced.

(1)_____ (6)_____

(2)_____ (7)_____

(3)_____ (8)_____

(4)_____ (9)_____

(5)_____ (10)_____

II. Name as many industries as you can that the automobile has helped to develop.

(1)_____ (10)_____

(2)_____ (11)_____

(3)_____ (12)_____

(4)_____ (13)_____

(5)_____ (14)_____

(6)_____ (15)_____

(7)_____ (16)_____

(8)_____ (17)_____

(9)_____ (18)_____

UNIT II

INDUSTRIAL DEVELOPMENT

Guide for Study

A. The following industries or trades have been entirely or very nearly eliminated by the development of the automobile.

1. Horseshoeing
2. Wagon making
3. Harness making
4. Blacksmithing
5. Livery stable
6. Horse-drawn stages
7. Teaming
8. Street sprinkling
9. Horse trading

B. The following industries have received considerable impetus from the development of the automobile.

1. Automobile manufacture
2. Metal trades
3. Agriculture
4. Petroleum industry
5. Rubber industry
6. Servicing industry
7. Transportation
8. Mining industry
9. Research
10. Chemical industry
11. Engineering
12. Designing and art
13. Salesmanship
14. Advertising
15. Radio
16. Highway building
17. Auto campus, tourist homes
18. Trailer manufacturing
19. Tourist recreation
20. Machinery manufacturing
21. Glass manufacturing
22. Lacquer and enamels
23. Parts and accessories
24. Operators and drivers

UNIT II

INDUSTRIAL DEVELOPMENT

Guide for Study - 2

25. Upholstering
26. Plastic working
27. Cloth and fabric

References:

Allen, F. J.: "Advertising as a Profession"

American Association of Engineers: "Vocational Guidance in Engineering Lines"

Hammond, J. H.: "The Engineer

Hendrick, E.: "Opportunitiesin Chemistry"

Lane, May Rogers: "Vocations in Industry"

Maxwell, Wm.: "Training of a Salesman"

Richards, C. R.: "Art in Industry"

Lapp, John A.: "Practical Social Science," pp. 69-87

Elliott, Merrill, Wright: "Our Dynamic Society," pp. 120-130

Exercise 1. Write a paper of about 500 words about one of the industries in Part "B". Give a description of the types of work offered and if possible, the chance for employment.

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline

A. Frames

1. Progressive steps
   - a. Wagon
   - b. Buckboard
   - c. Early automobile
   - d. Tubular backbone
   - e. Modern frames
     - (1) Y.K. bracing
     - (2) X bracing
     - (3) Kickup for lowering center of gravity
   - f. Steel forms used
     - (1) Angle section
     - (2) Tee section
     - (3) Channel section
     - (4) Box section
2. Application of gravity

B. Wheels

1. Importance in mechanics and civilization
2. Antecedent
   - a. Wagon wheel

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline - 2

3. Types
    a. Artillery
        (1) Wood
        (2) Steel
    b. Steel disc
    c. Wire
4. Drop center

C. <u>Springs</u>

1. Antecedent
    a. Full-elliptic transverse in buggies
2. Types
    a. Full-elliptic
    b. Three-quarter elliptic
    c. Semi-elliptic
    d. Cantilever
    e. Coil
3. Duties of the springs
4. Spring control-shock absorbers
5. Independent springing

D. <u>Steering Mechanism</u>

1. Antecedent
    a. Fifth wheel

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline - 3

2. Types
    a. Planetary
    b. Reversible
    c. Irreversible
3. Center steering
4. Gear ratios
    a. Power
    b. Speed
5. Mechanical advantage
    a. Leverage
        (1) Pitman arm
        (2) Steering knuckle arm

E. <u>Brakes</u>

1. Antecedent
    a. Wood block applied to tireof wheel
2. Types
    a. Mechanical
    b. Hydraulic
    c. Air
    d. Electric
    e. Transmission
3. Friction
4. "Servo" action

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline - 4

F. Tires

1. Antecedents
    a. Steel bands
    b. Hard rubber
2. Progressive steps
    a. High pressure, fabric, clincher
    b. High pressure, cord, straight side
    c. Low pressure balloon
    d. "Jumbo"
3. Construction
4. Care
5. Production of rubber
6. Application of friction
7. Minor repairing

G. Power Transmission

1. The clutch
    a. Types
        (1) Cone
        (2) Wet plate
        (3) Dry plate
    b. Application of friction and pressure

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline - 5

2. The transmission
    a. Antecedent
        (1) Friction type
        (2) Planetary
        (3) Selective sliding gear
    b. Synchromesh, silent gear
    c. Application of gears
3. Universal joints
    a. Metal
    b. Fabric
4. Drive shafts
    a. Enclosed
    b. Exposed

H. Rear Axles

1. Types
    a. Plain live
    b. Semi-floating
    c. Three-quarter floating
    d. Full floating
    e. Dead axle
2. Differential principle

UNIT III

THE AUTOMOBILE CHASSIS

Unit Outline - 6

3. Types of drive
    a. Torque tube
    b. Hotchkiss
4. Types of gears
    a. Bevel gears
    b. Spiral bevel
    c. Hypoid bevel
    d. Worm
5. Application of torque, gearing, thrust, shear, compression, bending moment

I. <u>Bodies</u>

1. Development of design
2. Advancement made in construction
3. External and internal finishes
4. Accessories

UNIT III

THE AUTOMOBILE CHASSIS

Unit Introduction

As we have seen in our unit on Transportation Development, the automobile had for its starting point the horse-drawn vehicles of the day. For that reason, the pictures of the early automobiles show the resemblance to wagons, buggies, coaches, and carriages. In the development of the automobile, one feature after another of the horse-drawn vehicle has been discarded for something that proved superior.

The modern automobile chassis has evolved to meet a direct need. Strength and rigidity of frames was required in order to use successfully the heavier and more powerful engines, and to keep the new type bodies in line.

In this unit the present day chassis is to be studied with the idea of finding out

1. What functions the parts perform
2. Why they are made in that particular way
3. What are the scientific principles involved.

UNIT III

THE AUTOMOBILE CHASSIS

Unit Test--Exploratory Form

Name_____Class Hour_____Date_____

Instructions: Fill in the above spaces. Write your answers on a separate piece of paper and return this sheet with your answers.

A. 1. What composes the chassis of an automobile?

2. What is the purpose of the bracing of the frame?

3. What is meant by "center of gravity?"

B. 4. Name as many types of automobile wheels as you can.

5. What mechanical advantage do you get with a wheel and axle?

C. 6. What is meant by an "elliptic" spring?

D. 7. Do all automobiles utilize a front axle? If your answer is "no" name one, and give the reason.

E. 8. What is meant by a steering ratio of 15 - 1?

9. What is meant by an irreversible steering gear?

F. 10. Name as many ways of applying brakes as you can.

11. What is "Servo action?"

G. 12. What is the initial source of rubber?

13. What is meant by a "breaker strip?"

14. How are tires measured?

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study

A. The Frame

1. Evolution of the frame

   a. Wagon

   b. Early automobile frame

   c. Modern frames

   d. Bracing -- "X", "KY" types

   e. Gravity -- center of gravity -- method of lowering the center of gravity

   f. Shapes used in frame steel -- angle, tee, channel, box

   g. Integral chassis and body frames

References:

Kuns: "Automotive Essentials," pp. 1-6

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia"

Kuns: "Automotive Service," pp. 1-8

Page: "Ford Model A Car," p. 18

Page: "Ford V8 Cars and Trucks," pp. 39-42

Chevrolet Motor Division, General Motors Sales Corporation: "Chevrolet 1938 Shop Manual," pp. 47-51

Millikan, Gale: "New Elementary Physics," pp 98-119

Dull: "Modern Physics," pp. 138-141

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 2

B. Wheels

1. Scientific importance of the wheel
2. Evolution of automobile wheel
3. Types of wheels -- artillery, disk, wire, drop center
4. Wheel alignment -- toein, camber, caster, turning radius

References:

Millikan, Gale: "New Elementary Physics," pp. 164-165

Dull: "Modern Physics," pp 229-230

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 3-4

Barry: "Motor's Handbook," pp. 75-77

Kuns: "Automotive Essentials," pp. 418-420, 379-383

Chevrolet's 1938 Shop Manual, pp. 69-73

General MotorsCorp.: "When the Wheels Revolve," p. 4

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 3

C. Springs

1. Types
   a. Full-elliptic
   b. Three-quarter elliptic
   c. Semi-elliptic
   d. Cantilever
   e. Coil
2. Duties of the springs
3. Spring control -- shock absorbers
4. Independent springing -- eliminates front axle

References:

Taylor and Blake: "Automotive Manual," pp. 156-158

Kuns: "Automotive Essentials," pp. 402-416

Dyke: "Dyke's Automotive and Gasoline Engine Encyclopedia," p. 11

Page: "Ford V8 Cars and Trucks," pp. 445-446

Barry: "Motor's Handbook," pp. 77-82

Chevrolet's 1938 Shop Manual, pp. 77, 109

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 4

D. Steering Mechanism

1. Types of steering gears
   - a. Planetary
   - b. Reversible
   - c. Irreversible
2. Center steering
3. Gear ratios
   - a. For power
   - b. For speed
4. Leverage
   - a. Pitman arm
   - b. Steering knuckle arm

References:

Dull: "Modern Physics," pp. 237-241, 221-225

Millikan, Gale: "New Elementary Physics," pp 156-168

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 10-11

Barry: "Motor's Handbook," pp. 83-86

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 5

E. Brakes

1. Types of brakes
   a. Mechanical
   b. Hydraulic
   c. Air
   d. Electric
   e. Transmission
2. Servo action
3. Friction

References:

Millikan, Gale: "New Elementary Physics," pp 178-181

Dull: "Modern Physics," pp. 196-201, 725

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp 12-13, 884-888

Kuns: "Automotive Essentials," pp. 356-373

Selvidge and Kelsey: "Principles of Automechanics," p. 67

Chevrolet's 1938 Shop Manual, pp. 113-126

Page: "Ford V8 Cars and Trucks," pp. 417-440

General Motors Corp.: "When the Wheels Revolve," pp. 19-20

General Motors Corp.: "We Drivers," pp. 14-17, 8-9

Barry: "Motor's Handbook," pp. 122-123, 88-96

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 6

F. Tires

1. Tire evolution
   a. Wooden rims
   b. Steel bands
   c. Hard rubber tires
   d. High pressure pneumatic, fabric tires
   e. High pressure pneumatic, cord tires
   f. Low pressure "Balloon" tires
   g. Low pressure "Jumbo" tires
2. Construction
3. Care
4. Production of rubber
5. Application of the principle of friction
6. Minor repairing

References:

Kuns: "Automotive Essentials," pp. 418-425

Page: "Ford V8 Cars and Trucks," pp. 391-415

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 3, 547-628

Schultz and Schultz: "School and Home Shopwork," pp. 223-237

Barry: "Motor's Handbook," pp. 120-121

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 7

G. Power Transmission

1. The clutch
   a. Types -- cone, wet plate, dry plate
   b. Application of principles of friction and pressure
2. The transmission
   a. Early types -- friction, planetary, selective sliding gear
   b. The synchromesh, silent gear transmission
   c. Application of principle of wheels and gears
3. Universal joints
   a. Types -- metal, fabric
4. Drive shafts
   a. Types -- enclosed and exposed

References:

General Motors Corp. "When the Wheels Revolve," pp. 13-16

Chevrolet's 1938 Shop Manual, pp. 178-202, 103-108

Kuns: "Automotive Essentials," pp. 23-24, 294-337

Millikan, Gale: "New Elementary Physics," pp. 167, 272-274

Dull: "Modern Physics," pp. 711-718

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 8

G. Power Transmission -- References, continued

Taylor and Blake: "Automotive Manual," pp. 124-141

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 2, 3, 7, 8-9, 24, 25-29, 20-24

Royce and Strouse: "Automobile Transmissions," entire

Barry: "Motor's Handbook," pp. 86-88, 118-119

UNIT III

THE AUTOMOBILE CHASSIS

Guide to Study - 9

H. Rear Axles

1. Types
   a. Plain live
   b. Semi-floating
   c. Three-quarter floating
   d. Full-floating
   e. Dead Axle
2. Principle of the differential
3. Types of drive
   a. Hotchkiss
   b. Torquetube
   c. Torque arm
4. Types of gears
   a. Bevel gear and pinion
   b. Spiral bevel gear and pinion
   c. Hypoid bevel gear and pinion
   d. Worm gear and worm gear
5. Application of principles of torque, gears, thrust, shear, compression and bending moment

References:

Millikan, Gale: "New Elementary Physics," pp. 275-276, 167-168

Dull: "Modern Physics," pp. 718-719

UNIT III

THE AUTOMOBILE CHASSIS

Guide for Study - 10

H. Rear Axle -- References, continued

Taylor and Blake: "Automotive Manual," pp. 161-165, 143-145

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 15, 7, 17-18

Selvidge and Halsey: "Principles of Automechanics," pp. 58-59

General Motors Corp.: "When the Wheels Revolve, pp. 17-19

Barry: "Motor's Handbook," pp. 120-121, 140-141

UNIT III

THE AUTOMOBILE CHASSIS

Unit Test--Form A

Name_____Class Hour_____Date_____

Directions: Fill in the above spaces. Write your answers on a separate piece of paper. Return this paper with your answer sheet.

A. 1. What is an automobile chassis?

2. What are the popular types of frame bracing called?

3. Name four shapes of frame steel.

4. What is meant by integral chassis and body frame?

5. In what way does the frame of a car with independent wheel suspension differ from one that has the conventional axle?

B. 6. What is meant by the following?
   a. Toein
   b. Caster
   c. Camber
   d. Turning radius

C. 7. Name and sketch five kindsof automobile springs

D. 8. What is meant by an irreversible steering gear?

9. What is center steering?

10. What is meant by a 10-1 steering ratio?

E. 11. What are the advantages of hydraulic brakes over mechanical?

12. What is the advantage of servo action?

F. 13. If tires are cupped out on the side, what is the probable reason?

G. 14. What is the purpose of the clutch?

15. How is the transmission shaft joined to the second speed gear in a synchromesh transmission?

UNIT III

THE AUTOMOBILE CHASSIS

Unit Test--Form A - 2

Name_____Class Hour_____Date_____

G. 16. What type of universal joint does not require lubrication?

17. Does the enclosed driveshaft require one or two universal joints?

H. 18. What type of rear axle will permit the removal of the axle shaft without disturbing the wheel?

19. What is the purpose of the differential?

20. What is the advantage of the use of hypoid bevel gear and pinion over the use of other gears?

UNIT IV

AUTOMOBILE BODIES

Unit Outline

A. Development of Design

1. Reasons for development
    a. Unsound construction practices
    b. Sales appeal through change of style
    c. Operating economy
    d. New theories of design
    e. Research in relieving driving fatigue
    f. Competition in marketing field

B. Development of Construction

1. Wood, the chief constructional material during the early period of the automobile
2. Substitution of steel for wood as a constructional material.
    a. Development of the steel industry
    b. Development of steel products
    c. Development of metal working processes
        (1) Welding
        (2) Pressing

C. Development of External Finishes

1. Need for improved finishes
    a. Enamels were slow drying
    b. Enamels were not elastic
    c. Enamels had a tendency to run

UNIT IV

AUTOMOBILE BODIES

Unit Outline - 2

C. 2. Development of lacquer

a. Shortens the length of time required to finish a car

3. Development of synthetic lacquers

a. Advantages

(1) Quick drying

(2) Hard finished surface

(3) Elastic

(4) Has better covering properties per coat than lacquer

(5) Work requires less preliminary preparation than when lacquer is used.

b. Disadvantages

(1) Slower drying than lacquer

(2) Greater tendency to sag and run than lacquer

(3) Longer time required before final rubbing can be done

c. Development in method of application

(1) Spray equipment

(2) Spray application

UNIT IV

AUTOMOBILE BODIES

Unit Outline - 3

D. Development of Automobile Interiors

1. Need for development

    a. Passenger comfort

    b. Style

    c. Better wearing materials

    d. Safety of driver and passengers

    e. Ease of operation

UNIT IV

AUTOMOBILE BODIES

Unit Introduction

The automobile body has evolved out of the wagon or buggy body. The horse-drawn vehicle body was adequate for the purpose it served. It was lightly built for there was no particular strain on it and light weight made the work of the horse easier. The buggy rolled slowly into the holes and the light springs and meager padding of the cushions were sufficient to protect the rider. It did not take long, however, to find that this body was wholly unsuited to the automobile. Increased speeds and increased dust showed the need for windshields and tops. Vibration of the engine shook the frail bodies to pieces, so they had to be built stronger to withstand the shaking. Wheels dropped into hole after hole with such rapidity that tires had to be built better and springs improved.

In this unit we will attempt to find out the improvements made in the bodies, in the finishes applied to them, and in the methods of manufacture.

UNIT IV

AUTOMOBILE BODIES

Unit Test--Exploratory Form

Name_____Class Hour_____Date_____

Directions: Fill in the above blank spaces. Answer the questions in the spaces provided.

1. Why has the rear engined car not been produced commercially in America?_____

_____

_____

2. What advantages would you think the rear engined car would have?_____

_____

_____

3. What safety features have engineers provided in the modern cars?_____

_____

_____

4. What are the materials used for exterior car finishes?

   a._____ b._____

5. What relatively new material is being used extensively for trim and accessories?_____

6. What is a composite body?_____

_____

7. How long has the steel top been available in automobile construction?_____

UNIT IV

AUTOMOBILE BODIES

Unit Test--Exploratory Form - 2

Name_____Class Hour_____Date_____

8. What is body insulation?_____

_____

_____

9. What is the advantage of streamlining?_____

_____

10. What is the principle on which a car heater works?

_____

UNIT IV

AUTOMOBILE BODIES

Guide for Study

A. Development of Design

1. Horse-drawn vehicles
2. Padding gave way to upholstery
3. Tops and windshields
4. Closed sedan models
5. Bodies designed to eliminate air resistance
6. Comfort of the consumer as a factor

B. Development of Construction

1. Wood, the chief constructional material
2. Wood frames covered with steel or aluminum sheet
3. Wood frames, reinforced with steel, covered with steel sheet
4. All-steel frames covered with steel sheet
5. Integral body and chassis frames

C. Development of External Finishes

1. Enamels
2. Lacquers
3. Synthetic lacquers
4. Improvement in methods of application

D. Development of Automobile Interiors

1. Leather upholstery
2. Imitation leather upholstery

UNIT IV

AUTOMOBILE BODIES

Guide for Study - 2

D. 3. Fabric -- mohair, etc.

4. Plastics

5. Chromium plating

6. Body insulation from heat and cold

7. Body treatment to absorb noises

8. Recessing of protruding parts

9. Comfortable seats

10. Adjustable drivers' seats

11. Slanting windshields to kill reflections

12. Narrow pillars for better visibility

13. Shatter proof glass for rider protection

14. Illuminated instrument panels

E. <u>Accessories</u>

1. Windshield wipers

2. Cigar lighters

3. Ash containers

4. Car heaters

5. Electric fans

6. Radios

7. Locked compartments

8. Sun visors

9. Clocks

UNIT IV

AUTOMOBILE BODIES

Guide for Study - 3

References:

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 4-5

Page: "Ford V8 Cars and Trucks," pp. 639-656

Chevrolet's 1938 Shop Manual, pp. 15-44

Kuns: "Automotive Essentials," pp. 3, 6-20

Kuns: "Automotive Service," pp. 1065-1085

UNIT IV

AUTOMOBILE BODIES

Unit Test--Form A

Name_____Class Hour_____Date_____

Directions: Fill in the above spaces. Answer the questions by filling in the blank spaces. Return this paper at the close of the class period.

A. 1. _____furnished the pattern for the early automobile bodies.

B. 2. The chief constructional material of the early automobile bodies was _____.

3. _____and_____were the metals used in the earliest introduction of metal on body frames.

4. Bodies composed of wood and steel were called _____bodies.

5. The_____ body is now used universally.

C. 6. The early method of finishing the exterior of an automobile was with _____.

7. Lacquer furnishes a quick method of finishing an automobile because the _____ in the lacquer evaporates quickly.

8. List three advantages of synthetic lacquer over lacquer.

a. _____

b. _____

c. _____

UNIT IV

AUTOMOBILE BODIES

Unit Test--Form A - 2

Name_____Class Hour_____Date_____

C. 9. What are two advantages of lacquer over synthetic lacquer? a. _____

b. _____

D. 10. Synthetic materials are made from _____

11. Bright parts are _____ plated.

12. Body insulation protects the passengers from:

a. _____

b. _____

c. _____

13. An automobile body must be equipped with _____ glass throughout to comply with the law.

E. 14. In the first column list all the accessories that are thought to be essential and in the second column those that are not essential but nice to have.

a. Essential	b. Non-essential
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
6. _____	6. _____

UNIT V

THE AUTOMOBILE ENGINE

Unit Outline

A. Engine Fundamentals

1. Parts
2. Function of the parts
3. Metals and metallurgy
4. "Four Stroke Cycle" principle
5. Principle of the "Diesel"
6. Application of compression, combustion, and heat
7. Types of heads
   a. "I"
   b. "T"
   c. "F"
   d. "L"
   e. Sleeve valve
8. Valve timing
9. Types of cylinders
   a. "V"
   b. "In line"
   c. Advantage of each

B. Fuel System

1. Parts
   a. Tank and fuel indicator
   b. Tubing

UNIT V

THE AUTOMOBILE ENGINE

Unit Outline - 2

B. 1. c. Fuel pump

d. Carbureter

e. Air filter

f. Combustion chamber

g. Manifold

h. Muffler

2. Carburetion

a. Principles

b. Fuels

C. Lubrication System

1. Types

a. Splash

b. Splash and pressure

c. Full-force-feed

2. Parts

a. Oil pan

b. Pump

c. Oil lines

d. Oil filters and purifiers

e. Oil coolers

f. Pressure indicator

g. Drilled oil passages

h. Oil grooves

UNIT V

THE AUTOMOBILE ENGINE

Unit Outline - 3

C. 3. Oil production

4. Oil tests

D. <u>The Cooling System</u>

1. Types

a. Air

(1) Fan

(2) Cooling fins on cylinders

b. Water

(1) Pump

(2) Water jacket

(3) Fan

(4) Radiator

(5) Thermostat

(6) Manifolds

c. Steam

(1) Fan

(2) Radiator

(3) Manifolds

(4) Steam jacket

2. Application of heat

UNIT V

THE AUTOMOBILE ENGINE

Unit Introduction

The modern automobile engine operates on the same principles as did the early gasoline engine. Improvement in the modern engine has come about through improvement in design, improvement in materials, improvement in fuels, and in short, refinement of the whole engine.

In this unit we will endeavor to get a thorough understanding of the underlying principles, a knowledge of the refinements that have been made, and an idea as to the trend which future improvements will take.

UNIT V

THE AUTOMOBILE ENGINE

Unit Test--Exploratory Form

Name_____Class Hour_____Date_____

Directions: Fill in the above spaces. Write your answers on a separate piece of paper and return both at the close of the period.

A. 1. What is a crankshaft?

2. What is meant by a "unit power plant?"

3. What are the fundamental differences between a "Diesel" engine and a gasoline engine?

4. Is the "Diesel" engine a new or old invention?

B. 5. What is the purpose of the carburetor?

6. Wherein does the fuel pump excel the vacuum tank?

7. Will a gasoline engine run on any fuel other than gasoline?

C. 8. What is meant by "full-force-feed" lubrication?

9. Why does the oil gauge show a higher reading when the engine is first started on a cold day?

10. What is the function of the fan in a water cooled engine system?

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study

A. Engine Fundamentals

1. Parts
2. Function of the parts
3. Metals
4. "Four stroke cycle principle"
5. Principle of the "Diesel"
6. Compression, combustion, and heat
7. Types of heads
   a. "I" head engine
   b. "T" head engine
   c. "F" head engine
   d. "L" head engine
   e. Sleeve valve
8. Valve timing
9. Types of cylinder blocks
   a. "V" type
   b. "In line" type
   c. Advantages of each

References:

General Motors Corp.: When the Wheels Revolve, pp. 3-13

Millikan and Gale: New Elementary Physics, pp. 268-271, 276-277

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 2

A. Engine Fundamentals -- References, continued

General Motors Corp.: "Metallurgy and Wheels," entire

Dull: "Modern Physics," pp. 708-710, 346-354

General Motors Corp.: "Diesel, the Modern Power," entire

Kuns: "Automotive Essentials," pp. 29-64, 80-122

Taylor and Blake: "Automotive Manual," pp. 8-12, 29-30

Barry: "Motor's Handbook," pp. 15-24, 102-111

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 330-75, 88-89, 1022-1033D

Federal Mogul Corp.: "Automobile Engine Bearings and How to Service Them," entire

Page: "Ford V8 Cars and Trucks," pp. 76-117

Brownlee, Fuller and others: "First Principles of Chemistry," pp. 631-659

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 3

B. The Fuel System

1. Tank
2. Fuel indicating apparatus
3. Fuel pump
4. Carburetor
5. Air filter
6. Combustion chamber
7. Manifold
8. Muffler
9. Carburetion
   a. Principles
   b. Fuels

References:

Page: "Ford V8 Cars and Trucks," pp. 118-181

Kuns: "Automotive Essentials," pp. 162-204

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 95-144

Chevrolet's 1938 Shop Manual, pp. 160-168, 203-205, 260-263

Royce and Strouse: "Automobile Carburetors," entire

General Motors Corp.: "Chemistry and Wheels," entire

Dull: "Modern Physics," pp. 710-711

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 4

B. <u>The Fuel System</u> -- <u>References, continued</u>

Millikan and Gale: "New Elementary Physics," p. 275

Brownlee, Fuller, Hancock and others: "First Principles of Chemistry," pp. 440-446

Barry: "Motor's Handbook," pp. 32-43, 112, 114

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 5

C. The Lubrication System

1. Types

   a. Splash

   b. Splash and pressure

   c. Full-force-feed

2. Component parts:

   a. Oil pan

   b. Pump

   c. Oil lines

   d. Oil filters and purifiers

   e. Oil coolers

   f. Oil pressure indicator

   g. Drilled oil passages

   h. Oil grooves

3. Oil production

4. Oil tests

References:

Kuns: "Automotive Essentials," pp. 126-144

Chevrolet's 1938 Shop Manual, pp. 146-149

Brownlee, Fuller and others: "First Principles of Chemistry," pp. 440-446, 254-256, 34

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 157-174B

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 6

C. The Lubrication System -- References, continued

Page: "Ford V8 Cars and Trucks," pp. 278-300

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 7

D. The Cooling System

1. Types of cooling systems

   a. Air cooling required:

      (1) Fan

      (2) Cooling fins on cylinders

   b. Water cooling requires:

      (1) Pump

      (2) Water jacket around cylinders

      (3) Radiator

      (4) Thermostat

      (5) Manifolds

      (6) Fan

   c. Steam cooling requires:

      (1) Radiator

      (2) Manifolds

      (3) Steam jackets around cylinders

      (4) Fan

2. Application of principles of heat and radiation

References:

Dull: "Modern Physics," pp. 314, 330-332, 731

Page: "Ford V8 Cars and Trucks," pp. 257-276, 89-91

UNIT V

THE AUTOMOBILE ENGINE

Guide for Study - 8

D. The Cooling System -- References, continued

Millikan and Gale: "New Elementary Physics," pp. 284-286, 210-211, 271

Kuns: "Automotive Essentials," pp. 146-160

Chevrolet's 1938 Shop Manual, pp. 169-171

Barry: "Motor's Handbook," p. 112

UNIT V

THE AUTOMOBILE ENGINE

Unit Test--Form A

Name_____Class Hour_____Date_____

Instructions: Fill in the above blanks. Answer the questions by filling the blank spaces.

A. 1. The strokes of a "Four stroke cycle" engine in the order they operate are 1. Intake, 2. _____, 3. _____, 4. _____.

2. An engine that has both intake and exhaust valve side by side in the block is called a _____ head motor.

3. An engine that has both of the valves in the head is called an _____ head engine.

4. An engine that has the intake valves on one side of the block and the exhaust valves on the other side is called a _____ head engine.

5. An engine that has one valve in the block and the other in the head is called an _____ head engine.

6. Valves must operate in time with the _____.

7. A _____ block is shorter than an _____ block using the same number of cylinders.

B. 8. The approximate mixture of air and gasoline used in an automobile is _____ part of air to 1 part of gasoline.

9. The fuel pump is more efficient than the _____.

UNIT V

THE AUTOMOBILE ENGINE

Unit Test--Form A - 2

Name_____Class Hour_____Date_____

B. 10. The air filter removes _____ from the air.

C. 11. The oiling system which pumps oil to all moving parts of the engine is called the _____ system.

12. Failure of the oil pump is shown by the _____.

D. 13. The purpose of the fan in a water cooling system is to cool the _____ in the _____.

14. The water is cooled by _____.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Outline

A. Magnetism

1. Kinds
   a. Natural
   b. Permanent
   c. Temporary
2. Magnetic fields
   a. Found
      (1) Around the earth
      (2) Around a magnet
      (3) Around a wire carrying an electric current

B. Electrical Current

1. Induction of electric current
2. Kinds of electric current
   a. Alternating
   b. Direct
   c. Pulsating direct
3. Transformers
   a. Step up
   b. Step down
   c. Open core -- Ignition inductance coil
   d. Closed core -- Door bell ringing transformer

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Outline - 2

B. 3. e. Methods of breaking down the field

C. Ignition System Parts

1. Distributors

a. Distributes high tension current

b. Interrupts low tension current

2. Condenser

a. Construction

b. Action

3. Spark plugs

a. Hot plug

b. Cold plug

D. Coordination of Ignition System Parts

1. Ignition timing

2. The ignition circuit

3. Double ignition

E. Generation of Current

1. The application of inductance to generators

2. Alternating current generators

3. Direct current generators

a. Series wound machine

b. Shunt wound machine

4. Current regulation

a. Third brush

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Outline - 3

E. 4. b. Field distortion

5. Application of resistance

6. The cutout

7. The ammeter

F. Electric Motors

1. Similarity between motor and generator

2. Application of magnetism

3. Starting motors

4. Horn motors

5. Fan motors

G. The Battery

1. Function

2. Chemical reactions

3. Component parts

H. The Lights

1. The circuits

2. Proper focus of headlights

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Introduction

Electricity in an automobile follows the same principles that electricity does in other places. In your home you have wires, switches, lights. Transformers are used for changing the voltage to suit your needs. Resistance units heat your ironing apparatus and in some localities heat your rooms. Bells give you warning that someone wishes your attention. Motors furnish power. In an automobile you have application of all these things, except instead of a bell you have a horn. The one material difference between the two situations is, that in your home you are dependent upon the constant generation of electrical energy at some distant power house. In your automobile, the power plant is self-contained, the generator being driven by the engine. The storage battery makes current available when your generator is not producing enough to supply the demands made upon it.

In order to be able to understand the electricity of the automobile, this unit will deal in the first place with the underlying principles of all electricity, and later show the adaptations to the particular parts under consideration.

UNIT VI

2 THE ELECTRICITY OF THE AUTOMOBILE

Unit Test--Exploratory Form

Name_____Class Hour____Date____

Directions: Fill in the spaces above. Answer the following questions by filling in the blank spaces. All papers are to be turned in at the end of the class hour.

A. 1. Three kindsof magnets are (1) _____, (2)_____, and (3)_____.

2. The sphere of influence around a magnet is called the _____ of the magnet.

3. The ends of a magnet are the poles. _____ poles attract each other and _____ poles repel each other.

4. The North Magnetic pole is near the _____ geographic pole.

B. 5. Current may be induced in a coil of wire if it is revolved in a _____ _____.

6. An ignition induction coil is a transformer. The purpose of the transformer is to change the _____.

C. 7. A hot spark plug has a long _____.

D. 8. The spark must occur in an engine at the top of the _____ stroke.

E. 9. Current output of a generator is modified by moving the _____ _____.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Test--Exploratory Form - 2

Name_____Class Hour_____Date_____

F. 10. A starting motor uses a large cable because the _____ is so heavy.

G. 11. A storage battery _____ electric current.

12. The electrolyte of a storage battery is_____ and distilled water.

H. 13. The depressed beam of the headlights uses a different _____ than the upbeam.

14. Headlights should be put in _____ by an expert.

15. If the headlights "blow out," you would expect to replace the bulbs, a _____ and to fix the lights permanently you should look for a _____ _____.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study

A. Magnetism

1. Kinds of magnetism
   a. Natural
   b. Permanent
   c. Temporary
2. Magnetic fields
   a. Found around the earth
   b. Found around a magnet
   c. Found around a wire carrying an electric current

References:

Millikan and Gale: "New Elementary Physics," pp. 295-309

Schultz and Schultz: "School and Home Shopwork," pp. 158-162

Dull: "Modern Physics," pp. 534, 500-513

Kuns: "Automotive Essentials," pp. 208-210

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 179-185

Kuns: "Automotive Practice," pp. 18-20

Swoope: "Lessons in Practical Electricity," pp. 1-24

Exercise 1. Construct a temporary magnet.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 2

A. Magnetism -- continued

Exercise 2. With a magnet and a sheet of paper over it, sprinkle iron filings showing the path taken by the lines of force.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 3

B. Electrical Current

1. The circuit
2. Induction of electrical current
3. Kinds of electrical current
   a. Alternating
   b. Direct
   c. Pulsating direct
4. Transformers
   a. Step up
   b. Step down
   c. Open core -- ignition inductance coil
   d. Closed core -- door bell ringing transformer
   e. Methods of breaking down the field

<u>References</u>:

Swoope: "Lessons in Practical Electricity," pp. 345-370

Millikan and Gale: "New Elementary Physics," pp. 391-432

Dull: "Modern Physics," pp. 617-626, 647-655

Kuns: "Automotive Essentials," pp. 210-213

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 4

B. Electrical Current -- continued

Exercise 1. Produce induced electrical current in a coil of wire, connected to a light bulb, held between the pole pieces of a "growler."

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 5

C. Ignition System Parts

1. Coil
2. Distributor
   a. Interrupts the low voltage current
   b. Distributes the high voltage current
3. The condenser
   a. Construction
   b. Action of the condenser under operating conditions
4. Spark plugs
   a. Hot spark plugs
   b. Cold spark plugs

References:

Kuns: "Automotive Essentials," pp. 213-227, 234-238

Dull: "Modern Physics," pp. 719-721

Millikan and Gale: "New Elementary Physics," pp. 271 pl. 276

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 188-191, 208

Burling and Grambsch: "Essentials of Ignition," Part 1, pp. 3-13

Page: "Ford V8 Cars and Trucks," pp. 182-224

Chevrolet's 1938 Shop Manual; pp. 254-259

Barry: "Motor's Handbook," pp. 108-109

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 6

D. The Coordination of the Ignition System Parts

1. Ignition timing
   - a. Reason for ignition timing
   - b. Results of improper timing
   - c. Methods of timing
   - d. Firing orders
2. Ignition circuits
   - a. Simple circuits
   - b. Circuits of modern cars
   - c. Short circuits
3. Double ignition
   - a. Synchronizing of contact points
4. Vacuum spark advance

References:

Kuns: "Automotive Essentials," pp. 229-230, 217-229, 207-208

Page: "Ford V8 Cars and Trucks," pp. 210, 185-187

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 291-307D

National Automotive Service: "Manual," section devoted to wiring diagrams

Chevrolet's 1938 Shop Manual, pp. 159, 255, 259

Barry: "Motor's Handbook," pp. 3-15

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 7

E. The Generation of Current

1. Principle of inductance in generators
2. Alternating current generators
3. Direct current generators
   a. Series wound machine
   b. Shunt wound machine
4. Current regulation
   a. Third brush
   b. Field distortion
5. Principle of resistance
6. The cutout
7. The ammeter

References:

Dull: "Modern Physics," pp. 622-635

Kuns: "Automotive Essentials," pp. 241-257

Page: "Ford V8 Cars and Trucks," pp. 226-227, 230, 231, 235-238

Millikan and Gale: "New Elementary Physics," pp. 398-404

Chevrolet's 1938 Shop Manual, pp. 234-250

Swoope: "Lessons in Practical Electricity," pp. 382-386

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 179-185, 331-366, 175, 351-353

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 8

E. The Generation of Current -- References, continued

Kuns: Automotive Electrical Practice, pp. 199-219

Barry: Motor's Handbook, pp. 43-48, 132

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 9

F. Electric Motors

1. Similarity between motors and generators
2. Motors used on an automobile
   a. Starting motors
   b. Horn motors
   c. Fan motors
3. Application of principles of inductance and magnetism
4. Motor control apparatus
   a. Manual controlled switches
   b. Electrically controlled switches
   c. Vacuum controlled switches
   d. Solenoids

References:

Dull: "Modern Physics," pp. 635-642, 561-562

Millikan and Gale: "New Elementary Physics," pp. 404-408, 345-346

Page: "Ford V8 Cars and Trucks," pp 232-235

Kuns: "Automotive Essentials," pp. 257-263

Chevrolet's 1938 Shop Manual, pp. 251-254

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 319-330

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 10

F. Electric Motors -- References, continued

Kuns: "Automotive Electrical Practice," pp. 277-292

Swoope: "Lessons in Practical Electricity," pp. 386-387, 407

Barry: "Motor's Handbook," pp. 48-53, 134

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 11

G. The Battery

1. Purpose of the battery
2. The parts of a battery
   a. Case
   b. Cell covers
   c. Plates
   d. Separators
   e. Cell connectors
   f. Electrolyte
   g. Sealing compound
3. The ampere hour capacity of the battery
4. The battery as a chemical factory
5. The generation of heat and its effect
6. Battery sulfation

References:

Motor Magazine. "What Goeson Inside a Storage Battery," March 1937, pp. 64-65

Kuns: "Automotive Essentials," pp. 281-291

Kuns: "Automotive Electrical Practice," pp. 50-65

Barry: "Motor's Handbook," pp. 108-109

Swoope: "Lessons in Practical Electricity," pp. 161-175

Chevrolet's 1938 Shop Manual, pp. 249-250

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 12

G. The Battery -- References, continued

Page: "Ford V8 Cars and Trucks," pp. 227-229

Millikan and Gale: "New Elementary Physics," pp. 378-381

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 521, 529-555

Burling: "Battery Testing and Repair," entire

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Guide for Study - 13

H. The Lighting System

1. The need for lights
2. The need for care in the use of lights
   a. Cause for police regulation governing the use of lights
3. The component parts of a lighting system
4. The lighting circuit
5. Chief causes of lighting failure
6. Proper focus of headlights

References:

Kuns: "Automotive Essentials," pp. 266-279

Chevrolet's 1938 Shop Manual, pp. 258-261

Page: "Ford V8 Cars and Trucks," pp. 238-241, 683

National Automotive Service: "Manual," section dealing with lighting circuits

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Test--Form A

Name_____Class Hour_____Date_____

Directions: Fill in the above spaces. Answer the following by filling in the blank spaces.

A. 1. Magnetism is of three kinds (a)_____

(b)_____

(c)_____

2. Magnetic fields are found around (a)_____

(b)_____

(c)_____

3. The poles of a magnet are connected by _____

B. 4. Current will be induced in a _____ if it is revolved in a magnetic field.

5. Electric currents are either _____ or _____.

6. Transformers either _____ or _____ the voltage of the current flowing through them.

7. In a tungar tube the _____ are collected on the plate of the tube.

8. A pulsating direct current is used to _____ when direct current is not available.

9. The core of a permanent magnet is made from _____.

10. The core of a temporary magnet is made from _____.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Test---Form A - 2

Name_____ Class Hour_____Date_____

11. The breakdown of the magnetic field in a transformer is caused by either (a)_____

or (b)_____

C. 12. The twofold function of the distributoris

(a)_____

(b)_____

13. A hot spark plug is one that has a _____ porcelain.

D. 14. The four steps in timing an engine are:

(a)_____

(b)_____

(c)_____

(d)_____

15. In a system employing two sets of distributor points, the points must be _____.

E. 16. A direct current generator uses a _____ and an alternating current generator uses a _____.

17. In field distortion the _____ of the field are drawn aside by the_____ of the armature.

UNIT VI

THE ELECTRICITY OF THE AUTOMOBILE

Unit Test--Form A - 2

Name_____Class Hour_____Date_____

E. 18. The cutout disconnects the generator and the battery when the _____ is too low.

F. 19. The commutator and the brushes of a motor serves as a _____.

20. The poles _____ and _____ the armature of a motor when the current is flowing into it.

21. A solenoid is a _____ without a_____.

G. 22. In charging a battery some form of _____ current is used.

23. A sulphated battery is one that has stood in a _____ condition for some time.

24. The specific gravity of a fully charged battery is from _____ to _____.

25. In order to keep the electrolyte at the proper level _____ is added.

UNIT VII

AUTOMOBILE ECONOMICS

Unit Outline

A. Ownership

1. Methods of acquiring
    a. Cash purchase -- advantage of bargaining
    b. Time payments -- cost of financing and interest
2. Cost of operation
    a. Comparison of operation at high and low speeds
    b. License fee
    c. Taxes -- annual, sales
    d. Insurance

B. <u>Responsibility</u>

1. To know and observe laws
2. To secure drivers' license
3. To respect rights of others
    a. Practice "Golden Rule"
4. To carry adequate insurance
    a. Types of policies
    b. Selecting the insuring company
5. Civil and criminal
    a. In regard to speed
    b. In regard to carelessness

UNIT VII

AUTOMOBILE ECONOMICS

Unit Outline - 2

B. 5. c. In regard to chance taking

d. In regard to absentmindedness

e. In regard to the mechanical condition of the car

f. In regard to the physical condition of the driver

(1) Intoxicants

(2) Illness

(3) Physical defects

(4) Sleepiness

6. To parents -- cost of raising an individual

C. Engineering

1. Safety features in the modern car

2. Safety features in modern highway construction

D. Automobile Operation

1. Operating a car

2. Care of a car

a. Washing and cleaning

b. Polishing

c. Refinishing

3. What to do in case of an accident

UNIT VII

AUTOMOBILE ECONOMICS

Unit Outline - 3

E. Changes in Standards of Living

1. Social
   a. Permits people to live closer together
   b. Permits more people to travel
   c. Allows communities to intermingle
2. Educational
   a. Makes possible the consolidated form of school
   b. Permits education by travel
3. Economic
   a. Allows people to live farther from their work
   b. Allows the worker to migrate to find work
   c. Replaces the old style barn with a modern garage -- necessitates smaller yards
   d. Makes possible faster handling of produce

UNIT VII

AUTOMOBILE ECONOMICS

Unit Introduction

We are all potential buyers of automobiles. Those of us who now own a car will want some day to trade it in and get another. Those of us who are still to experience the thrill of car ownership should know some of the principles of thrifty buying and operating. There is more involved in the purchase of a car than merely making the down payment and keeping up the installments as they fall due.

In this unit we will try to uncover some of these things so that we may better understand the full significance of car ownership and the responsibilities that we must assume to become better citizens, and not liabilities to the community.

UNIT VII

AUTOMOBILE ECONOMICS

Unit Test--Exploratory Form

Name_____Class Hour_____ Date_____

Directions: Fill in the above blanks. Answer the questions by filling in the blank spaces provided.

A. 1. Do you now own a car registered in your own name?

_____

2. Do you have a driver's license?_____

3. If you have a car, how much insurance do you carry on it? _____

4. In California is a car owner required to carry insurance? _____ If so, how much? _____

5. What is the cheapest method of financing the purchase of a car? _____

6. At what speed do you get the most economy of car operation? _____

7. What fees are sent to the Motor Vehicle Department by the car owner at the first of the year? _____

_____

8. To what agencies do we pay taxes for each gallon of gasoline we use? _____

9. Besides gasoline taxes, what taxes does an automobile purchaser pay?

UNIT VII

AUTOMOBILE ECONOMICS

Unit Test--Exploratory Form - 2

Name_____Class Hour_____Date_____

A. 10. If you were to buy a car today would you pay cash, borrow the money from the bank, or finance through a finance corporation? _____

11. What is the reason for the answer to the above question?_____

B. 12. Are traffic laws in Palo Alto any different than laws in any other California city? _____

13. What are the purpose of the traffic laws?_____

_____

14. If you were to take out an insurance policy today, how would you determine what company you would take it out in? _____

15. Why are modern cars safer than the older variety?

_____

_____

_____

16. What features of modern cars make them more dangerous than older cars?_____

_____

17. What is required of you if you have a traffic accident?_____

_____

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study

A. Automobile Ownership

1. Price level
    a. New cars
    b. Second hand
2. Methods of acquiring
    a. Cash purchase
    b. Credit purchase
        (1) Flat loan
        (2) Finance corporation loan
3. Cost of operation
    a. Comparison of operation at high and low speeds
    b. Interest and payments
    c. License fees
    d. Taxes
        (1) Property
        (2) Sales
        (3) Gasoline
    e. Insurance
        (1) Liability and property damage
        (2) Collision
        (3) Fire and theft
        (4) Loss of use

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 2

A. Automobile Ownership -- continued

References:

California Department of Motor Vehicles: "The Vehicle Code -- 1937," pp. 179-184, 70-83, 65-70, 179

Dyke: "Dyke's Automobile and Gasoline Engine Encyclopedia," pp. 1071-1072

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 3

B. Owner Responsibility

1. To know and observe laws
2. To secure drivers' licence
3. To respect rights of others
   a. Practice "Golden Rule"
4. To carry adequate insurance
5. Civil and criminal
   a. In regard to speed
   b. In regard to carelessness
   c. In regard to chance taking
   d. In regard to absent-mindedness
   e. In regard to the mechanical condition of the car
   f. In regard to the physical condition of the driver
      (1) Intoxicants
      (2) Illness
      (3) Physical defects
      (4) Sleepiness
6. To parents
   a. Cost of raising an individual

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 4

B. Owner Responsibility -- continued

References:

California Department of Motor Vehicles: "The Vehicle Code," pp. 70-83, 43-65, 88 (note 596, 596.5) - 124

California State Automobile Assn.: "Drivers of Tomorrow," Lessons 1-11

Kennedy: "Course of Study in Automobile Operation," pp. 15-19

Page: Ford V8 Cars and Trucks, pp. 474-484

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 5

C. Engineering

1. Traffic -- study of accidents and their causes
    a. Where accidents occur
    b. When accidents occur
    c. How accidents occur
    d. Why accidents occur
    e. Recommendations for elimination of the hazard
2. Highway
    a. Re-alignment of highways
    b. Elimination of grade crossings
    c. Provide smooth durable pavements
    d. Develop non-skid surfaces
    e. Traffic lane marking
    f. Provide reflector type caution and warning signs
    g. Elimination of sharp curves
    h. Widening of road shoulders
3. Automotive
    a. Four-wheel brakes
    b. Shatter-proof safety-glass
    c. Steel bodies

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 6

C. Engineering -- continued

3. d. Steel tops

e. Improved steering mechanisms

f. Improved lighting equipment

g. Better tires

References:

Schultz and Schultz: "School and Home Shopwork," pp. 223-229

Elliott, Merrill, Wright: "Our Dynamic Society," pp. 109-117

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 7

D. Automobile Operation

1. Operation of a car
2. Care of a car
   a. Washing the car
   b. Polishing the car
   c. Cleaning the interior of the car
   d. Refinishing the car
3. What to do in case of an accident
   a. Give information
   b. Render aid if necessary
   c. Make report

References:

Kennedy: Course of Study in Automobile Operation, pp. 10-14

California Department of Motor Vehicles: The Vehicle Code, pp. 96-102

Dyke: Dyke's Automobile and Gasoline Engine Encyclopedia, pp. 629-654

Page: Ford V8 Cars and Trucks, pp. 456-474 483-487

Schultz and Schultz: School and Home Shopwork, pp. 229-231

General Motors Corp.: We Drivers, entire

UNIT VII

AUTOMOBILE ECONOMICS

Guide for Study - 8

E. Changes in Standards of Living Caused by the Automobile

1. Social

   a. Permits people to live closer together

   b. Permits more people to travel

   c. Allows communities to intermingle

2. Educational

   a. Makes possible the consolidated form of school

   b. Permits more people to travel

3. Economics

   a. Allows people to live farther from their work

   b. Allows the worker to migrate to find work

   c. Replaces the old style barn with a modern garage -- necessitates smaller yards

   d. Makes possible faster handling of produce

References:

Lapp, John A.: "Practical Social Science," p. 151

Bogardus, E. A.: "Sociology," pp. 272-292, 349

Elliott, Merrill, Wright: "Our Dynamic Society," pp. 212, 252, 279, 285-289, 8, 80, 86, 93, 122, 154, 159, 207

UNIT VII

AUTOMOBILE ECONOMICS

Unit Test--Form A

Name_____Class Hour_____Date_____

Directions: Fill in the above blank spaces. Answer the questions by writing in the spaces provided. Hand in the paper at the end of the class period.

A. 1. In the purchaseof an automobile what three things must be taken into account?

a. _____

b. _____

c. _____

2. What is the name of the insurance policy that protects others? _____

3. What are the names of the policies that protect the property of the driver? _____

_____

4. To what agency is the property tax of an automobile paid? _____

5. What is the final disposition of the automobile property tax? _____

6. Where do road funds come from?_____

7. What is the most economical driving speed?_____

B. 8. What are the responsibilities of the automobile driver?

a. _____

b. _____

UNIT VII

AUTOMOBILE ECONOMICS

Unit Test--Form A-2

Name_____Class Hour_____Date_____

B. 8. c. _____

d. _____

e. _____

f. _____

9. What should a driver do if he should become sleepy or sick while driving a car?_____

_____

C. 10. How can we reduce traffic accidents? _____

_____

_____

_____

_____

11. What is the penalty for defacing highway traffic signs? _____

12. What is being done by the State Highway commission to eliminate accidents?_____

_____

_____

_____

_____

_____

UNIT VII

AUTOMOBILE ECONOMICS

Unit Test--Form A - 3

Name_____Class Hour_____Date_____

C. 13. What safety features are incorporated in cars?

a. _____ e. _____

b. _____ f. _____

c. _____ g. _____

d. _____ h. _____

D. 14. What is required of a driver that has been involved in an accident? _____

_____

15. What is the speed limit on the school grounds?____

16. What is the speed limit at intersections?_____

17. What vehicles have right of way at all times?

_____

18. What is required if you are driving an automobile and you hear a siren? _____

_____

19. When does the pedestrian have the right of way?

_____

20. What part of an automobile is prohibited to passengers? _____

APPENDIX II

BIBLIOGRAPHY OF REFERENCE MATERIAL USED IN THE UNITS

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Bogardus, E. S. Sociology, New York, The Macmillan Co., 1934.

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