STATE OF IOWA

1930

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Courses of Study for
High Schools

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# GENERAL SCIENCE

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Issued by the Department of Public Instruction

AGNES SAMUELSON, *Superintendent*

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Published by
THE STATE OF IOWA
Des Moines

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# FOREWORD

This course of study is one of a series of curriculum publications to be presented the high schools of the state from time to time by the Department of Public Instruction. It has been prepared by a subject committee of the Iowa High School Course of Study Commission working under the immediate direction of an Executive Committee. If it is of concrete guidance to the teachers of the state in improving the outcomes of instruction, the major objective of all who have contributed to its construction will have been realized.

From the start the need of preparing working materials based upon cardinal objectives and adaptable to classroom situations was emphasized. The use of the course of study in the development of proper pupil attitudes, ideals, habits, and skills was the criterion for selecting and evaluating subject matter material. At the same time it was important to consider the relation of the single course of study unit to the variety of textbooks used in the high schools of the state. The problem before the committees was that of preparing suitable courses of study representing the best in educational theory, practice, and research, and organized in such a way as to guide the teachers in using the textbook to greater advantage in reaching specified outcomes of instruction.

The selection of texts in this state is a function of the local school boards. The Department of Public Instruction and the committees do not recommend any particular text as essential to the working success of this course of study. The titles listed on the following pages are not to be interpreted as having official endorsement as against other and newer publications of value. They were found upon investigation to be in most common use in the high schools of the state at the time the units were being prepared; a follow-up survey might show changes.

Although many valuable studies have been made in the effort to determine what to teach and how to teach it, and to discover how children learn, these problems have not been solved with finality. For that reason and because no fixed curriculum can be responsive to changing needs, this course of study is to be considered as a report of progress. Its revision in accordance with the enriched content and improved procedures constantly being developed is a continuous program of the Department of Public Instruction. Your appraisal and evaluation of the material as the result of your experience with it are sincerely requested.

# ACKNOWLEDGMENTS

The Department of Public Instruction takes this opportunity of thanking the many college specialists, school administrators, and classroom teachers who have helped with this program. Without the active coöperation of the educational forces of the state it could not have even been attempted. It has had that coöperation both in general and specific ways. The support given by the Iowa State Teachers Association and the High School Principals' Section has enabled the Executive Committee to meet and also to hold meetings with the Commission as a whole and with the chairman of subject committees.

Special acknowledgment is given the Executive Committee for its significant leadership in organizing the program and to Dr. T. J. Kirby for his valuable services in directing its development. Sincere gratitude is also expressed to the various committees for their faithful and skillful work in completing the subject matter reports assigned them and to Dr. C. L. Robbins for his careful and painstaking work in editing the manuscripts. The state is deeply indebted to the High School Course of Study Commission for its expert and gratuitous service in this enterprise. Credit is due the publishers for making their materials accessible to the committees and to all who served in advisory or appraisal capacities. Many of their names may not have been reported to us, but we acknowledge our appreciation to every one who has shown an interest in this significant program.

In the following committee list, the positions held by members are given as of the school year 1928-1929.

## IOWA HIGH SCHOOL COURSE OF STUDY COMMISSION

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*Superintendent Chandler was appointed in 1929 to fill the vacancy created by the resignation of Superintendent Menefee.

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# GENERAL INTRODUCTION

At the first general meeting of the various subject committees a suggestive pattern for the courses of study, embodying the fundamental needs for teaching, was projected. Four crucial factors that should be emphasized in any course of study to make it an instrument that would cause teachers to consult it for guidance in the performance of their daily work were set forth as follows: objectives, teacher procedures, pupil activities, and evidences of mastery.

**Objectives**—The meaning of objectives as here used is those concepts which are set up for pupils to achieve. As used in current practice, there is a hierarchy of objectives as shown by the fact that we have objectives of general education, objectives for various units of our educational system such as those proposed by the Committee on Cardinal Principles, objectives for subjects, objectives for a unit of instruction, and objectives for a single lesson. In each level of this hierarchy of objectives a constant element is expressed or implied in the form of knowledge, a habit, an attitude, or a skill which pupils are expected to acquire.

In the entire field of secondary education no greater problem confronts us than that of determining what these fundamental achievements are to be. What shall be the source of those objectives, is a problem of too great proportions for discussion here, but it is a problem that each committee must face in the construction of a course of study. A varying consideration of objectives by the various committees is evident in the courses of study they have prepared. The value of the courses varies in terms of the objectives that have been set up, according to the value of the objective in social life, according to the type of mental techniques which they stimulate and exercise, and according to the objectivity of their statement.

**Pupil activities**—In our educational science we are attaching increasing significance to self-activity on the part of the learner. Recognition is made of the fundamental principle that only through their own activity pupils learn and that the teacher's rôle is to stimulate and direct this activity. No more important problem faces the curriculum-maker than that of discovering those fundamental activities by which pupils learn. In a well-organized course of study, that series of activities, in doing which pupils will attain the objectives set up, must be provided. These activities must not be chosen in a random fashion, but care must be taken that appropriate activities for the attainment of each objective are provided.

**Teacher procedures**—With the objectives determined and the activities by which pupils learn agreed upon, the function of the teacher in the pupil's learning process must be considered. In a course of study there should appear those teacher procedures of known value which make learning desirable, economical, and permanent. Here our educational science has much to offer. Where research has demonstrated with a high degree of certitude that a given technique is more effective in the learning process than others, this technique should be

included in a course of study. Common teaching errors with suggested procedures to replace them may be included. Pupil difficulties which have been discovered through research should be mentioned and methods of proven value for meeting these difficulties should be included. Suggested ways of utilizing pupils' experiences should be made. And as important as any other feature is the problem of motivating learning. Whatever our educational research has revealed that stimulates the desires of pupils to learn should be made available in a course of study. Valuable types of testing should be incorporated as well as effective type assignment. The significance of verbal illustrations as evidence of comprehending the principle at issue should be featured as a procedure. Where there is a controlling procedure of recognized value such as is recognized in general science—bringing the pupil into direct contact with the phenomena studied—forceful effort for the operation of this procedure should be made.

**Evidences of mastery**—What are to be the evidences of mastery of the objectives set up? There are all degrees of mastery from the memoriter repetition of meaningless terms up to a rationalized comprehension that shows grasp of both the controlling principles involved and the basic facts necessary to a clear presentation of the principles. These evidences of mastery may be in the form of dates *to be known,* formulae *to be able to use,* types of problems *to be able to solve,* quality of composition *to produce,* organization of materials *to be made,* floor talks *to be able to give,* papers *to be able to write.*

In no part of educational procedure is there need for more effort than in a clear determination of those evidences by which a well-informed teaching staff can determine whether a pupil has mastery of the fundamental objectives that comprise a given course. As we clarify our judgments as to what comprise the essential knowledge, habits, attitudes, and modes of thinking involved in a certain course, we can set forth with more confidence the evidences of mastery. Teachers are asking for the evidences of mastery that are expected of pupils, and courses of study should reveal them.

While these four elements constitute the basic pattern, the principle of continuity from objective to pupil activity, to teacher procedure, to evidence of mastery was stressed. The maker of a course of study must bear in mind that what is needed is an objective having accepted value; a pupil activity, in performing which, pupils gain a comprehension of the objective that is now being considered; that a teacher procedure is needed which evidence has shown is best adapted to stimulating pupils to acquire this objective for which they are striving; and that evidences of mastery must be incorporated into the course by which to test the degree of comprehension of the objective now being considered.

The courses of study vary in the degree to which these four fundamental features have been objectified and in the degree to which the principle of continuity from objective to evidence of mastery has been cared for. On the whole they will provide effective guides which teachers will use.

Realizing that these courses of study were prepared by school men and women doing full time work in their respective positions, one fully appreciates the professional zeal with which they worked and the splendid contribution to high school education which they made.

THOMAS J. KIRBY, Chairman, Executive Committee

# COURSE OF STUDY FOR GENERAL SCIENCE

## INTRODUCTION

General science came into being to provide a less abrupt transition from the science of the elementary grades to the more specialized sciences of senior high school level. It is now the accepted science course in most of our junior high schools. If no well-developed science program is active in the elementary grades, general science is offered in the ninth grade. If, however, there is a continuous science program throughout the elementary grades, general science is being moved down into the seventh and eighth grades. This placing of general science first has been justified by studies which indicate that it offers more life contacts than physics, biology, and chemistry combined.

The objectives of general science, as set forth by the committee, are:

1. To acquaint the pupil with both physical and biological environment
2. To help the pupil interpret and unify his experiences in relation to his surroundings in order that he may better command many factors which contribute to good citizenship
3. To provide acquaintance with the elementary laws of nature necessary for the maintenance of individual and community health
4. To give the pupil an appreciation of the laws of nature and their application to his environment
5. To build up an attitude of inquiry and investigation which shall lead to the scientific method of problem solving and train in the ability to apply information to the solution of new problems
6. To provide for the discovery of dominant interests and abilities which may serve as a guide for vocational and avocational activities
7. To develop an understanding of appliances which science has developed and which are useful in making for greater comfort and convenience in the home and community
8. To develop in the pupil a sensitivity to problems in science to the end that he will read with discrimination articles and books dealing with such problems
9. To acquaint the pupil with the lives and works of great scientists to the end that he may appreciate the spirit in which a true scientist works and come to know how the work of scientists in the past and present makes life better for all of us

The subject matter of general science has been divided into fifteen environmental units, each of which has been organized according to the method projected by the Executive Committee: (1) specific objectives, (2) teacher procedures, (3) pupil activities, and (4) evidences of mastery.

C. B. Yager, Chairman
Winifred Gilbert
Eunice Jones
W. O. Allen
R. F. Myers

# I. THE EARTH ON WHICH WE LIVE AND ITS NEIGHBORS

A. The earth as a part of the universe and solar system

B. The principal bodies of the solar system

### Unit Objective

To gain an appreciation of the unity and magnitude of the solar system

### Specific Objectives

1. To appreciate the vastness of the solar system and man's place in it

2. To distinguish between universe and solar system

3. To realize that the earth, though a part of the solar system, is only a small part of that system

4. To develop a permanent interest in the universe

5. To realize the wonderful system of behavior among all heavenly bodies

6. To develop an interest in reading materials along the line of astronomy and through this study be able to interpret the articles read

7. To realize that astronomy is a valuable science and that we now explain physical phenomena by scientific means rather than by superstitions

8. To know the men and their contributions that have supplied us with a knowledge of the solar system

### Teacher Procedures

1. Introduce this unit by giving a short talk on the solar system in such a way that pupils will begin to realize the vastness of the universe

   a. Number of stars visible to naked eye

   b. Number of stars visible by use of powerful telescope

   c. Distance of sun from earth (93,000,000 miles)

   d. Distance of other suns or stars from earth

   e. Meaning of light year and how many light years away are our nearest and farthest stars

2. Show how the earth fits into the plan of the solar system

   a. Bodies included

   b. Relation of earth to other planets and the sun

   c. Distinguishing planets from stars or suns; locating them

   d. Brief study of planets

3. Plan for actual observation of the phenomena studied. Plan also for accurate recording of observations

   a. The sun and its relation to the earth

      1) Size of sun—distance from earth

      2) Cause of sun's heat

      3) Cause of change of seasons

      4) Cause of variation of length of days and nights throughout the year. (Demonstrate to show the motions of the earth and its moon in relation to sun)

      5) Cause of seasons

      6) Effect of changes in the sun's altitude on heating

**Pupil Activities**

1. Find out what knowledge primitive man had of the universe and give short report

2. Find out who discovered and named the planets

3. Make a diagram to show the sizes and distances from the sun of the planets

4. Keep a record of the time of sunrise and sunset over a period of a month. Summarize results and try to account for them

5. Find out how physicists tell the composition of the sun

6. Learn to tell time of day by the sun

7. Make a sun dial and demonstrate how it tells time of day

8. Make field observations and reports upon animals and plan adaptation to seasons and climate

9. Keep records of phases of the moon from observation

10. Make drawings to show how eclipse of the moon is caused; explain the drawing

11. Collect star maps by months (*Nature Magazine* or other sources)

12. Make a star map of polar constellations

13. Learn to tell directions at night by stars

14. Find out how sailors of ancient times kept their bearings when at sea

15. Learn to locate the North Star

16. Take a star map on a clear night in September and locate the following constellations which are always visible in a northern sky: Big Dipper, Little Dipper, and Cassiopeia

17. Locate Orion and the Pleiades in the southeast later in the fall about the last of October

18. Draw a design to show the path of a comet around the sun

**Evidences of Mastery**

1. To know the kinds of heavenly bodies that make up the universe

2. To know the meaning of universe and solar system

3. To know the relation of earth to solar system

4. To gain a new appreciation of what seems commonplace (stars, planets, etc.)

5. To know primitive man's knowledge of the universe as compared with modern knowledge

6. To know the following significant facts concerning the planets

   a. Planets travel around the sun

   b. They shine by reflected light of the sun

   c. The planets that are easily seen at proper times are Venus, Mars, Jupiter, and Saturn

   d. The planets follow approximately the same path across the heavens as do the sun and moon; thus they are never seen in the northern sky

7. To know the following facts about the moon

   a. Phases of moon are caused by changes in relative position of earth, moon, and sun

   b. Moon shines by reflected light of sun

   c. No atmosphere on moon and reason

**References**

Ball, *Starland,* Ginn

Collins, *The Book of Stars,* Appleton

MacPherson, *Romance of Modern Astronomy,* Lippincott

Martin, *The Friendly Stars,* Harper

Moseley, *Trees, Stars, and Birds,* Harper

Proctor, *Easy Star Lessons,* Longmans Green

Seers, *The Earth and Its Life,* World Book Company

Bureau of Standards Circular Number 51, *Measurements of Time and Tests of Timepieces*

Monthly Star Maps in *Nature Magazine* (Also *Scientific American*)

**Teacher Procedures**

b. The moon and its relation to the earth
   1) Causes of phases of moon
   2) Source of light
   3) Surface of moon, whether it has atmosphere
   4) Effect of moon upon earth
   5) Distance of moon from sun and earth

c. Other stars (suns)
   1) Nature, number, composition, and distance away
   2) Cause of difference in brightness
   3) Meaning of constellation and method of naming
   4) Constellations which are always visible
   5) A few of very common constellations: those visible at all times of the year in the northern sky; those appearing in the southeast later in fall

d. Other bodies that move about the sun
   1) Meteors, their composition, why called "shooting stars"
   2) Planetoids
   3) Comets

e. The work of Galileo and Newton

f. Value of astronomy to man
   1) Getting correct time
   2) Determining and using standard time

4. Organize lessons to make clear

5. Help pupils organize the work of the entire unit by means of an outline, then use the outline for class review

6. Test pupils over the essential subject matter by means of an objective test

7. Place results of test on board by means of graph. Let pupils see how far they are from the median

**Pupil Activities**

19. Find out how the calendar originated

20. Give a report on new calendars proposed

21. Explain how time and direction can be told by the sun

22. Prepare a brief report on contributions to science by Galileo, Newton, and others

**Evidences of Mastery**

d. Eclipse of moon is caused by shadow of earth falling on moon

8. To know the following facts about the sun and how it affects the earth

a. The sun is the ultimate source of the earth's energy

b. Sun spots are eruptions on the sun's surface

c. Sun is a medium sized star

d. Sun is 93,000,000 miles from the earth

e. The composition of sun is revealed by the spectroscope

f. The variation of day and night throughout the year is caused by the inclination of the earth's axis away from the perpendicular to the plane of its orbit

## II. THE PLANT COVERING OF THE EARTH AND HOW GREEN PLANTS LIVE IN THEIR ENVIRONMENT

A. Plant associations of local regions

B. The green plants and their environment

### Unit Objective

To gain an active interest in and appreciation of the varied plant life of the world and to gain a knowledge of how plants carry on the work of growing and living

### Specific Objectives

1. To show that there are certain definite factors that determine types of plants that grow in definite regions

2. To show how plants differ widely according to their environment

3. To show how plants carry on their work of growing and reproduction

4. To give pupils an active, wholesome interest in, and an appreciation of the various common plants

5. Through the development of the subject matter of this unit, to lead pupils to see that plants are important as furnishers of all food

6. To show that a good citizen should participate sensibly in conservation of vanishing wild flowers of Iowa

7. To develop a sensible and intelligent attitude toward organizations attempting to con-

### Teacher Procedures

1. Try to determine the pupils' background for this unit—such as home garden work, testing of seed corn, nature work in camp, etc.

2. Place before the pupils the story showing dependence of man upon green plants and energy from the sun

3. Present problems to be performed in class which will furnish the best medium for attainments of objectives set forth

   a. Take field trip to several different types of locations where wild plants are growing, note types of plants growing together in each situation (Example: visit a swamp, natural meadows, timber, tracts on railroad right of way)

   b. Get map of national forests from United States Forest Service and see if any important national forests are near us. Does Iowa have state forest service?

   c. Germinate seeds by several different methods to find out needs of plants for growth

   d. Germinate radish seeds on moist blotting paper to show plants' absorbing organs, root hairs, and how they work for the plant

   e. Demonstrate the principle of osmosis to show how roots take in moisture

4. Select a series of topics which review the main points of the unit and have them discussed in the order of the main points which will make the recitation serve as a good review

### Pupil Activities

1. Make a list of plants growing in the same localities. If you do not know names of plants describe them. Write a short paragraph on how the plants of these associations differ

2. Bring cuttings of plants for window boxes

3. Bring seeds for germination. (Draw various stages)

4. Collect plants that grow best in water for a school aquarium

5. Collect pictures and clippings for bulletin board that illustrate any topic of interest in connection with plant study

6. Keep records of problems demonstrated in class

7. Keep list of new words used in this unit

8. Make collection of various plants that are successful in dispersing their seeds

9. Try to find out how plants invade new areas and establish themselves

10. Send to State Board of Conservation at Des Moines and get maps locating state parks. Try to find out something interesting about plant life of each. If possible visit one nearest you and report on plant life found there

11. Send to Wild Life Preservation Society at Washington, D. C. and get literature. Conduct a campaign to conserve rare wild flowers

12. Find out how to test for food materials stored up in seeds of plants (carbohydrates, fats, and protein); and test seeds before and during germination. Account for changes

13. Solve additional problems if time permits

   a. Special adaptations of plants for securing and digesting food materials; pitcher plant, sundew, Venus fly trap

   b. Changes you find in plant life as you ascend a mountain

   c. Care of house plants

### Evidences of Mastery

1. To know that the plant covering of the earth varies greatly in different regions because of certain climatic and soil factors

2. To know what conditions are necessary for a plant to live and grow

3. To know how the organs of the plant are fitted for particular uses

4. To know how and where plants secure materials for making food

5. To know how plants make food for themselves

6. To know how the food manufactured by plants is used for growth or stored for future use

7. To know why some plants produce flowers

8. To know how flowering plants produce fruit and seeds

9. To know some methods by which seeds of plants are scattered

10. To know how water is absorbed by plants

11. To know under what conditions plants give off oxygen

12. To know the purpose of many adaptations of seeds and fruits

13. To know that some plants have special adaptations for living in certain places.

14. To have an appreciation of the problems of all plants

| Specific Objectives | Teacher Procedures |
|---|---|
| serve wild plant life (Iowa State Conservation Board, Wild Flower Preservation Society, etc.) | 5. Have pupils make summary of unit either by topical or sentence outlines which may then be collected and pupils called upon to talk on main points in the outlines |
| 8. To develop certain study attitudes through the problems of this unit<br>a. Spirit of inquiry and investigation<br>b. Desire to solve arising problems<br>c. Formation of conclusions | 6. Have special reports from list under heading "Special Reports". (No pupil is allowed to work on these until he has mastered the essentials of the unit. They may be used for the pupil who finishes work before the others of the class |
| | 7. Use some form of objective test to make sure pupils have the unit well mastered |
| | 8. Place results of test on board by means of graph; let pupils see how far they are from the median |

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*Classroom Teacher,* Vols. 8 and 9

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Hessler, *Junior Science,* Sanborn

Snyder, *Everyday Science,* Allyn and Bacon

Trafton, *Science of Home and Community,* Macmillan

Transeau, *General Botany,* 1923, World Book Company

Van Buskirk and Smith, *The Science of Everyday Life,* Houghton Mifflin

**Pupil Activities**

d. Beautifying home and school grounds

e. Men who have given us better plants

f. Ways in which seeds travel

14. Consider problems studied under this unit and satisfy yourself that the important facts and relationships under each problem can be stated. This should help pupil to measure the progress made since beginning the study of the unit

15. Make any corrections or revisions that are necessary on problems of the unit

16 Make a sentence outline of the unit for a summary

**Evidences of Mastery**

15. To be able to summarize the work of the unit either by sentence or topical outline

16. To be able to use new scientific terms learned in this unit correctly, and to use them in summary outline and oral reports

## III. OUR ANIMAL NEIGHBORS AND THEIR RELATION TO PLANTS AND TO EACH OTHER

A. How animals solve their life problems

B. How man utilizes and controls the activities of plants and animals

C. How plants and animals are interrelated

D. How man improves and produces new kinds of plants and animals

### Unit Objective

To gain a simple knowledge of the adaptations animals possess for the life they lead and how man controls the activities of plants and animals

### Specific Objectives

1. To gain a knowledge of how different types of animals live and maintain themselves in their environment

2. To gain an appreciation of fitness which animals possess for food getting, protection, breathing and locomotion

3. To know how very simple animal forms live in their surroundings

4. To know that animals with highly developed sense organs and special adaptations have been more successful in living

5. To realize the importance and economic value of animal and plant life in relation to man's needs

6. To gain knowledge of the process by which man has domesticated the plants and animals to supply his needs

### Teacher Procedures

1. Help pupils summarize their material on differences of plants and animals

2. Show how animals adapt themselves to live and maintain themselves

   a. Adaptations for food getting (gnawing animals; those that tear food as dog; those that grind food; those taking food from water; those with beaks)

   b. Adaptations for locomotion (swimming types as seal, fish, and whales; climbing; flying; grasping; and running)

   c. Adaptations for breathing (forms breathing through skin as earthworm; those breathing through tube as insects; indirect air breathers as fish, tadpoles; and direct air breathers as turtle, man, etc.)

   d. Adaptations for protection (examples of those protected by coloration, keen sense, body coverings, and special means as skunk)

   e. Preservation of species through nest or home building, production of great numbers of eggs, and parental care

3. Show how animals in different surroundings vary widely

   a. Adaptation for the desert region

   b. Adaptation of land birds, water, and shore birds

   c. How deep-sea fish differ from those living in shallow water

**Pupil Activities**

1. Make a table to show differences between plants and animals; summarize

2. Collect from a pond or swamp some old grass or hay infusion. Try to find animal life in this infusion, and find out from observation how they are adapted to the life they lead

3. Select any animal for special study and report on its interesting habits of living

4. Collect pictures of prehistoric animals for bulletin board

5. Make a terrarium and stock with any available animal life, as small garter snakes, toads, frogs, earthworms, ets., and use this for a study of adaptations (good class or group project)

6. Make breeding cages for insects and collect as many stages as possible for further study of adaptations for food getting, locomotion and protection

7. Collect things insects have made, as deserted hornet nests, galls, cocoons, etc.

8. Study several animals from the standpoint of protective coloration or form, in relation to their environment (mimicry)

9. List ways plants are being utilized by man under such headings as producers of food for man, producers of food for animals, those that supply clothing, those that supply materials used in industry

10. Look up and list the important domesticated animals and their uses

11. Select one plant or animal and prepare a report on its origin and domestication

12. List plants that are injurious to man's interests

13. Prepare an exhibit showing as many plant and animal products as can be obtained

14. Find out what plants in the vicinity are poisonous and find out how to identify them, as poison ivy, etc.

**Evidences of Mastery**

1. To know principal differences between plants and animals. (Plants, independent for food, usually have stationary habits, etc.)

2. To know that both plants and animals have similar needs, air, water, etc.

3. To know what problems animals must solve in order to live and produce, to continue species, avoid enemies, get food, etc.

4. To understand some of the adaptations which vertebrates possess for successful living

5. To know why some animals of the past have disappeared

6. To know in what ways plants are utilized by man

7. To know uses of domesticated animals

8. To know history of a few of our common domesticated animals

9. To know how the domestication of plants and animals influenced the early history of man

10. To know some of the plants and animals injurious to mankind, as weeds, certain insects, etc.

11. To know methods by which man controls plant and animal pests

12. To be able to identify poison plants of vicinity

| Specific Objectives | Teacher Procedures |
|---|---|
| 7. To gain a knowledge of the means by which man controls plants and animals injurious to him | 4. Find out names of some of the prehistoric animals and explain why they disappeared (Examples: dinosaurs and saber-toothed tiger) |
| 8. To realize man's skill and work in the production and utilization of the plants and animals of the earth | 5. Show how we utilize the activities of plants and animals: food-making in plants, storing of honey by bees, pollination of red clover by bumble bees, etc. |
| 9. To gain a knowledge and appreciation of the interdependence of plants and animals | 6. Show by observation on field trip the characteristics of weeds which make them successful: production of many seeds and good means of scattering them as dandelion. Learn names of growth as rosettes, and types of roots |
| 10. To gain some knowledge of how man by scientific methods has been able to improve plants and animals which he has found useful | 7. Make a short study of plants that are injurious to man's interests as weeds, parasites, bacteria, fungi; enemies to crops (weeds) and those that produce poisonous substances |
| 11. To gain some knowledge of the great variety of plants and breeds of animals man has helped to develop | 8. Tell what group of plants offers greatest problems of control and explain the most effective methods of control |
| 12. To know the methods used in the improvement of plants and animals | 9. Explain how man has helped to make some plants and animals more injurious (introducing weeds, insects, etc.) |
| 13. To know the contributions of men to the improvement of plants and animal forms | 10. Explain the laws to regulate distribution of bulbs, etc. from other countries |
| | 11. Give illustrations of coöperation between plants and animals<br>a. Insects as pollinizers of ornamental plants, fruits, and field crops, as the fig insect, yucca, and red clover<br>b. Animal life in soil<br>c. Nitrogen-fixing bacteria and legumes |
| | 12. Show that ease of handling, rapidity of multiplication, and cheapness with which they can be kept have made flies (pomace fly) a subject of scientific study |
| | 13. Show some of the differences between the varieties of plants and breeds of animals of the locality<br>a. Reason for many breeds of dogs and horses<br>b. Kinds of pigeons (*National Geographic Magazine*) |

**References**

Downing, *Our Living World*, University of Chicago Press

Fabre, *Social Life in the Insect World*, Century

Gordon and Kellogg, *Animal Life*, Appleton

Herwood, *New Creations in Plant Life*, Macmillan

Mix, *Mighty Animals of the Past*, American Book Co.

Palmer, *Field Book of Nature*, Comstock

**Pupil Activities**

15. Summarize methods of controlling injurious plants

16. Make collection of plants injurious to man's interest. (This should include plants attacked by rust, smut, cedar apples, etc.)

17. Look up history of Russian thistle, and the English sparrow and starling

18. Look up and report on "How the Production of Clover Seed is Dependent upon the Bumble Bees," "The Dependence of the Smyrna Fig Culture in the United States upon the Wasp" (Plasto Phaga)

19. Find out what insects are used for scientific study and reason for the use of insects instead of rats, etc.

20. Collect varieties of important grains or fruits

21. Collect leaves from an oak tree to show as many variations as possible

22. Try planting some tomato seed and when they are about an inch above the ground plant some potatoes, then try grafting

23. Find out what varieties of vegetables we find on the market which your grandparents never knew

24. Prepare a list showing wild and domesticated animals of certain group, as cat family, dog family, hoofed animals, etc.

25. Visit markets and find new varieties of vegetables, nuts or fruit

26. Use bulb and seed catalogues and find varieties of tulips or other ornamental plants

27. Get from the International Harvester Company some charts showing breeds of horses, cattle, etc., and work out a class report

28. Find out where Jersey and Holstein breeds of cattle originated

**Evidences of Mastery**

13. To know something of the laws regarding the distribution of plants and animals from other countries (horses, etc.)

14. To know something of the interdependence of plants and animals

a. The oxygen cycle

b. The $CO_2$ cycle

c. Pollinization and production of fruit

15. To know some of the varieties of fruits, grains, ornamental plants, breeds of animals man has been able to produce

16. To know that greatest development of improvement in plants and animals has taken place recently

17. To know the meaning of variation

18. To know the three principles on which the methods of improvement depend: selection, variation, and heredity

19. To know some specific examples of the improvement of animals and plants

20. To know about Mendel's life and his discoveries

21. To know what other means are used in the producing of new and improved varieties of plants: budding, grafting, etc.

**References**

Stone and Cram, *American Animals,* Doubleday Page

Thomson, *Outline of Science,* Putnam

Geological Survey of Iowa, *Rodents of Iowa,* 1918, Bulletin 5

National Geographic Society, *Wild Animals of North America*

**Teacher Procedures**

c. Reasons for man's developing different kinds of cattle

d. Sheep which produce finest wool

e. Number of types of apples found on market

14. Show how the improvement of plants and animals has added to the worth of our country

a. Burbank potato

b. Oranges and grapefruit in South and Southeast

c. Improvement of cotton in South

15. Show how man has changed and improved the kinds of animals and plants

a. Do plants and animals improve under natural conditions?

b. Are any plants and animals alike?

c. What varieties are there in any given species?

d. What are the methods of selecting seeds?

e. What methods of budding are used to produce desired qualities in plants?

f. Why was progress in improving the apple slow until grafting was understood?

16. Find out the better varieties of plants and animals man has been able to produce

a. Sugar beet

b. Varieties of flowers: Shasta daisy, etc.

17. Study reports of Luther Burbank, Mendel, etc.

**Pupil Activities**

29. Read about the work of Luther Burbank and report on his work

a. Why is he called the "plant wizard"?

b. How many new varieties of flowers, fruits, and vegetables did he develop?

c. Why was he successful in his work?

**Notes by Teacher**

## IV. THE FOOD WE EAT

A. Primitive man's food supply
B. Sources of food
C. Kinds of nutrients in our foods
D. Selection and preparation of food for man's use
E. Preservation of food

### Unit Objective

To gain a knowledge of the principal foods of man in order to understand the proper selection of food for healthful living

### Specific Objectives

1. To realize man's progress is partly determined by his ability to secure adequate food supply

2. To know the principal source of food is from green plants

3. To gain a knowledge of the principal food nutrients and their use to the body

4. To gain an understanding of the proper selection of foods necessary to keep in a healthy condition

5. To realize the value of scientific methods used in production, preparation, and preservation of our food supply

6. To develop an interest in the proper diet for one's self

7. To know that foods to be of greatest use to the body must be properly prepared

### Teacher Procedures

1. Review briefly the unit on plant life. Have pupils answer the question: How is their food supply dependent upon the sun?

2. Put the story of the unit before the pupils so they see the interrelationships of the detailed study that is to follow

3. Discuss "The Food of Primitive Man" and show how his food supply depended greatly on the climate of the region

4. Present these problems and exercises

a. What are the principal sources of our foods? This should require pupil to classify the kinds of food he eats. This may be made competitive and result in pupils reading references and visiting stores

b. Have pupils list foods eaten during the day, then list their sources. Then summarize work on sources of food. It should bring out the fact that we get our food directly or indirectly from plants

c. Why do we eat food? This problem should be raised and answered before pupils consider classes of food and their special uses. Such questions as: How hibernating animals live during period of inactivity? Why do people doing hard manual work require more food than an office worker? Why our diet may include more of certain foods in winter than in summer?

d. How is the fuel value of any food determined (calorie)?

**Pupil Activities**

1. By means of an encyclopedia or other source find out all you can about the food of primitive man—how prepared, etc.

2. Make a list of the foods you ate yesterday and in table form show the source of each

3. List common plants and their products under headings: roots, stems, buds, leaves, flowers, fruits

4. Summarize the work on sources of food by a short topical outline

5. Find out how our sources of food compare with those of the Indian

6. Try to solve the problem of why we eat food; compare body with an engine; use reference book, newspapers or other sources of information

7. Look up 100-calorie portions in cook books, farmers' bulletins, etc., and determine the amount of food which any one individual requires

8. Bring food stuffs for testing, make the tests in class, chart your results and summarize by listing foods to eat which contain these different substances

9. Make graphs or charts showing the amounts of the nutrients found in common foods as potato, beans, egg, milk, etc.; or illustrate the principal foods containing carbohydrates, fats, and proteins

10. Collect menus from various sources and criticize them, drawing conclusions on the basis of whether all necessary foods are included

11. Find out from a chart how much you should weigh for a person of your age, sex, and height, and determine whether you are overweight, or just right. If you find there is a difference in your weight and that indicated on the chart, try to account for it. If you are overweight or underweight make out a week's menu that would tend to correct this

**Evidences of Mastery**

1. To learn the chief sources of food and the parts of the plant that furnish them

2. To realize our dependence upon green plants

3. To learn how to test for the presence of nutrients in foods

4. To know what nutrients common foods contain

5. To know what foods to eat to obtain vitamins

6. To know the reasons for cooking foods

7. To know the effect of different methods of cooking

8. To know how to select a well-balanced menu and compute its value in calories

9. To know that good health is dependent upon intelligent eating and involves proper selection of food

10. To know that fuel value of food is determined by calories

11. To know the chief methods by which foods are preserved in home for future use

12. To know how foods are preserved outside the home

13. To develop an interest in an investigation of special processes of food preservation and manufacture

14. To have an interest in the selection of one's diet

15. To know the use of food in relation to body uses

**Specific Objectives**

8. To gain a sensible attitude toward and knowledge of organizations that deal with the safeguarding of our food supply

9. To develop an interest in reading articles and books relating to the selection of our food supply

10. To gain a knowledge of the lives of men that have contributed to food supply, as Pasteur, Burbank, etc.

**References**

Barber, *Lessons in Science,* Holt

Barber, *First Lessons in Science,* 1924, Holt

Caldwell and Eikenberry, *Elements of General Science,* Ginn

Carpenter, *Foods and their Uses,* Scribner

Chamberlain, *How We are Fed,* Macmillan

Hessler, *Junior Science,* Sanborn

Longworthy, *Food Charts,* Superintendent of Documents, Washington, D. C.

Pieper and Beauchamp, *Everyday Problems in Science,* 1925, Scott Foresman

Rush and Winslow, *The Science of Things about Us,* 1928, Little Brown

Trafton, *Science of Home and Community,* 1926, Macmillan

Van Buskirk and Smith, *The Science of Everyday Life,* Houghton Mifflin

Yates, *Boys' Play Book of Chemistry,* Century

**Teacher Procedures**

e. Of what substances are our foods made? This will require testing common food stuffs for sugar, starch, protein, fat, and minerals

f. What kind of foods should we eat? Value of mixed diet. How to select our food. Why are green vegetables essential for a well balanced diet? What factors determine how much we should eat? This should include a study of menus found in various sources to determine what well balanced means. Try to get pupils interested in watching their diet. Make a special study of vitamins and foods that contain the various kinds

g. How are foods prepared for our eating? Effect of cooking on foods. Principles of cooking. Types of cooking as frying, boiling, roasting. Reasons for cooking foods. Report on camp cookery

h. What causes food to spoil? Bacteria, yeast and mold. Make a brief study of these from the standpoint of causing food to spoil. Action each has on food, etc. How they get into foods

i. Methods of preventing food from spoiling. Make a study of pasteurizing, refrigeration, smoking, drying, canning and use of salt and other chemicals

j. How does the body use food? Compare body to engine, considering fuel, repair, and generating power. Then study the digestive system and how it uses food. This should include the organs of digestion, digestive juices, etc.

5. Call for floor talks on main headings of the unit. The main headings of pupils' topical outlines may be used

6. Give some form of objective test over the unit

7. Use your test for remedial work. It should help you find out parts of the unit that have not been clear to some pupils. If results of the test are placed on the board by means of graphs the pupil can see for himself where he stands with regard to the median

**Pupil Activities**

12. Keep your daily menus for three meals, bring them to class and study them critically

13. Report on vitamins in our diet

14. Find out how milk is pasteurized and effect upon the flavor

15. Look up in books and articles the types of cooking. Tell about methods of camp cookery you have used. Try roasting potatoes and eggs in hot ashes

16. Bring fruit that has partly spoiled to school, as apples, oranges, etc., bread with mold on surface; then try to find out how these organisms cause food to spoil and how to prevent the process. List ways of storing and handling food to prevent spoiling. Visit a meat market to see how meats are protected and report to class on findings

17. Review the unit on foods by making a topical outline. If any parts are not clear take your text and reread sections on food, then ask for class discussion

18. Make a list of eating habits to follow

*Additional work if time permits*

If you are a member of an organization of Campfire Girls, Girl Scouts, Boy Scouts, or 4 H Clubs use this school work on foods as a means of earning honors for homecraft work

*Topics for special reports*

Camp cookery
Evolution of cookery
How maple sugar is made
Testing food for adulterations
Refrigeration
Birds that help in food production
Milk as a food

**Evidences of Mastery**

16. To know that production and distribution of food is one of the world's greatest industries

17. To know the lives and work of Pasteur, Lister, and others

## V. WATER AND ITS USES

### Unit Objective

To learn the properties of water and to understand how a pure supply of it is obtained and used

### Specific Objectives

1. To show that the freezing point of water is 0°C or 32°F

2. To show that water boils at about 100°C or 212°F and that reduced pressure reduces the boiling point

3. To show that the rate of evaporation is affected by (1) the temperature, (2) humidity of the air, (3) movement of air above water, and (4) area of surface exposed

4. To show that water expands when heated, contracts when cooled (within limits) and expands again when it goes from 4°C to 0°C

5. To show the importance of 4 in the preservation of water life during winter

6. To show that water is a good solvent and usually has some substance dissolved in it

7. To prove that water is composed of the two elements hydrogen and oxygen

8. To demonstrate the working of the siphon and to prove that it is dependent on air pressure for its operation

### Teacher Procedures

(Regular assignments are assumed)

1. Suspend a test tube containing 10cc. water in a container containing a freezing mixture of ice and salt. Place thermometer in test tube and have pupils note the temperature at which ice begins to form

2. Insert thermometer in a flask half filled with water and heat. Have pupils note temperature at which boiling begins. Note here, also, that continued heating does not raise temperature appreciably

3. Demonstrate the effect of the four factors mentioned in objective 3

4. Demonstrate the expansion and contraction upon heating and cooling; pupils are already familiar with expansion on freezing. That this expansion begins at 4°C could probably be demonstrated but unless sure of one's self this part should be omitted

5. Picture the situation which would arise if water continued to contract even from 4°C to 0°. One can imagine streams beginning to freeze at the bottom and eventually freezing solid, thereby causing the death of much water life

6. Take ordinary tap water and evaporate on watch glass. Notice scum left. Repeat with distilled water. Try rain water

7. Demonstrate electrolysis of water

8. Let pupils demonstrate siphon to class. If an air pump and bell jar be available one can prove easily that air pressure is responsible for siphon operation

9. Assign diagrammatic drawings of both kinds of pumps, with written and oral explanation of their operation

**Pupil Activities**

(It is assumed that regular assignments are studied)

1 & 2. Following the method demonstrated by the teacher, check the freezing and boiling points of several thermometers. Check freezing point on thermometer at home. Don't attempt to check boiling point because most home weather thermometers do not register that high

3. Devise and try out at home experiments which will prove that (a) warmth increases rate of evaporation (b) a large surface hastens evaporation (c) a rapid movement of air hastens it and (d) dry air causes fast evaporation

4. Fill two cheap bottles with water and cork tightly. Heat one and place other one in ice and salt. Explain results

5. Cut through thick ice in winter, get decaying matter from bottom and bring it (without freezing it) to school and examine for living matter

6. Take two clean granite pans; in one place one pint of rain water; in the other one pint of deep well water and place both on the stove and boil dry. Compare the results

7. Figure out why water isn't explosive, since is consists of hydrogen and oxygen

8. Using barrels or tubs and six or eight feet of garden hose find what conditions are present when a tub can be emptied in shortest possible time. Learn two ways of starting a siphon

9. See teacher procedure. Pupils should be able to make blackboard drawing of both kinds of pumps and explain their operation to the class

10. Report on the water plant field trip, tracing the movement of the water from its original supply to the home

**Evidences of Mastery**

1. Define the following terms: distillation; evaporation; condensation; filtration; aqueduct

2. Draw diagrams and explain the operation of lift and force pumps

3. Which can be siphoned over the highest obstacle, water, gasoline, or mercury?

4. Would a siphon work in a vacuum? Give reasons for your answer

5. Why is there a crook in the sink pipe?

6. Of what two elements is water composed?

7. What is the weight of 4½ cubic feet of water?

8. Why are intake points of lake cities many miles from the shore?

9. If a rock having a volume of 2 cubic feet weighs 900 pounds in air, what will it weigh in water?

10. What part do bacteria play in sewage disposal tanks?

11. Give a floor talk on the water supply of a modern city

12. Why is rain water soft water?

| Specific Objectives | Teacher Procedures |
|---|---|
| 9. To show how lift and force pumps operate | 10. Perform experiments showing how filtration removes suspended matter; how lime and alum hastens the settling of muddy water. Conduct trip to local water plant |
| 10. To make a study of the steps in the purification of water for cities<br>a. Coagulation<br>b. Filtration<br>c. Chlorination | 11. Assign individual reports on house plumbing. Have pupils bring out the fact that the city mains carry the water from the reservoirs or pumps to the houses and then describe the ordinary method of plumbing |
| 11. To make a study of typical house plumbing | 12. Use lecture-recitation to bring out the fact that bacteria serve one of their useful purposes in the decomposition of sewage into harmless products |
| 12. To understand how a safe disposal is made of sewage | 13. Check record of personal habits of bathing and drinking |
| 13. To appreciate the importance of water in maintaining personal health | |
| 14. To make a study of distillation | |
| 15. To understand the principle of buoyancy and its application to submerged and floating objects | |

**References**

Garnett, W., *A Little Book on Water Supply,* Macmillan

Rogers, J. E., *Earth and Sky Every Child Should Know,* Grosset

Department of Interior Bulletin Number 257, *Well-drilling Methods,* Supt. of Documents, Gov't Printing Office, Wash., D. C.

**Pupil Activities**

11. Prepare diagrams showing typical house plumbing. Learn how to repair faucets. Why is there a crook in the sink pipe?

12. Give reports on the importance of efficient sewage disposal and the dangers of improper disposal

13. Record amount of water drunk for a week

**Notes by Teacher**

# VI. THE WEATHER

### Unit Objective

To help the pupil understand what causes some of the ordinary weather changes and to develop some appreciation of the work of the weather bureau

### Specific Objectives

1. To develop an appreciation of the part played by weather and climate in determining our mode of living

2. To arrive at an understanding of those factors which give rise to our ordinary weather changes: (a) temperature (b) air pressure (c) humidity (d) the interrelation of (a), (b), (c), as it concerns the setting up of air currents, evaporation, dew formation, fog, rain, thunderstorms, tornadoes, etc.

3. To learn something of the nature of the weather bureau
   a. Daily weather reports
   b. Special warnings of storms and frosts

### References

Longstreth, T M., *Reading the Weather*, Macmillan

McAdie, A., *Wind and Weather*, Macmillan

United States Weather Bureau Bulletins
Number 42, *Weather Forecasting*, 5c
Number 41, *Forecasting Frost in the North Pacific States*, 10c
*The Weather Bureau* (free)
*Explanation of Weather Maps* (free)
*The Daily Weather Map* with explanations (free)

### Teacher Procedures

1. Assign individual reports on the life of peoples in different climates, or have pupils bring out in reports the changes we would make in our mode of living if our climate should change suddenly to a very hot, very cold, very dry, or very wet one

2. Use text and outside reading assignment, followed by oral report, question and answer recitations

Demonstrate
   a. That dark objects are warmed more by sun's rays than light objects
   b. That nearly perpendicular rays produce a greater heating effect than slanting rays
   c. That warm air is lighter than cold air
   d. That mercurial barometer indicates pressure of the atmosphere
   e. That evaporation produces a cooling effect. Use ether, gasoline and water
   f. That condensation of moisture results when warm, moist air is cooled

3. Let pupils develop this portion. Let them try to estimate the savings to our citizens of regular storm warnings, frost warnings, and the usual daily reports. Stress the importance of the routine work of weather observers in collecting data on rainfall, temperature, etc., as a guide to future forecasting

**Pupil Activities**

1. The teacher procedure indicates the pupil activity here.

   a. If it be winter, spread white and black cloths on the snow in the sunshine. Note that the black one quickly sinks in the snow. Try same on (1) north slopes, (2) south slopes, and (3) level places to study effect of slant on heating effect. Look in almanacs to find longest and shortest days of year. Reports can be made on July 4 snowball fights on mountains

   b. Read weather forecasts containing statements of barometric pressure in the west and try to guess the time until those pressures reach us. Set up pinwheel and spiral "paper snakes" over stoves or radiators to show upward motion of heated air. Place lighted candle in heated room to see movement of air, horizontally toward heated portion

   c. Memorize definitions of humidity, absolute humidity, and relative humidity. Account for the fact that a pitcher of ice-water sweats on some days and not on others. Make a wet and dry bulb thermometer and correlate its indications with those of a pitcher or glass of ice water

   d. Keep a daily record for some months of the air pressure (in cm. and inches), temperature (on C and F scales), the relative humidity, type of weather, and direction of wind. Try to forecast tomorrow's weather conditions from today's observations. Read the text and other references as to causes of rain, dew, frost, snow, hail, tornadoes, hurricanes, etc.

2. Pupil activity here is indicated by teacher procedure. Pupils should keep record for a month or so of the daily forecasting as compared with the weather that did follow

**Evidences of Mastery**

1. Knowledge of the use of barometer, thermometer, barograph, thermograph, and hygrometer

2. Define isobar; low and high; humidity; absolute humidity; relative humidity

3. Answer these questions

   a. How fast does a "low" move across the country?

   b. In general, where do cyclones originate?

   c. Why is the rainfall heavier on the western slope of the Rocky Mountains than on the eastern side?

   d. Why does the wind blow harder sometimes than others?

   e. How is it that some days when the thermometer reads 80, everyone suffers more than some other day when the temperature is 90?

   f. What is normal air pressure?

   g. Does the dry air of winter aid or hinder our keeping warm? Why?

   h. Why does it save fuel to keep the relative humidity of a house up well?

   i. What is the effect of change of temperature on the volume of a gas?

   j. What will happen if the temperature be lowered if a given quantity of air has a relative humidity of 100%?

## VII. FIRE: ITS ORIGIN, CONTROL, AND USE

A. Discovery of fire

B. Uses of fire to man

C. Conditions for combustion and its products

D. Common fuels

E. Fire losses

F. Fire prevention

G. Heating our homes: early methods, modern methods, types of heat distribution

### Unit Objective

To gain a knowledge of fire and man's dependence upon fire for his every day needs

### Specific Objectives

1. To gain an appreciation of man's dependence on fire for his needs

2. To learn how man has improved the methods of making and controlling fire

3. To learn the requirements for burning

4. To learn what is meant by kindling temperature

5. To acquire an understanding of how fire has multiplied man's powers

6. To gain a knowledge of the danger due to carelessness in use of fire

7. To develop a feeling of personal responsibility in the matter of observing precaution in fire prevention

8. To gain a knowledge of our dependence upon fuels for light, heat, power, etc.

### Teacher Procedures

1. Have pupils give reports on early history of fire and fire-making

2. Have some boy scout or campfire girl demonstrate making fire without matches. Have pupils try to find out why certain woods are used for the fire making apparatus. What is used for tinder and why?

3. Discuss the various uses of fire to man

4. Demonstrate one or more of the uses of fire to man

5. Demonstrate the requirements of fires

a. Kindling temperature

b. Combustible material

c. Oxygen (how supply is maintained)

Good experiments will be found in any general science text or in School Document, No. 7, pamphlet No. 10, Boston Public Schools. The experiment used should show that a continuous supply of fresh air is necessary for fire and should also show how the supply is maintained and reaches the flame

6. Have pupils find out uses of dampers and drafts on furnaces and stoves and discuss findings in class

7. Study types of stoves as oil stoves, gas stoves, coal ranges, etc. Alcohol lamp or candle may be used in schools where no gas is available. Note the following in any type studied

**Pupil Activities**

1. Look up and list superstitions relating to fire and report them to the class

2. Find out all you can about the discovery of fire

3. List all the methods by which fire can be made without matches

4. List the things which you use that were made by the use of fire

5. List all the uses of fire to man

6. List the three requirements of burning

7. Determine for yourself how a fire supplies its own air; make drawing to illustrate

8. Formulate a working definition for kindling temperature

9. Use a candle and find out and report on the use of the wick, how the wax is changed to liquid, then to gas. Why are there two parts to the flame? Try to account for these. Why is part of the flame yellow and part blue?

10. Study your stoves and furnaces used at home and report on use of dampers and drafts. Try to fire a furnace or stove smokelessly

11. Account for all the changes that take place in the demonstration. What takes place in burning? What new products are formed? Where do they come from? Why does vapor collect on a lamp chimney when it is first lighted? What is the test for $CO_2$? How could you prove $CO_2$ is formed in burning?

12. After class work on kindling temperatures, list the kindling temperatures of the following in order, beginning with those materials having lowest kindling temperatures: yellow phosphorus, basswood, oak, sulphur, alcohol, cotton, kerosene, soft coal, hard coal and asbestos

13. Report on different types of camp fire, how made and value of each

14. Describe completely how a match kindles

**Evidences of Mastery**

1. To recognize fire as a powerful agent

2. To know how man has improved the methods of making and controlling fire

3. To know the requirements for burning: fuel materials, kindling temperature, supply of air

4. To know what is meant by kindling temperature

5. To know about the properties of the gases of air and their relation to burning

6. To know what substances are found in the fuel materials (hydrocarbons)

7. To know what becomes of materials when they burn

8. To know how destructive fires can be prevented

9. To know the best methods of extinguishing different kinds of fires

10. To know what causes spontaneous combustion

11. To know the cause of explosions

12. To learn the laws and ordinances relating to fire control

13. To know that many great industries depend upon the use of fire

14. To know how simple home fire extinguishers are made

15. To know best methods of building camp fires

**Specific Objectives**

9. To develop an interest in the further study of the chemistry of fire

10. To gain some knowledge of the comparative value of fuels

11. To develop an interest in conservation of fuels

12. To gain some knowledge of the effect of heat upon the three forms of matter

13. To gain knowledge which will enable us to employ heat with more convenience and less waste

14. To gain knowledge which will enable one to avoid overheated rooms and other waste of heat

15. To give pupils a knowledge of the various methods used in heating and ventilating buildings and to give comparative values of each method

16. To gain an appreciation of the importance of proper methods of heating and ventilating buildings in relation to health of the individual

17. To gain a knowledge of the application of scientific principles involved in the various heating and ventilating systems

18. To gain a knowledge of the factors needed for good ventilation (humidity, temperature, and moving air)

**References**

Caldwell and Curtis, *Introduction to Science,* Ginn

**Teacher Procedures**

a. Type of flame produced
b. Hottest part of flame
c. Cause of the yellow color
d. Control of amount of air
e. Nature of soot; its formation
f. Absence of smoke in proper combustion

8. Demonstrate what takes place in burning
   a. What part of air is necessary for burning to take place?
   b. What becomes of the materials burned?

This may be used as demonstration, using a candle and cutting off air supply by placing a fruit jar over burning candle. Are some or all parts of air necessary? This should lead to a study of the composition of air and the generating of carbon dioxide, oxygen, and nitrogen, and testing each with glowing pine splints to see which supports combustion. Then study the burning process and have pupils see that new products are formed, such as moisture, ashes, soot, smoke, carbon dioxide, etc. Have pupil find the solution for these questions

   a. What new products are formed by burning?
   b. What is smoke?
   c. Why did water vapor collect on the jar?
   d. Where did this vapor come from?
   e. How can we test to see if carbon dioxide has been formed? etc.

9. Demonstrate to show the different kindling temperatures of substances; use phosphorus, sulphur, wood and coal. Page 8 of pamphlet No. 10, Boston Public Schools, tells how the experiment may be carried out. Have class answer such questions as the following
   a. Why is it difficult to kindle fire with furnace coal?
   b. Why is kerosene sometimes used to start fire?
   c. What difficulties have you experienced in kindling a fire?

10. Find out something about our common fuels, both solid and liquid. Have pupils list fuels, find out about their origin and heat val-

**Pupil Activities**

15. Work in groups on problems such as
How does a candle burn?
What becomes of a candle when it burns?
How does a kerosene lamp burn?
How does kerosene go up a wick?
How does wood burn?
How does coal burn?
What is charcoal and how is it made?
How does the height of a chimney affect the fire?
Why do you split kindling wood into small pieces?
Why does a fire sometimes go out when you add fresh coal?
How are matches made?

16. Bring samples of common fuels to school for study: coke, bituminous coal, anthracite coal, charcoal, etc.

17. Prepare a table to show how coal is sold, using these three headings: size of coal, cost per ton, and where used

18. Learn what peat is and where it is found

19. Work out rules for firing a furnace smokelessly

20. Report on how to eliminate smoke from private homes

21. List ways in which a city could lessen the amount of smoke

22. Get an outline map of Iowa and mark the coal areas. Also get from the United States Geological Survey maps to show the coal areas of the United States

23. List ways in which our present supply of fuels may be preserved

24. Keep records of fires in the community and determine the causes, loss of each, as well as what preventative measures could have been used

25. Find out why water is not used to extinguish gasoline fires

**Evidences of Mastery**

16. To know that much smoke in firing a furnace is unnecessary

17. To know what progress man has made in methods of heating homes

18. To know the methods of heat distribution (conduction, convection, and radiation)

19. To know what materials convey heat easily

20. To know that every good heating system must provide proper temperature, humidity, and satisfactory quantities of fresh air

21. To know the principal heating systems by which buildings of various types are heated

22. To know that heat travels by radiation in waves without the help of matter

23. To know that heat travels by convection and conduction only by means of matter

24. To know that radiant heat travels at great speed and in straight lines and in any direction

25. To know that heat carried by conduction and convection travels slowly and often in curving routes

26. To know that all wind and air curves are caused by convection

### References

Darrow, *Boy's Own Book of Great Inventions,* Macmillan

Hill, *Fighting a Fire,* Century

Husband, *A Year in a Coal Mine,* Houghton Mifflin

Pack, *Our Vanishing Forests,* Macmillan

Rush and Winslow, *The Science of Things about Us,* Little Brown

White, *The Fuels of the Household,* Barrows

Whitman, *Civic Science in the Home,* American Book Company

Farmers Bulletins, No. 1174 and No. 1230, United States Department of Agriculture

Forest Service Bulletin, No. 117, *Forest Fires,* 10c

*Forestry Primer,* Forestry Department, Iowa State College, Ames, Iowa

*School Document, No. 7, 1922,* Pamphlet No. 10, Boston Public Schools

*School Document, No. 8, 1922,* Pamphlet No. 11, Boston Public Schools

Taylor Instrument Company, Rochester, New York, bulletin on *Humidity,* 10c

### Teacher Procedures

ues. What are our fuel problems? Have pupils find out what fuels are smokeless. What is a noncumbustible substance? Obtain maps to show coal fields for class study. Where are important coal areas?

11. Have pupils study fire losses
    a. Kinds of fires which cause losses
    b. Fire hazards in homes and public buildings
    c. Forest fires (use *Forestry Primer*)
    d. Oil wells
    e. Fires of vicinity, their causes, losses, and how handled
    f. Types of buildings in regard to fire hazards
12. Have pupils study fire prevention
    a. Use of fire drills
    b. Fire exits and escapes
    c. Care of handling fire in the home
    d. Fire extinguishers, types; use
    e. First aid to fire victims; use of woolen blankets to put out flames in clothing; treatment of burns; use of dust and sand to extinguish flame
13. Have the early methods of heating the home reported on in class. Have pupils find out when first chimney was invented, also first hard coal stove, etc. Why a hole was left in top of the Indian's wigwam
14. Demonstrate the methods by which heat is distributed. School Document, No. 8, 1922, from Boston Public Schools, gives some good experiments that can be easily carried out by teacher. Demonstrate to show how heat travels by conduction, convection, and radiation. Teachers should be sure pupils know what substances are good conductors and poor conductors of heat and what is meant by a good or poor conductor of heat
15. Discuss modern heating and ventilating systems. Study various hot air furnaces, hot water systems, and steam systems. This should also include a study of special forced systems used in large buildings. Study natural and artificial methods of ventilation
16. Review the main points of the unit. Then give some form of objective test to check pupils' mastery of the essentials of the unit

**Pupil Activities**

26. Find out the rates of insurance for various types of buildings: stone, brick, wood, use of asbestos shingles, etc.

27. Find out about different types of fire extinguishers and tell principles involved in use of each. Bring in old extinguishers

28. Find out all you can about the French chemist, Lavoisier

29. Make a survey of the different types of heating devices used in your community, then see if you can account for your results

30. Find out the way early homes were heated

31. Learn what systems was used by the Romans to heat their homes

32. Collect advertising material from various dealers dealing in stoves and furnaces. Classify your material and report on it

33. Study and report on the "washed air" systems used in theatres

34. List advantages and disadvantages of common heating systems

35. Study and report on the methods of heating and ventilating your homes, church, and schools

36. Find out what devices are used to regulate humidity of air in homes

37. Work out a score card for efficient home heating, then score your own home by your score card

38. Make a diagram to show the principle of the cold frame

39. Study the construction and control of various furnaces

40. Study the construction and principle of thermos bottle and fireless cooker

41. Find out how much air per hour should be supplied to each person in a room in order that it should be fresh at all times

42. Find out why furnace pipes are covered with asbestos

43. Summarize the work covered in this unit by a topical outline

## VIII. HOW MAN OBTAINS AND USES CLOTHING MATERIALS

A. Fibers used for clothing
B. Use of clothing
C. Choice of clothing
D. Care of clothing

### Unit Objective

To learn the properties of clothing materials in relation to their hygienic value and care

### Specific Objectives

1. To give pupils the principles underlying the proper selection and care of clothing

2. To give pupils knowledge of fibres used for clothing and the practical value of each

3. To give information that will enable pupils to judge the quality of the clothing they buy

4. To develop pride in keeping clothing clean

5. To develop an interest in reading articles on clothing

6. To gain a knowledge of the properties of clothing materials in relation to their hygienic value and care

7. To gain knowledge of care of clothing, how stains are removed from each, and what method is best for cleaning of each fiber

8. To gain knowledge of the life history of the clothes moth and means of control

### Teacher Procedures

This unit may be introduced by showing that animals of various regions are adapted to differences in temperature by special means while man is forced to provide himself with clothing to meet changes in temperature

1. Guide study of clothing materials
   a. Fibers: cotton, wool, silk, linen; where each comes from and how made into cloth
   b. Leather: kinds used for clothing and how prepared
   c. Rubber: how and where obtained

2. Direct study of uses of clothing: protection, ornamentation. This will lead to the question of how clothing keeps us warm or cool. Take up problems of how fabrics conduct heat. Use four types of fabrics as near same thickness as possible and by placing each in turn on back of hand then holding a warm iron on the cloth determine which are good and which are poor conductors. Then explain their use in clothing on the score of their conducting power

Color work may enter here and some experiment may be carried on to determine how colors affect temperature

3. Teach how we can identify the various clothing fibers. This should acquaint the pupil with simple tests using the hand lens and chemical tests. Any general science text or clothing text will give directions for making the tests

The pupil should get a general idea of how to tell the fibers apart, and also what are

**Pupil Activities**

1. Collect samples of different kinds of cloth, mount them under headings: cotton, wool, silk, and linen fabrics. Under the heading "silks" get samples of artificial silk, weighted silk, silk mixture, etc.

2. Collect samples of raw fibers (cotton, silk, wool, etc.)

3. Make posters to show the various sources of the chief clothing fibers

4. Look up and report on, "The Earliest Methods of Making Clothing", using pictures to illustrate

5. Trace and report on history of clothing used by man

6. Make charts to show the sources, useful properties, and uses of various fibers

7. Collect samples of rubber fabrics and leathers and report on their uses and preparation

8. Look up simple tests for the various clothing fibers and be able to demonstrate them to the class. The burning tests, lens tests, are simple, but chemical tests may also be undertaken

9. Find out the effect of strong alkali on clothing fibers

10. Find out how soap is made and explain why certain soaps are better to wash animal fiber (wool and silk) in than others

11. Find out from your class demonstrations or your readings what type of materials are best for outer and under garments for the various seasons, also for hiking in winter or summer (See *Scout Manual*)

12. Take pieces of cloth representing the four fabrics and soil them, then wash them in ivory soap using equal care. Rinse, dry, and press. Then draw conclusions on whether or not they all wash equally well. Why are most woolen goods dyed rather dark?

**Evidences of Mastery**

1. To know the principal clothing fibers and their sources

2. To know the characteristics of fibers which make them useful for clothing

3. To be able to identify and test various fibers

4. To know that non-fiber materials are used as clothing: leather, rubber, etc.

5. To know how fibers are made into cloth

6. To know how stains are removed from clothing, and reasons of principles involved

7. To know how to select suitable clothing for various seasons

8. To know the important reasons for types, kinds, and styles of clothing worn by various peoples

9. To know that the kind of clothing we wear has a direct bearing upon health

10. To know spots and stains may be removed from clothing if proper methods are used

11. To know the effect of strong alkali on fibers (soaps)

12. To know that all fibers cannot be cleaned in the same way

13. To know the four methods of removing stains: by solution, by absorption, by bleaching and by neutralization

14. To know which stains are best removed by each method

**References**

Carpenter, *How the World is Clothed,* American Book Company

Kinne and Cooley, *Shelter and Clothing,* Macmillan

Rush and Winslow, *The Science of Things about Us,* Little Brown

Webb and Didcoct, *Early Steps in Science,* Appleton

Bulletins from the United States Department of Agriculture,

No. 861, *Removal of Stains from Clothing*

No. 669, *Fiber Flax*

Corticelli Silk Company, Chicago, bulletins on *Silk Culture*

Pamphlet No. 6, *Clothing and Building Materials,* Boston Public Schools

**Teacher Procedures**

the characteristics of the fabric when fibers are woven into cloth

Why is woolen warm? Why is linen used in the tropics? etc.

4. Teach choice of clothing

After fibers are studied and characteristics of fabrics are discussed the subject of choice of clothing should be introduced. This problem of choice of clothing, should include both under clothing as well as outer clothing

Take up each fiber and list its advantages and disadvantages for outer and under garments

Raise such questions as: Why are rain coats made of very closely woven materials? Why are wool bathing suits more comfortable than cotton ones? What fibers are useful because of their smoothness?

5. Present care of clothing

a. Find out what kind of treatment is best for the various fibers

Use of soap to remove grease

Use of soft and hard water (Review Unit V)

Use of borax, washing soda, and ammonia in washing

Why wool requires greater care than other fibers in washing

b. How to remove various stains. Any good clothing book will give experiments on removal of stains which can be used in class. Stains are removed by solutions, by absorption, by bleaching, or by neutralization. List the stains that are removed by each method, and be sure the principle involved in each case is understood by the pupils

6. Make a study of insect pests of clothing: type of damage done by the insect; stage of life history of insect which does damage to clothing; means of control

7. Use some form of objective test to cover important points in the unit

**Pupil Activities**

13. Formulate rules for the proper washing of animal and vegetable fibers

14. Collect samples of cleaning mixtures and find out something of their relative value

15. Make rules or cautions for cleaning various materials

16. Formulate cautions for cleaning with gasoline, naphtha, etc.

17. Make a table of stains commonly found on clothing and opposite each stain tell what method is used to remove it and the principle involved

18. Try to get all stages of the clothes moth for study; mount specimens on chart along with samples of cloth to show damage done

19. Summarize by a topical outline the work of the unit on clothing

**Evidences of Mastery**

15. To know the life history of the clothes moth; which is the destructive stage, and how to rid clothing of the pest

## IX. MICRO-ORGANISMS AND THEIR WORK

A. Types of microörganisms—bacteria, yeast, mold and protozoa
B. Habitat
C. Conditions for growth
D. Effect upon man
E. Control measures
F. Contributions of Pasteur, Lister, and others

### Unit Objective

To give pupils an understanding of microörganisms so they will better realize the part these organisms play in the work of industries and health of the community

### Specific Objectives

1. To understand the meaning of microörganisms and what groups of plants and animals are classed as such

2. To learn the characteristics of the group of microörganisms which determines their economic relation to man

3. To understand why this group contains man's worst enemies and best friends

4. To realize the importance of man's knowledge of this group of organisms in order to control them

5. To realize that all non-green plants are dependent upon other plants for their living

6. To teach pupils whether these forms of organisms are useful or harmful

### Teacher Procedures

The unit may be introduced by a short review of Unit II, in which pupils found that green plants are the food makers of the world. All foods which can give energy to other forms of living things have first been in the form of green plants. This leads to the thought that all animals and all non-green plants must constantly be striving with each other for food which has been produced by plants

1. Look up some of the forms which are classed as microöganisms (fungi, including bacteria, yeast, and mold; protozoa, one-celled animals)

2. Find out the forms, sizes and abundance of these organisms. Bacteria can be obtained by placing a small amount of chopped hay in a glass and covering with water. Place beans in water. Cover both and place in a warm room. In a few days examine the scum found in each glass for bacteria, the rod-shaped bacteria will be most abundant. Find out something about the size of the bacteria and general appearance. Prepare a growth medium for bacteria. (Sterile nutrient agar may be obtained from a hospital or a doctor. If this is not possible use slices of freshly cooked potato for media in petri dishes.) Expose dishes of agar to air, cough in some, draw a finger through some. Leave one dish untouched for a check. Place the exposed dishes in warm place, some in cold place, some in strong sunlight, others in dark place. Watch and record changes and draw conclusions as to conditions for growth.

**Pupil Activities**

1. Collect pictures and specimens to show as many forms of organisms included in this unit as possible

2. Collect plants or plant products affected by plant diseases (Examples: cedar apples, rusts, smuts, etc.)

3. Bring into class all kinds of molds you find growing on fruit, vegetables, bread, etc. and place them in moist enclosed vessels for examination and observation. Keep records. Find out if mold will develop on dry bread, or when bread is exposed to the air. Plant mold on moist bread and place in covered dish. Put one in dark and one in light. Place others in cold place, others in warm dark places. Then determine what are the most favorable conditions for growth of molds

4. Bring some compressed yeast to school and mix with water, then add a ten per cent solution of molasses. Divide into three containers, place in different temperatures and observe after 24 hours. Note and account for any changes, such as bubbles of gas rising through the liquid. Can you collect some of this gas and test it with a flame or with lime water?

Considering that you start with three essential materials: yeast, water, and molasses, which increases, which decreases, which remains unchanged. You can answer this by heating some of the solution in a flask and collecting the distillate

5. Study bacteria by use of the scum that collects on the top of the hay infusion. "Mother of vinegar" is a mass of bacteria which changes the alcohol into acetic acid of vinegar. Determine what conditions are necessary for growth of bacteria

Hay infusion will contain forms of protozoa, (one-celled animals) as well as bacteria. Find out all you can about them. Find five rules of the Board of Health depending on knowledge of bacteria

6. Collect all kinds of plant diseases due to microörganisms as cedar apples, smut on corn, rusts, mildew, etc.

**Evidences of Mastery**

1. To know what varied kinds of plants are included in this group

2. To know meaning of saprophytes and parasites

3. To know that all the plants included in the group of microörganisms are without chlorophyll

4. To know why the plants included in this group are dependent upon other plants

5. To know the characteristics of yeasts and their activities and relation to man

6. To know the characteristics of molds and their activities and relation to man

7. To know the characteristics of bacteria, their activities and relation to man

8. To know conditions necessary for growth of bacteria, yeasts, and molds

9. To know how molds are useful in the preparation of some foods

10. To know the way yeast is useful to man

11. To know what kinds of plant diseases are caused by this group: mildew, smut, rust, blight

12. To know what methods of control are used in connection with these organisms

13. To know the great importance of bacteria in relation to the soil

### Specific Objectives

7. To gain knowledge of the nature of the various microörganisms, their form of reproduction, where they are commonly found

8. To gain some knowledge of the conditions necessary for growth of the organisms

9. To gain a knowledge of how this group of organisms is spread

10. To develop an interest in the reading of good magazines and books dealing with this unit

11. To develop an interest in the reading about the lives of such men as Pasteur, Reed, Lazear, etc.

### References

Conn, *Bacteria, Yeasts, and Molds,* Ginn

Farmers' Bulletin, No. 490, *Bacteria and Milk,* Superintendent of Documents, Government Printing Office, Washington, D. C.

Lipman, *Bacteria in Relation to Country Life,* Macmillan

Prudden, *The Story of Bacteria,* Putnam

Tower and Lunt, *The Science of Common Things,* Heath

Vallery, *The Life of Pasteur,* Doubleday

### Teacher Procedures

Mold can be collected from fresh fruits, tops of canned fruit, bread, etc. Examine the different molds and note different colors of mold, where it obtains its food, how it grows and reproduces

Pupils carry on experiments to determine best conditions for growth of molds

Mildew is a term applied to mold growing on clothing, leather, and walls. Have pupils solve such problems as why do starched clothes mildew in summer? Why do dry or ironed clothes not mildew?

Protozoa (one-celled animals) can be found in hay infusion. Amoeba will be a common form. Study them as to size, means of locomotion, conditions necessary for growth, method of reproduction

3. Have pupils answer questions such as the ones that follow to make sure they can apply the principles they have been studying

Why sweep with a moist broom?
Why sweep with a carpet sweeper?
Why use a vacuum cleaner?
Why should food be protected from street dust?
Why should the hands be washed before handling food?
Why do our teeth decay?
Why should dust cloths never be shaken indoors?
Why is milk pasteurized?
How is the water supply protected?

4. Show that some microörganisms are of value to man (Those used in cheese industry, those in soil, those used in fermentation, and bread making)

5. Study the methods of protecting the food supply from microörganisms (Cold storage, sterilization, use of salt, sugar, spices, and vinegar, drying of foods and other common ways of protecting foods)

Be sure pupils know the underlying principles involved in protecting food from microörganisms

6. Review the unit briefly by use of pupils' topical outlines. Test pupils on essentials of unit

**Pupil Activities**

7. Find out about soil bacteria and their value to men. Find and bring into the laboratory some alfalfa or clover showing nodules on the root. Explain why the nodules are there

8. List ways in which microörganisms are of value to man, also in what ways they are harmful

9. List ways in which food can be protected from microörganisms. List the principle involved in each method, and give advantages and disadvantages of each

10. Learn why preserves and jelly keep without being sealed air tight; and why salting meat keeps it

11. Look up the lives of Pasteur and Lister and report on them

12. Summarize the work on the unit by a topical outline

**Evidences of Mastery**

14. To know that yellow fever, malaria, and sleeping sickness are caused by certain protozoa and not by bacteria

15. To know the contribution of Pasteur, Lister, and others

## X. HOW MAN PROTECTS AND IMPROVES THE HEALTH OF THE INDIVIDUAL AND THE COMMUNITY

A. How the individual's health is protected

B. How the community is protected

C. How scientific knowledge is applied to the present problems of everyday living

### Unit Objective

To develop the pupil's practical knowledge of personal and community health and his will to practice and coöperate in maintaining and improving this personal and community health

### Specific Objectives

1. To teach pupils that microörganisms are spread in various ways, many of which can be controlled by the individual or the community

2. To gain an appreciation of the responsibility of keeping fit as the best way to prevent attack of microörganisms

3. To show that many superstitions about disease have been proven false by medical science

4. To show that patent medicines are to be avoided

5. To develop a wholesome and intelligent respect for advice and work of well trained nurses and doctors and such organizations as board of health

6. To develop an interest in observing various sources of disease dangers and to aid in eliminating them

### Teacher Procedures

Knowledge of the nature of germs and how they produce toxins, grow and reproduce, which is fundamental to an understanding of this unit on health should be briefly reviewed from Unit IX

1. After a review of microörganisms take up the problem of how these organisms spread and get into the body

2. Present natural and artificial means of protecting individuals from disease. What diseases have been most prevalent in the last 40 or 50 years? What diseases have been almost completely overcome in the last 50 years? What are the most successful means of control and prevention of contagious diseases? How does antitoxin treatment of diphtheria differ from vaccination for smallpox? What diseases are in the experimental stages? What is meant by immunity and how is it acquired?

3. Guide study of care regarding health conditions in the home and individual protection from disease

a. Precaution against spreading colds

b. Care of foods

c. Attention of wounds

d. Disinfectants and antiseptics of value in home

e. Use of sunlight

f. Reporting of light cases of measles, etc. to proper authorities

**Pupil Activities**

1. Find out about early theories regarding diseases and how they have hindered the progress of the human race

Collect information from older people in the community in regard to traditions, charms, and superstitions regarding health

Find out the earliest beliefs of primitive tribes regarding cause of disease

Look up the following:

What classes of people were permitted to practice surgery for many centuries?

What did people of the fourteenth and fifteenth centuries believe regarding plagues and epidemics?

What methods were used in treating diseases?

Collect information regarding the history of the practice of medicine

2. Find out how scientific methods of solving problems differ from unscientific or haphazard methods

How to distinguish a scientific truth from a superstition

Collect advertising material and labels of patent medicine regarding any false or unscientific methods of handling disease

Look up how scientific methods proved that mosquitoes were carriers of the organism that caused malaria

Learn how the results of scientific thinking are a benefit to man

3. Make a table of common diseases to show how the organism causing the disease leaves the body, how the organism is carried, and how the organism enters the body

4. Make a survey of diseases of the community with suggestions of causes and remedies

5. Make a study and report on the health laws of the community; give reasons for each law

6. Study methods of handling food in stores of community; give suggestions for improvements with reasons

**Evidences of Mastery**

1. To know how certain microörganisms that cause disease are spread and carried

2. To know what means are necessary to prevent and control contagious disease

3. To know that good health is the best insurance against attacks by disease germs

4. To know how the various microörganisms that cause disease enter the body

5. To know what insects are carriers of disease and to know how these insects carry the various diseases

6. To know the life histories of the various insect disease carriers and how they are controlled

7. To know the dangers arising from false pretensions and unscientific methods of treating disease and to know dangers which arise from lack of scientific thinking and investigation

8. To know requirements of the Pure Food and Drug Act

9. To know how the body overcomes and develops resistance to disease

10. To know how germs cause disease (production of toxins)

11. To know how artificial immunity for certain diseases may be acquired (small pox, diphtheria, and typhoid)

12. To know what means are necessary to prevent and control contagious disease

**Specific Objectives**

7. To develop a wholesome interest in reading articles dealing with health

8. To develop an interest in keeping in good health

9. To gain an appreciation of the achievements of scientific knowledge in improving and lengthening human life

10. To gain a knowledge of the work done by city, state, and national governments in protection against disease

11. To realize the responsibility of all citizens in the prevention and control of disease

12. To realize the contributions of modern science in mastering the problems of daily living

13. To gain a permanent interest in present and future possibilities of science in relation to human progress

**References**

Blount, *Health,* Allyn and Bacon

Bulletins from the United States Public Health Service and the United States Department of Agriculture

Bulletins from local and state departments of health

*Hygeia,* American Medical Association

Publications of American Medical Association, Chicago, Ill., *Medical Fakes and Fakers* *The Great American Fraud*

Publications issued by the American Association for Medical Progress, 370 Seventh Avenue, New York City, *How Pasteur Convinced the World*

Ritchie, *Primer of Sanitation,* World Book Company

**Teacher Procedures**

4. Guide study of methods used successfully to prevent disease

   a. Local: (1) determining whether individual is susceptible, as by use of the Schick test in relation to prevention of diphtheria; (2) vaccination and its value; (3) Pasteur treatment for rabies; increasing bodily resistance for the control of disease; (4) proper care of sick; (5) duties of health officers

   b. State and federal: (1) food inspection; (2) protection of water supply; (3) sewage and garbage disposal; (4) building regulations; (5) laws regarding working hours; (6) health clinics; (7) pure food and drug laws; (8) state regulations in regard to licenses for doctors, nurses, etc.

5. Have pupils study responsibility of the individual for health of the community

   a. Health conditions about homes

   b. Reporting unhealthful conditions about homes

   c. Coöperation of individuals in controlling diseases

   d. Responsibility in obeying the laws pertaining to health

6. Show what recognition is given to those who make outstanding contributions to scientific knowledge

7. Show how the public press contributes to scientific information on health

8. Sum up the main points in the unit and give some form of objective test

**Pupil Activities**

7. Make a survey of community to determine the possible causes of epidemics

8. Study the fly menace in community and suggest control measures. Know the life history of the fly. How does borax kill the larval stage of the fly?

9. Bring in water from pond or rain barrel if in spring or fall and try to get all stages of the life history of the common mosquito. Find out how oil prevents growth of mosquitoes

10. Determine methods of exterminating rats and mice

11. Study and report on the water filtering plant of your community

12. Determine methods of testing the purity of the town's water supply

13. Find out how vaccines and antitoxins were discovered and how they are prepared and used

14. Learn how to disinfect a room

15. Report on Lister, Koch, Schick, and others

**Evidences of Mastery**

13. To know the community is organized for the control and prevention of disease

14. To know how the proper care and treatment of certain diseases aid in the building up of bodily resistance (tuberculosis)

15. To know the contributions of men like Jenner, Lister, Koch, Schick, and others

# XI. MACHINES FOR DOING WORK

## Unit Objective

To understand the workings of the six simple machines, their combination into complex machines, and the importance of inventors in perfecting new and better machines

## Specific Objectives

1. To review man's condition as it must have been before the perfection of machines.

2. To gain the conception that all work can be expressed as the product of force times distance

3. To get the conception that energy is the capacity for doing work; that it cannot be created or destroyed, but can be changed from one form to another; that it is measured in work units; that it can exist as kinetic or potential energy

4. To understand the principles of the six simple machines: lever, wheel and axle, inclined plane, screw, wedge, pulley; and to learn the use of the law of moments in solving machine problems

5. To learn to recognize the type or types of machines represented in the wheelbarrow, nut cracker, sausage grinder, ball bat, oars, windlass, axes, chisels, block and tackle, vises, scissors, car jacks etc.

6. To learn the meaning of mechanical advantage and to

## Teacher Procedures

1. Assign pupil reports on the life of man as it must have been as a tree dweller, cave dweller, and on through the ages. Have it brought out that man has increased his ability to do things by the invention and perfection of machines

2. Use a lecture demonstration in which the lifting of known weights known distances is employed to establish the conception that work always involves a force acting through a space. Do not leave the impression that this force must act vertically, however. Teach the expression of work in foot pounds and gram centimeters

3. Show that energy may be lost as far as an individual person is concerned but that it merely changes its form, probably to that of heat, and is not ultimately lost

4. a. Set up a lever and demonstrate the lifting of heavy weights with smaller ones. Introduce here the conception of mechanical advantage. Bring in the law of moments by having pupils calculate FD and F'D' from several of the demonstration set-ups. Assign many lever problems. Pupils like them

   b. If a wheel and axle model be available, demonstrate it and show that the law of moments holds. One can show that the wheel and axle is merely a modification of the lever

   c. Demonstrate the inclined plane. Have pupils record all everyday examples of it they can. Show how the law of moments holds. Show how to calculate the mechanical advantage of the inclined plane. This is a good place to introduce efficiency

### Pupil Activities

1. Prepare oral or written reports on man's condition before the discovery and perfection of machines. Prepare imaginary stories of how the principles of the wheel and axle, lever, and inclined plane were discovered

2. Work numerous problems involving a knowledge of the two factors of work. Calculate work done by one pupil or the entire school climbing one flight of stairs, etc.

3. Make lists of examples of wasted energy and decide what has become of it in each case

4. Work numerous problems on levers. See-saw problems make good ones. For the work in general science the weight of the lever may be ignored. Learn to calculate F, F′, D, or D′ from FD=F′D′ when three of the four quantities are known. For b, c, d, e, and f, arithmetical problems involving everyday applications may be used

5. Learn to recognize the type or types of machines listed under objectives

6. Calculate mechanical advantage of pulley systems, inclined planes, levers and the wheel and axle

7. Work several problems involving the finding of efficiency from data concerning "work in" and "work out"

8. Tear up old bicycle wheels to study ball bearings. Bring advertisements for oils, ball bearings, etc. Pupils should learn to see the scientific facts underlying such advertisements

### Evidences of Mastery

1. To be able to draw a pulley system whereby a boy who can pull with a force of 90 lbs. can lift 250 lbs. Could he lift any more than this? How much? What is the mechanical advantage?

2. To be able to work such problems as: two boys are see-sawing on a board 12 ft. long. One weighs 140 lbs. and is 4 feet from the fulcrum. The other boy is eight feet from the fulcrum. What does he weigh?

3. To be able to work such problems as: a man rolls a 200 lb. barrel up a 12 ft. inclined plane, one end of which is 3 ft. off the ground. He applies a force of 60 lbs. What is the efficiency of the inclined plane?

4. To define work, energy, mechanical advantage, and efficiency

5. To describe two means of reducing friction

6. To explain what causes a "hot box" on a railway car

**Specific Objectives**

be able to calculate it from information concerning a machine

7. To learn the meaning of efficiency and to be able to calculate it from information concerning a machine

8. To become acquainted with the meaning of friction and to learn ways used to eliminate it

**References**

Barnard, *Tools and Machines,* Silver Burdett

Bond, *With the Men Who Do Things,* Scientific American

Burns, *The Story of Great Inventions,* Harper

Forman, *Stories of Useful Inventions,* Century

Mowry, *American Inventions and Inventors,* Silver Burdett

Reynolds, *How Man Conquered Nature,* Macmillan

**Teacher Procedures**

d. Explain the screw as a modified inclined plane. Again the application of the law of moments should be stressed. Problems here may be omitted

e. Mention the wedge as a modified inclined plane

f. Demonstrate the pulley. Show that the law of moments holds. Fortify the concept of mechanical advantage and also that of efficiency. Assign numerous problems and the diagramming of pulley systems with advantage of 1, 2, 3, etc.

5. Use an informal recitation to realize this objective. Pupils enjoy trying to name the kind or kinds of machines represented in the complex machines

6. Show that mechanical advantage is the ratio of force overcome to force applied in all machines

7. Call up the fact that, if a machine were perfect, one could get as much work out of it as is put into it. Show that no machine is perfect and that the ratio of "work out" to "work in" can never be 1. Assign problems involving this concept

8. Show that machines serve us best when their efficiency is high but that friction reduces efficiency. Show the use of oil in reducing friction. Demonstrate the principle of roller bearings by means of sticks of chalk under a book. If possible exhibit roller and ball bearings. Have pupils clip advertisements of oils, balls bearings, and roller bearings from magazines

**Notes by Teacher**

## XII. MAKING THE FORCES OF WATER AND AIR WORK FOR US

### Unit Objective

To understand the principles involved in the operation of those machines dependent upon air or water pressure

### Specific Objectives

1. To gain the conception that air occupies space, that it has weight, that it exerts pressure, and that we are moving around on the bottom of an ocean of air

2. To understand how men can work under water by aid of diving bells and caissons

3. To understand the operation of the windmill

4. To review the operation of water pumps and siphons

5. To get an understanding of the operation of air brakes

6. To make a study of miscellaneous devices dependent upon air pressure such as air hammers, vacuum cleaners, plumber's friend, vacuum cup tires, etc.

7. To gain the conception that water pressure is great and that it increases with depth

8. To understand the use of water wheels in converting the energy of stored water into mechanical and electrical energy

9. To understand the operation of the hydraulic press

### Teacher Procedures

1. Demonstrate that air has weight, that it occupies space; recall experiments concerning air pressure performed in the unit on weather. Review the use of barometers in measuring altitudes

2. Invert a glass and thrust it into a large glass jar filled with water. Call attention to the fact that the water does not fill the glass because air occupies space. From this proceed to the explanation of the diving bell and caisson

3. Have pinwheels cut from paper and arranged where the wind blows. Explain how these illustrate the action of a windmill and how the windmill is used to convert the energy of moving air into a form useful to man. One might call attention to ways of increasing the power of a windmill

4. Recall the fact that pumps and siphons depend upon air pressure for their operation

5. Assign diagrammatic drawings of air-brake systems on trains. Explain how the brakes are automatically set if a car should break loose from the main train

6. If possible bring air pressure devices to the class room and study them instead of the pictures. Demonstrate the use of plumber's friend in removing obstructions from water pipes

7. Call attention to the fact that the water pressure per square inch at any point in a body of water equals the weight of a column of water 1 sq. in. in cross section and as high as the depth of the given point. Demonstrate that water pressure does increase with the depth

### Pupil Activities

1. Fill a glass with water, place a cardboard over it; invert; why doesn't water force cardboard off? Why do we punch two holes in a can of milk? Why do we not place our mouths over the entire opening when drinking from a bottle?

2. Diagram diving bells and caissons and explain how they make it possible for men to work under water

3. Make windmills from paper and wood

4. Try to siphon water from a bottle stoppered with a one hole stopper through which the siphon extends. Why doesn't it work? Try to suck the water from a similar bottle. Repeat, using a two hole stopper. Explain results

5. Visit railway station and locate, if possible, the air pump on the locomotive, the connecting air lines between the cars, the air tanks, the cylinders, and connections of the pistons with the brakes. Why can one man brake a train better with air brakes than 25 or 30 could with hand brakes?

6. Bring to class and study medicine droppers, soda fountain straws, ink wells, chicken waterers, tire gauges, automatic milk skimmers, aneroid barometers, vacuum cup basket ball shoes, atomizers, etc.

7. Report on cases of submarines being unable to withstand the great pressure encountered at considerable distance below the surface. Inflate a rubber balloon and hold it beneath the water; notice how it becomes smaller at increasing depths

8. Hand in diagrams of overshot, undershot, and Pelton water wheels. Visit a hydroelectric plant to observe conversion of energy of running water to electrical energy

9. Diagram hydraulic press and work numerous problems on it. Report on its uses

### Evidences of Mastery

*Completion exercises*

1. Air normally exerts a pressure of.....pounds per square inch

2. When a force is applied to an inclosed liquid it is transmitted.....to all parts of the .....
.....

3. Siphons or pumps would not operate if it were not for
.....

4. Air pressure is ..... on mountains than at sea level

5. Water can be siphoned over obstructions about ..... .....feet high

6. Barometers are used to measure .....

*Questions*

1. The small piston of an hydraulic press has an area of 2 sq. in. The large piston has an area of 32 sq. in. What force on the small one will lift 1600 lbs. on the large one?

2. What makes coca cola rise when you suck on the straw?

3. Would a siphon work in a vacuum? Give reasons for your answer

**References**

Corbin, *The Romance of Submarine Engineering,* Lippincott

Williams, *Thinking it Out,* Nelson

Williams, *The Romance of Modern Engineering,* Lippincott

**Teacher Procedures**

8. Review the conception of kinetic and potential energy. Have pupils calculate the potential energy of given bodies of water at a given height above their outlet and show how this energy by means of water wheels and turbines, is transferred to other forms. Stress the importance of full utilization of available water power

9. Present Pascal's law of the transmission of forces in liquids and sketch section of hydraulic press on board. Ask class to look for the advantage of using it. If a laboratory hydraulic press be available demonstrate the lifting of pupils with small columns of water. Assign hydraulic press problems and show how to work them

**Notes by Teacher**

## XIII. ELECTRICITY AND OUR DAILY LIVES

### Unit Objective

To develop an appreciation of the importance of electricity in our daily lives and to help pupils understand something of its generation, nature, and use

### Specific Objectives

1. To develop in the pupil an appreciation of our dependence upon electricity and things electrical, such as lights, irons, toasters, fans, refrigerators, radios, street cars, telephones, telegraphs, automobiles, and airplanes

2. To understand something of the different ways of generating electricity
   a. Static, by rubbing ebonite on fur and glass on silk
   b. Current, from Voltaic cells, ordinary dry cells, and dynamos

3. To get an understanding of the nature and use of electricity, including
   a. The difference between conductors and non-conductors
   b. The necessity for a closed circuit
   c. Heating effects of a current
   d. Chemical effects of a current
   e. Power from electricity
   f. The induction coil and its uses

### Teacher Procedures

1. Have pupils prepare a list of the modern devices and conveniences of which we would be deprived if all means of generating electricity were suddenly lost

2. Demonstrate that there are two kinds of static electricity, that like charges repel and unlike charges attract

Pupils can carry out their own experiments with static electricity, using rubber combs on woolen cloth or glass rods upon silk. Call to their attention the fact that lightning is static electricity on a large scale. One can study to advantage the use of the lightning rod and the dragging chain underneath oil trucks

Introduce current electricity by the assembling of a Voltaic cell. Show that the plates must be of different materials. Take an old dry cell to pieces and show that it is a modified Voltaic cell. Follow this with text assignment over cells and dynamos. The introduction of the subject of the dynamo takes more time and care. The fact that needs first to be established is that lines of force are present near the poles of a magnet. With a coil of many turns attached to a sensitive galvanometer one can show that a current can be set up by thrusting a magnet in and out of the coil, but that current does not flow while magnet is still. One can demonstrate also that a current can be generated by rotating a coil between the poles of a horse shoe magnet

The important fact to be firmly fixed in the mind of the pupil is that *a current of electricity will flow in a closed coil of conducting wire when the number of lines of force going through the coil is changing.* Follow this simple demonstration of the dynamo with a problem of this nature: "You have seen a dynamo generate electricity, but the current was a very feeble one; write out and hand in ways of making a dynamo which would turn out a much larger current"

**Pupil Activities**

1. See (1) under Teacher Procedures

2. Make a pith ball from the inside of a corn stalk and suspend with a silk thread. Rub a rubber comb through the hair and bring near the pith ball. Result? Why is the ball first attracted and then repelled? Rub glass on silk and bring near the ball which has been charged with the rubber rod. Explain what happens

Tear up an old dry cell, a radio B battery or a flashlight battery. What parts here take the place of the zinc, copper, sulphuric acid, and beaker of the Voltaic cell demonstrated in class? Is a dry battery really a dry battery? What is the purpose of the sealing wax? Reproduce textbook drawings of dynamos which show the coils of wire turning within a magnetic field. Try to hold the current outlets of an old telephone magneto while a friend turns the crank. Locate the essential parts of the magneto

3. List all conductors and non-conductors you can. Hand in a written explanation of why insulation must be used on electric light wires. Make a collection of old light bulbs. How can you prove that there is a vacuum inside the bulb? Why is this vacuum necessary? Some bulbs now are filled with nitrogen; what is the advantage of this over a vacuum? Tear a bulb to pieces and trace the current as it would have gone before the bulb was burned out. Make a diagram showing a battery, a switch, and a small light bulb. Indicate how a "short" might occur. Connect the poles of an ordinary dry cell with a small hairpin. Note the heating effect. How is this effect used in fuses?

Bring in articles plated with nickel, silver, cadmium, etc. Sketch a typical electroplating bath showing the anodes, articles to be plated, the solution used, and the source of current. Take an old storage battery to pieces—note attachment of plates to outlets and series connections on top of the battery. Find the insulators. Make a list of all the devices in which electricity is used to produce motion. Sketch induction coil, labeling source of cur-

**Evidences of Mastery**

Ability to deal with such exercises as:

1. Why would not an automobile or airplane run without electricity?

2. Explain fully how fuses are used to prevent fires and to protect electrical appliances

3. Show how the practice of putting pennies in burned out fuses is dangerous

4. Explain the difference between a dynamo and a motor

5. What are three ways in which the current output of a dynamo may be increased?

6. Make blackboard drawings of series and parallel connections of lights and explain why parallel wiring is to be preferred for house lighting

Ability to pass objective tests, such as the following:

1. Materials which will carry an electrical current are called .....

2. The device used to open and close a circuit is called a .....

3. Our house lights are connected in .....

4. If the resistance is decreased the current is ..... .....

5. Devices used to break the circuit in house wiring when the current becomes dangerously high are known as ..... .....

**Specific Objectives**

g. The transformer and its uses

h. Measuring electricity

i. Series and parallel wiring

**References**

Adams, *Harper's Electricity Book for Boys,* Harper

Baker, *The Boys' Second Book of Inventions,* Doubleday

Willoughby, *Practical Electricity for Beginners,* Manual Arts Press

**Teacher Procedures**

Point out that current output can be increased by increasing the number of turns of wire, the strength of the magnet and the speed of rotation. Nothing demonstrates better the simple dynamo than the magneto from an old fashioned telephone. Herein can be seen the magnets, the rotating coil and means of turning it. By touching the outlet points and turning the crank one can get first hand information concerning the generation of a current. At this point a visit to the local power plant is valuable

3. Demonstrate that some materials are conductors, some are not. Demonstrate that a closed circuit is necessary for current flow. Have broken and burned out light bulbs brough in to demonstrate broken circuits. Demonstrate heating effect of a current. Show how fuses operate and have pupils bring in old burned out fuses. Show the necessity of using fuses for safety and the danger of the practice of using a penny in place of a fuse. Demonstrate a simple storage cell by means of sulphuric acid, lead plates and a source of direct current. Some battery manufacturers will send cut away sections of batteries which teach very well the construction of the ordinary storage battery. Demonstrate the use of electricity in electroplating and show how electroplating lowers the cost and increases the usefulness of articles. Demonstrate the attraction and repulsion of magnetic poles. Sketch a simple direct current motor. Explain its operation. If one be available, let it be used to show that magnetic attraction and repulsion are responsible for its action. The same principle is employed in other electric motors. Demonstrate induced currents with hand made induction coil. If a good induction coil be available demonstrate how a sufficiently high voltage can be obtained to cause quite a spark to jump across a gap and show with a blackboard diagram the part played by the induction coil in the ignition system of the automobile. Sketch transformer and show that it and the induction coil work upon the same principle, namely, that a current will flow in a closed coil if the number of lines of force threading

**Pupil Activities**

rent, circuit breaker, secondary coil, and spark gap. Sketch a ring transformer. How does the transformer resemble an induction coil? How do they differ? Sketch a transformer hook-up which will step up 1100 volts to 33,000; one that will step down 660 volts to 110 volts. Calculate the cost of using a 550-watt iron for 2½ hours if electricity sells for 10c per kilo-watt-hour. Draw series and parallel connections of lights and show why one is better than the other for ordinary house lighting

4. Read gas and electric meters

**Evidences of Mastery**

6. The fine wire inside a light bulb is called the .....

7. The fine wire in most bulbs is made of .....

8. A device for measuring current flow is an .....

9. If 110 volts cause a current of one ampere to flow through a wire, what is the resistance of the wire? ..... .....ohms

10. The metal most used for electrical conductors is ..... .....

11. A device for raising or lowering voltage of an alternating current is called a ..... .....

12. A storage battery is tested with a .....

13. The metal most commonly attracted by magnets is .....

14. A device for changing mechanical energy into electrical energy is called a ..... .....

15. A machine for changing electrical energy into mechanical energy is called a ..... .....

16. We buy electricity by the .....

17. A current flowing through a coil around an iron core forms an .....

18. Ordinary electric lighting current has a voltage of .....

19. The voltage of a three-cell storage battery is ..... .....

20. The first type of incandescent light bulb was invented by .....

**Teacher Procedures**

through the coil be changing. Show the voltage ratio of the two sides of the transformer and stress the usefulness it has in stepping up and down alternating currents

Present briefly Ohm's law: I=E/R

Show that watts=amperes x volts

Teach pupils how to calculate the operation cost of common electrical devices at current rates per kilowatt hour. Demonstrate parallel and series wiring of lights. Have pupils work out the reasons for the use of the parallel wiring in preference to series

**Notes by Teacher**

# XIV. COMMUNICATION

## Unit Objective

To cultivate in the pupils an appreciation of the part played by communication in our modern life and to help them understand how devices for this communication operate

## Specific Objectives

1. To develop in the pupil an appreciation of the fact that much, if not all, of our modern mode of living depends upon the existence of dependable and speedy methods of communication

2. To bring before the pupil the conception that communication has not been always as it is now; to show the different stages through which it has passed, and to point out that the labor and thought of many men have been necessary for the development of the systems we now use

3. To understand the workings of our postal system
   a. The duties of the postman, both urban and rural
   b. The reason for putting stamps on letters and packages
   c. The meaning and use of insured and registered mail
   d. The part played by the mail clerks, both in the post offices and terminals; also on the trains

## Teacher Procedures

1. Conduct class discussion on the importance of our postal system. Show the condition that would result if postal accomodations were stopped for one week

2. Assign reports on how Indians used smoke signals; the ride of Paul Revere and the Pony Express. A class discussion following the reports will help

3. Assign reports on the personnel and workings of the postal system, the use of stamps, the use of postal insurance and registration

4. Demonstrate the principles of the electro-magnet, showing with a simple magnet, made there before the class, that the flow of electricity through the coil is necessary for the magnetism of the core. Follow this with an assignment in the text which deals with the technical explanation of the telegraph. Tell them that they will find an electro-magnet in a telegraph set but that it may differ in appearance from the one demonstrated to them. Start a contest to see how many can find it. The following day use a lecture-recitation during which the teacher draws on the board, or has a pupil draw, a diagram of a simple telegraph sender and sounder. If a set be available, set it up and ask for explanations of how any sort of message can be sent with a thing that merely clicks when one closes the switch. Use the next recitation period in practicing the Morse code, either with the telegraph set or with pencil and paper

5. Introduce the work on the telephone by drawing upon the board an electric circuit in which is a segment made up of carbon granules and ask the class what would probably be the effect upon the flow of current of pressing the carbon granules closer together. Then call

**Pupil Activities**

1. For the most part, pupil activities for this objective are suggested in the teacher procedure. Contrast presidental campaign methods of one hundred years ago and those of the present

2. Look up the history of the telegraph, using one or more of the following references: *The Story of Great Inventions* by Burns, *The Boy's Own Book of Great Inventions* by Darrow, *Wonders of Physical Science* by Fournier d'Albe, *The Conquest of Air and Ether* by Williams and others. These reports are to be given before the class or submitted in the form of themes

3. Pupils can bring to class stamps of different denominations, special delivery stamps, receipts for insured and registered mail, wrappings for packages stamped "Insured" or "Registered". The teacher procedure suggests sufficient pupil activity for this objective

4. Hand in a carefully made diagram showing a telegraph system including the battery, key, sounder, and wire connections. Label all parts and beneath the diagram, trace the flow of the current, given the function of each of the parts named. For those who feel competent to attempt it there can be included in this system a relay with an explanation of its function and the way in which it does its work. Boys of experimental turn of mind should describe ways in which a simple telegraph set can be made from very simple, cheap materials. Others can set up real sets between their homes and practice upon code messages. The entire class could take up the learning of the code as a project

5. Perform experiment with tuning forks which shows that one vibrating tuning fork will set another fork of the same frequency into vibration. Report upon instances where windows have been broken by large explosions or blasts, as a proof that sound is an atmospheric disturbance in most instances. Hand in a carefully made diagram showing a telephone

**Evidences of Mastery**

1. To understand
   a. Insured mail
   b. Registered mail
   c. Special delivery

2. To give a floor talk on
   a. The necessity for good communication in our modern life
   b. The life of Bell, Morse, or Marconi

3. To diagram and explain telegraph system and telephone

4. To write a brief discussion of the principles underlying radio

5. To respond correctly to such test items as
   a. The instrument which closes the circuit of a telegraph system is called the .....
   b. Before any object can give off sound it must be .....
   c. Rather than saying, "Wires carry the sound" we should say, "Wires carry .....
   d. In a telephone, the carbon granules are found in the .....
   e. The source of current in a telegraph system is a .....
   f. An electric current flowing in a coil around an iron core makes an ..... .....
   g. Why is bare wire not used in making an electro-magnet?

| Specific Objectives | Teacher Procedures |
|---|---|
| e. The air mail<br><br>4. To understand how a simple telegraph set works<br><br>a. Magnetism; natural and electro. To demonstrate that an electro-magnet functions only so long as the current flows<br><br>b. The function of the battery, the key, the sounder, and the relay<br><br>c. The necessity of some code in a system of this sort<br><br>5. To understand how the telephone operates<br><br>a. To show that all sound comes from vibrating objects<br><br>b. To show that the vibrations of one body may be transmitted through the air and thus set another vibrating<br><br>c. To understand how this principle is applied in the transmitter of a telephone<br><br>d. To understand how a receiver changes a varying electric current into intelligible sounds (Sound does not come over the wires)<br><br>6. To understand how the radio operates<br><br>a. To show that electro-magnetic waves set up by one conductor produce electrical currents in conductors around which they pass | to their minds the fact that sounds such as explosions or thunder may so disturb the air that windows are broken. Tell that the two facts thus presented are at the bottom of an understanding of the telephone. Assign the text material which deals with the telephone and the following day have either a demonstration telephone or a diagram on the blackboard. Make the diagram on the board, and go slowly enough to ask members of the class to give the name and function of each part as it is represented upon the board. When it is complete, the teacher can begin the explanation of the operation of the telephone, putting much of it in the form of questions. Rather than saying, "The voice of the speaker causes the diaphragm to vibrate and this compresses and then releases the carbon granules", it is better to develop this in two questions: "What effect will the voice of the speaker have upon this little diaphragm?" and "What will the vibration do to the little carbon granules inside the transmitter?" When the explanation is complete, let each pupil know that he will be called upon soon to make the diagram and explain the operation, either orally or written. This will probably stimulate them to ask questions which they have withheld to this point<br><br>6. If at all possible, demonstrate that electro-magnetic waves are set up by a spark gap in operation. This can be done with the use of an induction coil large enough to give a strong spark and a crystal receiving set. From this point on, one will be confined pretty largely to text readings and blackboard drawings for explanation. Most of the new texts have a fair explanation of the way sound waves are used to modulate the electro-magnetic waves and how these modulated waves are received and interpreted by the receiving set. Likewise, there are good explanations of the function and construction of the vacuum tube, the loudspeaker and other accessories |

| Pupil Activities | Evidences of Mastery |
|---|---|
| system, consisting of transmitter, source of current, wires, induction coil, and receiver. Label all parts and beneath the diagram, trace the flow of current, giving the function of each of the parts named. A class trip to the telephone exchange might be made by the class, requiring, however, that each pupil hand in the following day a written description of the trip with definite statements as to what things were learned. If a discarded telephone be available it can be taken to pieces and many of the important parts of it located | h. Why are telegraph sets "grounded"?<br>i. How many years has the telegraph been in use?<br>j. Explain what is meant by the statement "The world is much smaller than it was 100 years ago"<br>k. When was the telephone invented?<br>l. When was the wireless telegraph invented?<br>m. Could telegraph, telephone, or radio work without electro-magnets? Why?<br>n. How is the telephone superior to the telegraph? To the radio?<br>o. Why is a diaphragm needed in a telephone, wireless, and telegraph? Which one cannot America claim as her own? |
| 6. Since the radio involves many principles and facts beyond the scope or understanding of the pupil of general science some of the explanation will, of necessity, be omitted. Hand in diagram showing the principal parts of a sending set designed to send only code messages with dots and dashes. Label all parts and below the diagram state the function of each. Include source of current, induction coil, key, spark gap, ground and aerial. Also, make similar diagrams showing crystal receivers and vacuum tube receivers. Some may memorize the symbols used in diagramming radio hook-ups, such as ground, condenser, spark gap, battery, aerial, etc.<br>Radio can be used to teach location of cities. A large map of North America should be placed on the bulletin board and as pupils report stations heard with home sets, a colored pin should be stuck through the map at these points. This can be a class project | |

**Specific Objectives**

b. To show how these effects can be utilized in the sending of code messages with a simple spark gap set

c. To explain that different results can be obtained by modulating the outgoing waves by means of sound, and that these modulations, received and interpreted by the receiving set give rise to sounds similar to those made at the sending station

d. To explain somewhat the working of the crystal and vacuum tube receiving sets

**References**

Baker, *The Boys' Book of Inventions,* Doubleday

Bond, *With the Men Who Do Things,* Scientific American

Burns, *The Story of Great Inventions,* Harper

Caldwell and Slosson, *Science Remaking the World,* Doubleday

Collins, *The Book of Wireless Telegraph and Telephone,* Appleton

Meadowcroft, *The Boy's Life of Edison,* Harper

Morgan, *The Boy Electrician,* Lothrop

**Notes by Teacher**

# XV. HOW THE WORLD RIDES

## Unit Objective

To understand our modern means of transportation and to appreciate the steps necessary in its development

## Specific Objectives

1. To get some idea of primitive transportation and the stages of improvement leading to the present

2. To understand our modern means of land transportation, consisting of steam and electric trains,gasoline cars, and trucks

3. To understand the main facts underlying water transportation

4. To learn how man can fly

## References

Chamberlain, *How We Travel,* Macmillan

Collins, *The Air Man,* Century

## Teacher Procedures

1. Assign pupil reports on travel during the time of the tree dweller, on Indian travel, the first locomotive, the first steamboat, the first airplane etc. Let one group picture the situation that would result if all our modern means of transportation were to be stopped for one month

2. Explain by drawings, models, and lecture, the main facts underlying the operation of the steam engine and turbine. Show how the power of the steam engine is used to turn the locomotive wheels

Recall the electric motor and show how it is used in moving street cars, interurbans, and trains. Call attention to the over-head wire and the trolley for completing the circuit

Demonstrate the energy of an explosion of a mixture of gas and air. Explain by blackboard drawings how this energy is utilized in gas engines. Assign pupil reports on the operation of a 4-cycle gas engine. Conduct expedition to the school shop or to a garage to see the relation of the engine to the rest of the car. Spend some time on the use of other essential parts of the car. Indicate the similarity of operation between the car, truck, and big motor busses

3. Demonstrate Archimedes' principle. Show that a floating body displaces exactly its own weight of water. Assign reports on the development of water transportation, including mechanically driven oars, paddle wheels, and the modern propellor

4. Draw an analogy between the floating of objects in water with the floating of gas filled balloons in the air, and show that crafts that float in the air must displace their own weight of air. Consider gases used to fill them; compare the lifting power of the different gases. Consider the advantages and disadvantages of lighter-than-air craft as compared with the heavier-than-air craft

### Pupil Activities

1. Prepare oral reports on the probable and known steps in the development of transportation. Include the domestication of animals and their use in serving man's needs. Consider the use of sleds, carts, the first boats, the Roman galleys, the stage coach, the first steamboat, the first locomotive, airplane, etc.

2. Copy diagrams of simple steam engines, labeling all parts. Go to the railway station, observe locomotives and find all the parts possible

Added projects: Discover use of sand tubes, pop off valve; distinction between fire tube and water tube boilers

Discuss the advantages of electric trains over steam. Locate on maps those regions using most electric trains

3. Prepare diagrams showing relation of engines to propellers. Prepare sketches showing side and stern wheeler boats. Obtain data concerning time required for Columbus to sail the Atlantic, dimensions of modern liners, their carrying capacity. Formulate reasons for the cheapness of water transportation as compared with land transportation

4. Visit the local air field and report on the construction of any planes seen. Give oral reports on the work of Langley, the Wright brothers, and others prominent in aviation development. Make paper gliders and model planes with rubber band motors. Write to the Chief of the Air Service, War Department, Washington, D. C. for records in aviation

### Evidences of Mastery

1. Locate and give the use of the following parts of a steam engine: cylinder, piston, connecting rod, fly-wheel, slide, valve, eccentric

2. State on what two strokes of a gas engine both valves are closed

3. State on what two strokes one valve is open

4. Explain why a steam engine runs more smoothly than a gas engine of the same number of cylinders

5. Give the function of the transmission, clutch, differential, induction coil, spark plugs, cam shaft, and timing gears

6. Explain the statement that "Modern inventions have made the world much smaller"

7. Tell why a steam engine is called an external combustion engine

8. Tell why it is easier to swim in salt water than in fresh water

9. Solve: A flat bottomed boat is three feet wide and ten feet long. How many pounds of cargo must be placed in it to make it sink one foot more?

10. Tell for what is each of the following noted: Robert Fulton, James Watt, Langley, the Wright brothers, Lindbergh

11. Describe fire tube and water tube boilers

12. State the function of the carburetor on a gas engine

**Teacher Procedures**

For the heavier-than-air craft begin with a consideration of birds, calling attention to the fact that they are heavier than air and cannot depend upon the principle of flotation to keep them up. From there go on to kites. Show they are kept up by the wind. Show that an airplane is different only in that it moves through the air and is not tied. Bring out the importance of the partial vacuum above the wings. Study the history of aviation: the Langley machine; the Wright brothers; Lindbergh; Byrd's expeditions; Wilkins' flights. Have pupils get facts concerning average plane speed, speed record, transcontinental record, the longest distance flight, the flight of longest time, refueling in air. It is thought that the average textbook does not deal adequately with the subject of aviation to suit the average high school boy. Any teacher feeling capable will do well to try to keep abreast of the latest developments in the field and discuss them with the pupils

# APPENDIX

## Reference for pupils


Barber, *Lessons in Science,* 1925, Holt
Bowden, *General Science,* 1923, Blakiston
Caldwell and Eikenberry, *Elements of General Science,* 1926, Ginn
Caldwell and Curtis, *Introduction to Science,* 1929, Ginn
Hessler, *The First Year of Science,* 1925, Sanborn
Hodgdon, *Elementary General Science,* 1923, Hinds, Hayden and Eldredge
Hunter and Whitman, *Civic Science in Home and Community,* 1923, American Book Company
Lake, *General Science,* 1917, Silver Burdett
Pieper and Beauchamp, *Everyday Problems in Science,* 1925, Scott Foresman
Snyder, *Everyday Science,* 1925, Allyn and Bacon
Tower and Lunt, *Science of Common Things,* 1922, Heath
Trafton, *Science of Home and Community,* 1926, Macmillan
Van Buskirk and Smith, *Science of Everyday Life,* 1925, Houghton Mifflin
Washburne, *Common Science,* 1924, World Book Company
Webb and Didcoct, *Early Steps in Science,* 1924, Appleton
Wood and Carpenter, *Our Environment,* 1927, Allyn and Bacon


## References for teachers


Curtis, *Investigations in the Teaching of Science,* Blakiston
Curtis, *A Synthesis and Evaluation of Subject Matter,* Topics in General Science, Ginn
Downing, *Teaching Science in the Schools,* University of Chicago Press
Eikenberry, *Teaching General Science,* University of Chicago Press
Frank, *How to Teach General Science,* Blakiston
Twiss, *Teaching of Science,* Houghton Mifflin
Bulletin No. 26, 1920, *Reorganization of Science in Secondary Schools,* Bureau of Education, Washington, D. C.
Bulletin No. 13, 1925, *Bibliography of Science Teaching in Secondary Schools,* by Glenn and Walker, Bureau of Education, Washington, D. C.


## Tests and books on testing


Denver Public School *General Science Tests*
Downing, *Range of Information Tests in Science,* University of Chicago Press
Dvorak, *General Science Tests,* Forms R-1, S-2, and T-2, each 50c pkg. of 25, Public School Publishing Company, Bloomington, Illinois
Giles, Schmidt, and Osburn, *Wisconsin General Science Tests,* Eau Claire Book and Stationery Company, Eau Claire, Wis.
Orleans and Sealy, *Objective Tests,* World Book Company
Powers, *General Science Tests,* Bureau of Publications, Teachers College, Columbia University, New York City

Ruch, *The Improvement of the Written Examination,* Scott Foresman

Ruch, *The Objective or New Type Examination,* Scott Foresman

Ruch and Popenoe, *General Science Test,* Form A and B, each $1.30 per pkg. of 25; this includes a manual of directions, key, percentile, graph, and class record, World Book Company

Ruch and Stoddard, *Tests and Measurements in High School Instruction,* World Book Company

Russell, *Classroom Tests,* Ginn

Toops, *General Science Tests,* Institute of Research, Columbia University, New York City