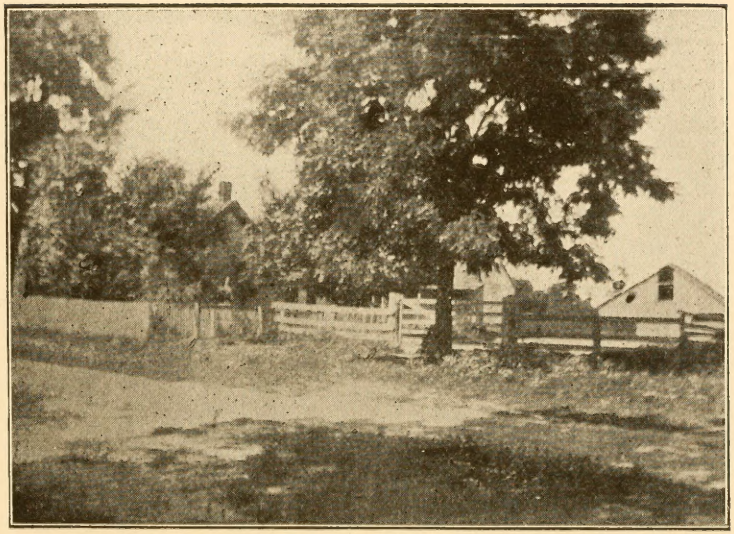
One Hundred Lessons in Agriculture

NOLAN



THE OLD HOME IN THE COUNTRY

ONE HUNDRED LESSONS

IN

ELEMENTARY AGRICULTURE

A MANUAL AND TEXT OF ELEMENTARY AGRICULTURE
FOR RURAL SCHOOLS

BY

ARETAS W. NOLAN, A. B.

Professor of Horticulture, Forestry, and Economic Entomology
West Virginia University.
Formerly Superintendent of Lima, Indiana, Consolidated Schools.

FAITH

Here in the country's heart,
  Where the grass is green,
Life is the same sweet life
  As it e'er hath been.

Trust in a God still lives,
  And the bell at morn
Floats with a thought of God
  O'er the rising corn.

God comes down in the rain,
  And the crop grows tall—
This is the country faith,
  And the best of all.

—Norman Gale

The Acme Publishing Company
Morgantown
West Virginia

TO

MY FATHER AND MOTHER

WHO ALL THEIR LIVES

HAVE DWELT AMONG THE FIELDS

IS THIS BOOK DEDICATED.

PREFACE

The preparation of this book was undertaken primarily that the classes in Agricultural Education in the Summer Sessions of the West Virginia University might have in one book the directions for all laboratory experiments and exercises, and such information as will enable the student to teach the elements of agriculture in the public schools.

It has been the aim of the author to simplify the subject-matter, materials, and methods usually presented in text-books on Agriculture, so that the teacher in the one-room country school, or in the upper grammar grades of a graded school, may find the lessons easily practical, within the range of the pupil's power, and full of profitable interest and educational value.

It is taken for granted that the teacher will have time for only one class in this subject, and with probably two or three recitation periods per week; therefore the lessons have been adapted to the capacity of pupils of the sixth, seventh, and eighth grades, below which, in the opinion of the writer, elementary Agriculture, as such, should not be taught.

The lessons do not follow each other in very close sequence, each being complete in itself and allowing the teacher to choose as the season and occasion make the materials available. If the work is not conducted by means of real things, the educational value is lost. The lessons are given for the purpose of teaching the

fundamental principles of Agriculture, and if handled properly, will mean an intellectual development of the pupil.

Any energetic teacher, by carefully planning the work in advance, can do creditable class work, if he is willing to "do things." Most of the lessons of this book have been personally taught or supervised by the author, and they have been found entirely feasible, even in the country schools.

The author wishes to express his grateful appreciation to all those who have kindly helped by reviewing the manuscript or by loaning illustrations.

The following persons have been very helpful:

Dr. T. C. Atkeson, Prof. D. W. Working.

We are indebted to the following persons and experiment stations for illustrations, and bulletins:

Dr. L. H. Bailey, for the use of the "Rural School Leaflets;" Prof. B. M. Davis, for the Miami Bulletins; West Virginia Experiment Station, B. F. Johnson and Orange-Judd Publishing Cos., and Purdue University, Indiana.

Morgantown, 1908. THE AUTHOR.

INTRODUCTION

Teachers everywhere are awakening to the belief that there are two great relations to be brought about in the educative process. First, the close relation of head, heart, and hand; second, the close relation of school and community life. The dominant interests in the community may well be the key to intelligent, interesting work in the school. The dominant interest in rural life is nature and agriculture. Agriculture in its many phases will furnish the subject-matter for the widest correlation and the deepest interpretation of life for the country child.

The vast majority of the people of this country, as elsewhere, must get their sustenance from the soil; and the education of the future must in some way, more than ever before, inspire a love for the land. We do not teach literature and composition to make poets and authors of the boys and girls; neither do we teach agriculture primarily to make farmers of them. If we teach literature to give knowledge, culture, and appreciative attitude toward the highest of fine arts, so we teach agriculture to give knowledge, culture, and appreciative attitude toward the highest of natural arts.

Heretofore the schools, text-books, and teachers emphasized the city life and neglected the farm and country life. Now the fifty agricultural colleges have become so many infection points, infusing new life, and establishing new units of education, and bringing

to the country all the advantages, with few of the evils of city life. With the agricultural college at the apex of this new system, the agricultural high schools growing into the central portion, and the improved rural schools as the basis of the structure, a system of education is being established out of which shall evolve a new earth.

It is not the purpose of education to latinize or to agriculturize the people into classes, but to socialize through active and efficient participation in the most helpful services at hand. The teaching and study of elementary agriculture may fulfill this modern aim of education, and so our state legislators spoke wisely when they decreed that elementary agriculture shall be taught in the common schools of West Virginia.

One great need now confronts us. The agricultural knowledge is available, the children are waiting and ready—where are the trained teachers? We believe, however, that the teachers will not be less progressive than the legislators, but will heartily approve this advance step, and speedily prepare themselves to do their part. While this preparation proceeds, the teacher must hold these two keys which will unlock the doors to successful progress: (1) a close study of the child, his weakness, his strong points, his dominant interests, and his inclinations; and (2) a careful study of the community life, its dominant interests and its ideas.

Agriculture in some form or other is the dominant interest of rural life. It is the common topic of conversation. It is the thing the children hear and know most about. From it illustrations may be drawn in

every subject of the school curriculum. If the teacher in using agriculture as a means in his teaching knows enough about the science of the subject itself to speak with authority, so much the better. If the teacher can show what industry, application, and brains can accomplish in agriculture, it is an easy step to the application of these qualities in the formation of character. If the rural teacher cannot do this, he is not fit to teach in the country school. The rural school must forever remain a part of the country, and the boys and girls here have a right to the best of advantages. And it remains for the teacher, partly through the teaching of elementary agriculture, to make the rural school the highest and best factor in the fulfillment of that vision, seen by the prophet of the Apocalypse, "A New Heaven and a New Earth."

The vital question for the teacher is—what to do now? Given the sympathetic, intelligent attitude toward the subject, and a desire to teach it successfully, we may proceed to some detailed subject-matter and methods. It is the purpose of the writer to outline a series of lessons in elementary agriculture, adapted to the needs and conditions of the rural schools and the grammar grades of city schools. These lessons have been found practical by the writer, and if the teacher is willing to "do things" they may prove helpful and suggestive and may lead to ideas and practices which will bring money returns to the farmer.

These three principles should be the criterion in the presentation of every lesson:

1. The method, to be observational whenever possible.

2. The materials, the common things and processes of nature, directly or indirectly related to farm life.

3. The view-point, the human interest relation in every-day life.

It is not the purpose to make "ready-made" lessons which will discourage or take away the need of effort on the part of the teacher, but to furnish suggestive subject-matter and methods, upon which the teacher may build from his own initiative and individuality. The lessons may seem unorganized as here presented, for the attempt is to organize educationally upon the above principles, rather than upon sequence of subject-matter.

SUGGESTIONS TO TEACHERS

1. Read from other text-books the subject-matter treated in these lessons.

2. Collect beforehand the materials needed for experiments, and have everything ready for the recitation.

3. Ask the pupils to assist in collecting the materials, and have them perform the experiments when possible.

4. Make many excursions for observations of good and bad farming methods. Bring the class to the material when the material can not be brought to them.

5. Have a school garden, if possible.

6. Write to the State Agricultural Experiment Station and to the Department of Agriculture at Washington for information, bulletins, and seeds.

7. Each pupil should have a permanent note-book in which to keep a neat pen-and-ink record of each lesson. An example of how each lesson may be written up, is given in the appendix. The work of writing each lesson creates a better interest and gives the pupil something definite to do.

8. The lessons need not follow the order given in the text. The suggestions for the season accompany each lesson, those for the winter being so suggested, because the material used is then more available than much of that in the other lessons.

9. The writer will gladly reply to inquiries from teachers concerning any points in these lessons not clearly understood.

TABLE OF CONTENTS

Elementary Agriculture

LESSON I

Title.—Composition of Soils.

Season.—Any season when ground is not frozen.

Object.—To study the composition of some of our farm soils.

Material.—A cupful of ordinary soil, some humus, three one-quart fruit-jars and water.

SUBJECT-MATTER AND METHOD

Soil is composed of particles of rock and a greater or less amount of humus, including air and soil water. Before soil is a good place for plant roots, it must contain the proper amount of heat, and the soil water in which the plant food is soluble must be slightly alkaline.

Humus is the decaying roots, stems, manures, leaves, etc. Leaf mould from the woods is the best example. Ask the pupils to bring some leaf-mould for this lesson.

To obtain the sand, clay, and silt from the soil, proceed as follows:

Place the cupful of soil in one of the jars, cover

with water, and let it soak for a few hours. This will separate the soil granules. Fill the jar two-thirds full of water, stir the contents thoroughly, then let the soil particles settle for one minute. Drain off the water and suspended soil into another jar, leaving sand and gravel in the first jar.

Let the contents of the second jar settle for five minutes and drain off as before, into the third jar. In the second jar is left silt.

Let the contents of the third jar settle three days; then drain off the water. You have left clay.

This experiment may be carried on during several days, in connection with other experiments in soil.

Compare sand, silt, clay, and humus, as to origin, color, size of particles, and stickiness. Rub the different soils between the fingers, and it will help you to compare size of particles, and characteristic qualities.

Place some humus on a hot stove. Does it burn? Does the sand or clay? Which is the stickiest soil? Which is the heaviest? Which ought not to be worked while it is wet? Why?

The different proportions of these ingredients give us our farm soils. A loam is a mixture of sand, silt, clay, and humus. The ingredient predominating, distinguishes the kind of loam.

Note.—Soil particle dimensions:

Stones—above 1 millimeter.

Sand—between 1 millimeter and .05 millimeter.

Silt—between .05 millimeter and .005 millimeter.

Clay—between .005 millimeter and .0005 millimeter.

Humus varies from woody fragments to black powdery material. (By Ethel Cowans.)

Note.—Fill out and learn the following table showing the ways in which soil is formed:

By atmosphere.	By water.	By plants.	By animals.	By man.
Winds.	Rivers.	Root pressure.	Burrowing.	Tillage.
Chemical action.	Landslides.	Acid secretion.	Earthworms.	Irrigation.
Temperature changes	Oceans.	Bacteria.	Animal accumulation.	Control of streams.
	Frost.	Vegetable deposit.		Mining.
	Ice.			Lumbering.
	Glaciers.			
	Chemical action.			

LESSON II

Title.—A Study of Soils.

Season.—Fall or Spring.

Object.—To learn the nature and properties of different kinds of soil.

Material.—The different soils in the school-room in convenient vessels, or pupils in the field.

SUBJECT-MATTER AND METHOD

Have the different types of soils before the pupils as follows:

1. Clay soil, of heavy, sticky consistency.
2. Sandy soil, a large amount of sand present.
3. Sandy loam, containing more sand than clay.
4. Clay loam, containing more clay than sand.
5. Humus soil, containing a large amount of decaying organic matter.

Have pupils observe and feel each of these types.

Which is the commonest in this locality? How was the soil formed?

Name some crops which will grow best on each kind of soil.

The following table should be made out in the pupils' note-books:

Kind of Soil	Where found	Growth on It	Price per Acre

Note.—In all these lessons the pupil should keep a note-book record, following the form given, for each lesson, and under Subject-matter and Method in his note-book, he should make all tabulations and answer all questions.

LESSON III

Title.—Relation of Soil with Water.

Season.—Any season when soils are obtainable.

Object.—To show the absorbing and retaining powers of the different kinds of soil.

Material.—The five different kinds of soil, or merely the sand, clay, and humus; box prepared as described below; cloth, and lamp chimneys. (Apparatus of Fig. 1 may be used also.)

SUBJECT-MATTER AND METHOD

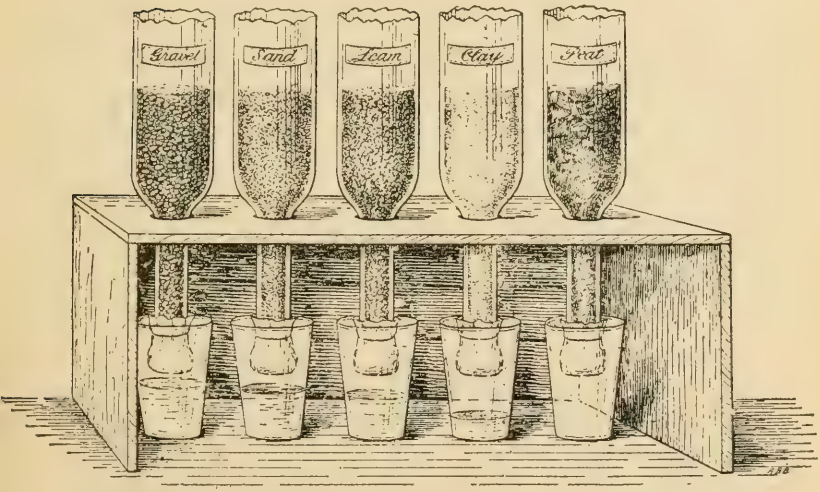
Make a rack to hold three straight lamp chimneys, by boring holes in the side of a box. Tie a cloth over one end of the chimneys, fill each with one of the different kinds of soil. Place the cloth end of the chimney downward through the holes in the box. Have a glass tumbler under each chimney. Slowly pour water into the top of the chimneys. Through which does it drip first? Which absorbs most before it begins to drip? Pour the same amount of water into each chimney, and observe which soil retains the most.

For a second part of this exercise, fill the same chimneys as before with dry soil, and set them in the rack so that the cloth-end reaches down into the tumblers, filled to equal heights with water. In which chimney does the water rise most rapidly? In which

does it rise the highest? The teacher may easily apply the facts learned in this experiment.

For a third part of this study, fill two flat pans with the same kind and amount of soil, and thoroughly soak each pan of soil with water. Then cover the wet soil of one pan with a thin mulch of dust and leave the other uncovered. Set aside and notice again after 24 hours. Which has lost the greater weight through surface evaporation? The dust mulch prevents evaporation, and is thus a good covering for soils to help them retain their moisture.

FIG. 1.



APPARATUS TO TEST THE CAPACITY OF SOILS TO TAKE IN RAINFALL

LESSON IV

Title.—Capillarity of Soils.

Season.—For any season.

Object.—To determine the effect upon the germination of seed, of firming the soil about them, and also the effect upon the movement of soil water.

Material.—Two tin cans, pea seeds, soil, pie-tins, and water.

SUBJECT-MATTER AND METHOD

(a) Number the tin cans 1 and 2. Put good soil in both cans. In No. 1 leave the soil as loose as possible, and cover the seeds planted in it with loose soil. In No. 2 press down the soil as you are filling it, then plant the seeds at the same depth as in No. 1, but lightly firm the soil over the seeds in No. 2. Observe and record which seeds germinate first.

(b) Make holes in the bottoms of the tin cans used in part (a). Have equal amounts of soil in both cans. Firm the soil well in No. 2, so that it is smooth and level. Leave the soil loose in No. 1. Sprinkle dry dust over the surface of both soils. Set the cans of soil in the pie-tins, and fill the pie-tins with water. Observe and record in which can the water from below, first dampens the dry soil on the surface.

Note.—In this experiment you observe a phenomenon called capillarity. In this case it is the passage

of water through the minute spaces between the soil particles. When the particles of soil are far apart and there are many air-spaces, the water cannot pass readily by capillarity. Some clay soils may be so fine and closely packed, however, that capillarity acts very slowly. In sandy soil capillarity acts quickly

On the other hand, the soil particles may be so loosely connected as to prevent capillarity. This is the explanation of the value of the surface mulch. The looseness of the surface soil, prevents the escape of the soil water below, brought up by capillarity.

LESSON V

Title.—Fertilizers and Plant Foods.

Season.—Any time. May be a Winter study.

Object.—To understand plant foods, and how to fertilize the soil.

Material.—Two cans or flower-pots filled with clean sand, (made clean by stirring in water, and pouring off the cloudy water), a handful of wheat, and Bigelow's compressed tablets*.

SUBJECT-MATTER AND METHOD

To prepare the pupils for this and the next lesson, the teacher should present the following introductory facts in as simple a way as possible:—

*Note.—The tablets to be used in this lesson, can be obtained from Edward F. Bigelow, Stamford, Conn., at 10c a box. Each tablet is composed of the following ingredients:—

Common salt (sodium chloride), 2½ grains.

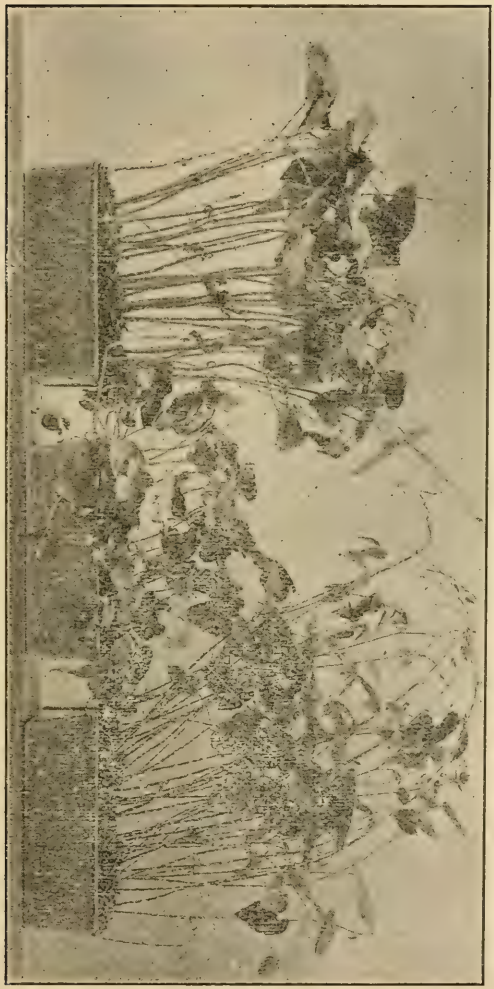
Plaster of Paris (calcium sulphate), 2½ grains.

Epsom salts (magnesium sulphate), 2½ grains.

Phosphate of lime (calcium phosphate), 2½ grains.

Salt-petre (potassium nitrate), 5 grains.

Compounds of iron and chlorine (ferric chloride), 1-10 grain.



"A WINDOW GARDEN WITHOUT SOIL"
(Courtesy of E. F. Bigelow, in Guide to Nature.)

Chemists have found that all the different substances of the world can be separated into about eighty different things. These are called elements. Iron, gold, silver, tin, carbon, sulphur, etc., are elements. No one has been able to separate them into different things. Gold cannot be separated into anything but gold. For centuries men tried to make gold out of other things, but they failed. Water is not an element; it is a compound. A chemist can separate it into two gases, hydrogen and oxygen.

All living things are made up of different compounds of elements. The starch of corn is a compound of carbon, hydrogen, and oxygen. Only a few of the eighty elements are necessary for the growth of plants and animals. The following elements are commonly found in plants, and the first ten are absolutely necessary for good plant growth: oxygen, hydrogen, carbon, nitrogen, iron, potassium, phosphorus, calcium, sulphur, magnesium, sodium, chlorine, and silicon. Oxygen, hydrogen, and nitrogen are invisible gases, so we do not see them. Iron and sulphur occur as free elements. Calcium is not ordinarily seen, but quicklime is either calcium or magnesium combined with oxygen. Silicon and oxygen combined make up the large part of sand. Salt is a compound of sodium and chlorine. A green plant is mostly water. Of the other substances, carbon makes up nearly one-half; nitrogen comes next; and there are smaller amounts of other elements.

No plant can grow unless supplied with the first ten elements mentioned above. The soil furnishes an

A TANGLE OF PLANTS, GROWN IN SAWDUST AND NUTRIENT SOLUTION

(Courtesy of E. F. Bigelow, in Guide to Nature.)

abundance of iron, sulphur, magnesium, sodium, chlorine, and silicon; a farmer does not need to give special attention to these. The carbon dioxide gas of the air furnishes carbon; water furnishes hydrogen and oxygen; and the remaining elements, nitrogen, potassium, phosphorus, and calcium, are often insufficient in the soil, and must be supplied if a good crop is to grow. So these, particularly the first three, are the elements that the farmers buy in their fertilizers.

Now these little tablets, described in the note, contain the plant food of the soil and of the commercial fertilizers. To demonstrate the effect of fertilizing the soil, proceed as follows:

Fill two cans or flower-pots with clean sand. Plant six grains of wheat in each. Keep one moist with rain-water. Keep the other in the same condition as to moisture, to which has been added plant food at the rate of two compressed tablets to each pint of water.

At first there will be no difference in the growth, but in two or three weeks, when the food stored up in the grain is exhausted, the plants in the first can will grow but little, while those in the second will grow vigorously. Such substances, when applied to soil, are known as fertilizers.

How to know what kind of plant food the soil needs is a difficult problem. Many times certain fertilizers are added to the soil, but produce no results. It is important to know the needs of the soil with respect to an intended crop. Tests are explained in Farmers' Bulletins. The tests in Circular No. 18 are

simple enough to be worked out by any eighth grade pupil.

The further study of plant foods is continued in the next lesson.

WHEAT GROWING IN NUTRIENT SOLUTION
(Courtesy of E. F. Bigelow.)

LESSON VI

Title.—Plant Foods.

Season.—Any time. May be a Winter study.

Object.—To study the effects of fertilizing compounds on the growth of wheat plants.

Material.—Manure, nitrate of soda, muriate of potash, and acid phosphate, ten flower-pots or tin cans, wheat, and about one-half bushel of poor soil. Any interested boy can get this soil even in the Winter time.

SUBJECT-MATTER AND METHOD

Have these commercial fertilizers before the class for observation. Fill each of the pots with soil, and add plant food to the different pots as follows:

1. Nothing.
2. Nitrate of soda (one-half teaspoonful).
3. Acid phosphate (one teaspoonful).
4. Muriate of potash (one-fourth teaspoonful).
5. Nitrate of soda and acid phosphate.
6. Nitrate of soda and muriate of potash.
7. Acid phosphate and muriate of potash.
8. Nitrate of soda, acid phosphate, and muriate of potash.
9. Same as No. 8, but double the amount of each.
10. Stable manure.

Mix the fertilizers into the soil; then plant about

a dozen grains of wheat in each pot. Label each pot with the names of the fertilizers used. Place the pots in a window or light place, and keep the soil moistened. When the wheat seedlings come up, thin out to the same number in each pot. Note the difference in the color of the leaves in each pot. Which fertilizers give the greatest increase in growth?

Make a complete record of this experiment in the note-book.

Note.—Those who cannot readily secure the fertilizers for this lesson, may get a sufficient amount for this experiment, by writing to the author, and enclosing 50 cents to cover cost of the material.

Practical Problems.

I

The usual prices of the common fertilizers is as follows:

Nitrate of soda, $57.00 per ton.
Acid Phosphate, $12.50 per ton.
Muriate of potash, $42.00 per ton.
How much would a pound of each cost?

When a farmer speaks of a fertilizer as being 2:8:10, he means that it contains 2% nitrogen, 8% phosphoric acid, and 10% potash.

How would 400 pounds of fertilizer of this type be made up?

Dirt as a filler should be added to this to make up a ton of material to spread upon the soil.

2

At the College of Agriculture, Cornell University, two tons of manure that had been weighed and analyzed were left exposed from April 25 to September 22, with the following results:—

	April 25.	Sept. 22
Total weight	4000 lbs.	1730 lbs.
Nitrogen	19.6 lbs	7.72 lbs.
Phosphoric acid	14.8 lbs.	7.79 lbs.
Potash	36. lbs.	8.65 lbs.

What was the value of the nitrogen, phosphoric acid, and potash in this manure on April 25, and on September 22? (Use the values given above). How much was lost?

There are two ways to prevent such losses,—the manure may be hauled and spread on the land every few days, or it may be kept in covered sheds.

A WASTE OF MANURE
(Courtesy of B. F. Johnson Pub. Co.)

3

A good fertilizer for timothy hay has been found to be one containing 200 pounds of nitrate of soda, 100 pounds of acid phosphate, and 50 pounds of muriate of potash, per acre.

How much would this cost per acre?

What percentage of each would this fertilizer contain?

About how much hay at the price in your neighborhood would be worth this much?

(Data for this lesson was adapted from the Cornell Rural Leaflets.)

LESSON VII

Title.—Slopes and Drainage.
Season.—Any season.
Object.—To teach slopes by means of observation and to show their human interest.
Material.—A hillside in view.

SUBJECT-MATTER AND METHOD

Take the class to observe a slope, and bring out the following points:—

Where have you seen slopes before?

When are slopes a good thing, and when not a good thing?

What do you see on these slopes? What things are on other slopes?

Would it be better to have trees on this slope? Why?

Would it be well to plow this slope? Are there any washed places?

Where does the slope wash most, where plowed or wooded?

Explain how the forests hold the soil on the slopes.

Have pupils show the slant of this slope with rulers. Ask them to find pictures of other slopes in their books. Make drawing sketches of slopes, or models in sand.

LESSON VIII

Title.—The Root System of the Plant.
Season.—Spring or Autumn. May be a Winter study.
Object.—To learn the different kinds of plant roots.
Material.—Whole plants of clover, grass, turnip. and as many others as can be gathered up.

SUBJECT-MATTER AND METHOD

The root system of the plant consists of the entire group of roots upon the plant. There are two kinds of root systems:—

(a) Tap-root,—central main root with smaller roots coming out from it.

(b) Fibrous,—many roots of nearly the same size.

Either of these two types may have either slender or fleshy modifications.

Dig up a clover plant, and remove the soil from it. Observe that it has a strong central root which joins the stem. Make a drawing of this.

Dig up a single grass plant, with as many of its roots as possible, and remove the soil from them. Observe the many similar roots projecting from the stem at or below the surface of the ground. Draw.

Make a list of the common plants and classify them as to the character of the root system.

The amount of food material taken in by the plant

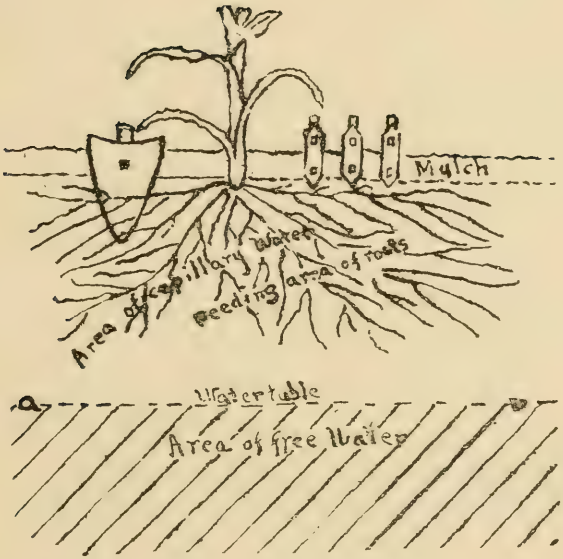
depends largely upon the amount of root surface there is.

Select some plant, as corn, for instance, carefully dig a trench around it, and remove the ball of earth, containing most of the roots. Remove and wash as much of the soil from the roots as possible. Remove and measure each root separately, and find the total length of the whole root system.

Methods of cultivation should take into account that many roots, especially in the growing season, are near the surface. Deep cultivation will destroy all such roots, and to that extent cut off the food supply of the plant. See Figure.

Make the drawings of each of the types of roots referred to above, and in addition, the drawings of a fleshy tap-root, such as the turnip or radish. Fill out the following table:—

Slender tap-roots.	Fleshy tap-roots.	Fibrous roots
1.	1.	1.
2	2.	2.
3.	3.	3.



ROOT SYSTEM OF A PLANT

Showing distribution of roots with reference to surface of the soil and soil moisture, and also effect of deep and shallow cultivation.

LESSON IX

Title.—Root-Hairs.
Season.—At any time.
Object.—To learn the use of the root-hairs of plants.
Material.—Small seeds, wheat or radish, newspaper or blotting paper, and water.

SUBJECT-MATTER AND METHOD

The root-hairs are the absorbing organs of the plant. They have the power to transfer the water and the plant food from the soil to the rootlets.

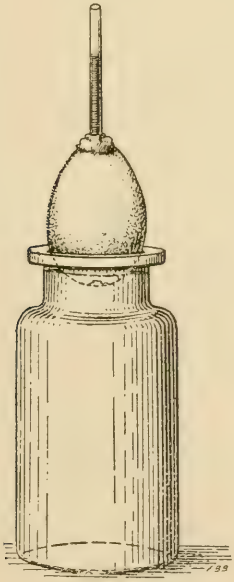
Put some small seeds, that have been soaked in water about twenty-four hours, between two layers of blotting paper. Keep the covering moist, and in two or three days roots will develop, covered with a thick fuzz of root-hairs. Make a drawing of these to show the zone and length. Select a seed with a straight root, and lay it aside on a moist blotting paper, and mark with a pencil the two extreme ends of the root-hair zone. Cover with a glass tumbler and set away for a few days. Note the change of position and method of growth of the root-hair zone.

Note.—The root-hair may be considered as an elongated bag filled with a liquid denser than water. When two liquids of different densities are separated by a thin membrane, the less dense liquid tends to pass through the membrane, more rapidly than the denser liquid. This process is called osmosis.

This principle may be illustrated, if desired by the teacher, from the common demonstration of the broken egg-shell and the glass of water.

Crack the large end of an egg and remove a part of the shell, being careful not to break the shell membrane. Remove a small circle of the shell, about a half inch in diameter. Remove the shell in the same way from the small end, over an area equal to the diameter of a glass tube. Pierce the shell membrane at this end with a pin and glue a short glass tube exactly over the hole and broken shell of the small end. Now fill a wide mouthed bottle full of water, and place the egg on the bottle so that the exposed egg membrane of the large end remains below the surface of the water.

In about an hour the contents of the egg will be



TO SHOW OSMOSIS

seen rising in the glass tube. Explain this action. Make a drawing of the apparatus.

Root-hairs have the power of taking up water that adheres to soil particles. This fact is fundamental. If the water does not exist as films adhering to soil particles, the root-hairs are unable to do their work.

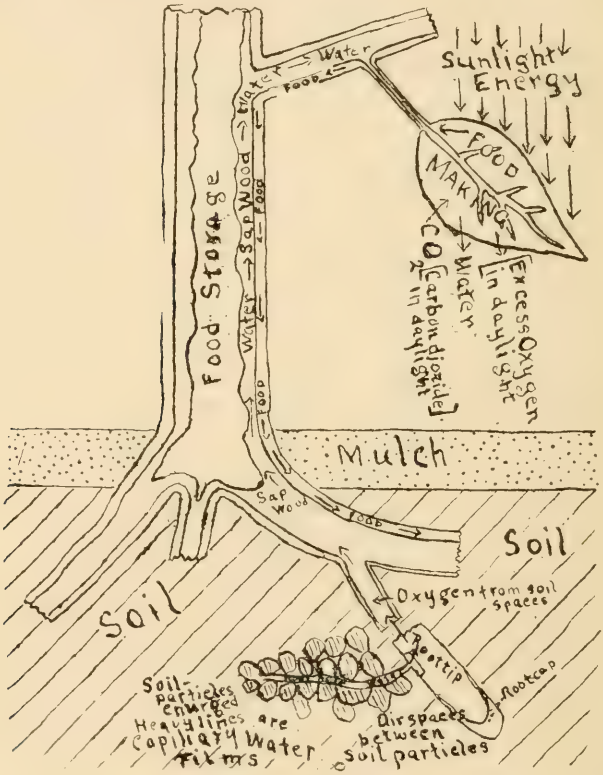


DIAGRAM OF A PLANT

Showing its most important relations: sunlight, moisture, oxygen, and soil. (Courtesy of Prof. B. M. Davis.)

LESSON X

Title.—General Study of Germination.
Season.—At any time.
Object.—To learn the conditions necessary for the germination of seeds.
Material.—Pea or radish seed, four or five pint glass fruit-cans, and some cotton.

SUBJECT-MATTER AND METHOD

(a) Place some seeds on thoroughly moistened cotton at the bottom of can No. 1, and keep the seeds in a warm place and water each day.

(b) Place other seeds on dry cotton in the bottom of can No. 2, and do not water at any time.

(c) Place some seeds on cotton, as before, in the can No. 3, and fill the can with water that has been boiled and cooled. Seal the can tightly, and keep in a warm place.

When the seeds have germinated in (a), examine the seeds in the other cans, and compare with the growth of those in the first.

What conditions for germination are necessary, as shown by these experiments?

In the above experiment it is found that seeds will not germinate without water. The question arises, does water enter the seed?

Weigh two beans of nearly the same size. Put

one in water and leave the other dry. After 24 hours compare each as to weight and size. Draw a conclusion.

Place a lima bean in water and observe the hourly changes in the appearance of the bean. Make a series of drawings to show these changes.

It may be shown that seeds exert a strong force in their absorption of water and in germination.

Fill a bottle with dry pea seeds, and add as much water as the bottle will hold. Cork tightly, and secure the stopper by means of a wire. Set away 24 hours and note the result.

LESSON XI

Title.—Structure of Seeds.
Season.—At any time.
Object.—To study the structure of typical seeds.
Material.—Lima beans, pen-knife, paper and pencil.

SUBJECT-MATTER AND METHOD

To facilitate the study of seeds they should be left in water over night.

Observe the following points of the bean, and make a sentence note of each of the words in black type.

1. Markings on the surface:

(a) Scar or **hilum** where the seed was attached to the pod.

(b) Near the hilum a small opening, the **micropyle.**

2. Remove the coat or **testa.** Near the hilum a small pointed body, the **caulicle**, will be seen.

Separate the halves or **cotyledons,** observe that the caulicle bears two small leaves, the **plumule.**

The cotyledons, caulicle, and plumule constitute the **embryo.**

Make a drawing of the whole bean showing these parts, and of the single cotyledon with the caulicle and plumule in place.

Study the grain of corn, making notes upon the following points:—

1. The general shape. The embryo lies in the groove.

Cut the grain lengthwise, at right angles to the flat surface, and make out the caulicle, plumule, and cotyledon.

The hard outer portion is called, **the endosperm.**

Make a drawing to show these parts.

Always name every part of the drawing.

Note.—All seeds except the seeds of conifers, are of one of these two types. In the bean, there are two cotyledons, and the food material of the seed is stored in these cotyledons.

In the corn there is only one cotyledon, and the food material is stored outside of the embryo, in a part called the endosperm.

LESSON XII

Title.—Selecting Seed Corn in the Field and Storing It for the Winter.

Season.—In the Autumn.

Object.—To learn how to select the seed corn in the field and how to store it until planting time.

Material.—A field of ripened corn or several stalks brought into the school room for observation.

SUBJECT-MATTER AND METHOD

If possible, take the class into the field to select the corn, but if not, have an armful of stalks of corn brought into the school room.

I. The first point to notice in selecting an ear for seed is its position on the stalk. The ear should be set about mid-way up the stalk, not too near the bottom nor too near the top. Next, notice the shank that holds the ear. It should not be too long, so that it holds the ear at a considerable distance from the stalk. On the other hand it should not be so short that it causes the ear to stand upright against the stalk. The ear should come from the stalk, slightly bending downward at the tip. See the illustration given.

The stalk should be of medium size, strong and tapering.

II. The next point to observe, is the general shape and development of each ear selected. For

hasty selection in the field, be governed by the following points:—

1. Length of ear, between 8 and 10 inches.

2. Circumference of ear, about three-fourths the length.

3. Rows of grains straight and running well out to the tip and butt of the ear. Grains well shaped and firmly set in place, deeply dented, and all of the same purity of color.

A GOOD STALK OF CORN
(Courtesy of B. F. Johnson Pub. Co.)

Governed by all these points in the selection of the ear, the student or farmer may select as much as is needed for his seed, and prepare to store it for the winter.

III. It is better to select more than is needed, so that the best type of ears may be chosen at planting time.

In storing the corn, it should either be hung by the husks torn back from the ear, or placed in racks made of narrow strips with spaces between. In any case, the corn should be stored in dry, well-ventilated places, in such a way that there may be a free circulation of air about each ear.

For a school-room method, forty or fifty ears might be hung in the attic or in the room for that matter, to be used later in corn-scoring and in the germinating tests.

For the storing, scoring, and final selection of seed corn, the use of a special farm laboratory building is strongly advised. Such a building on the farm would facilitate many important operations, and make possible many others that would benefit the farmer's business.

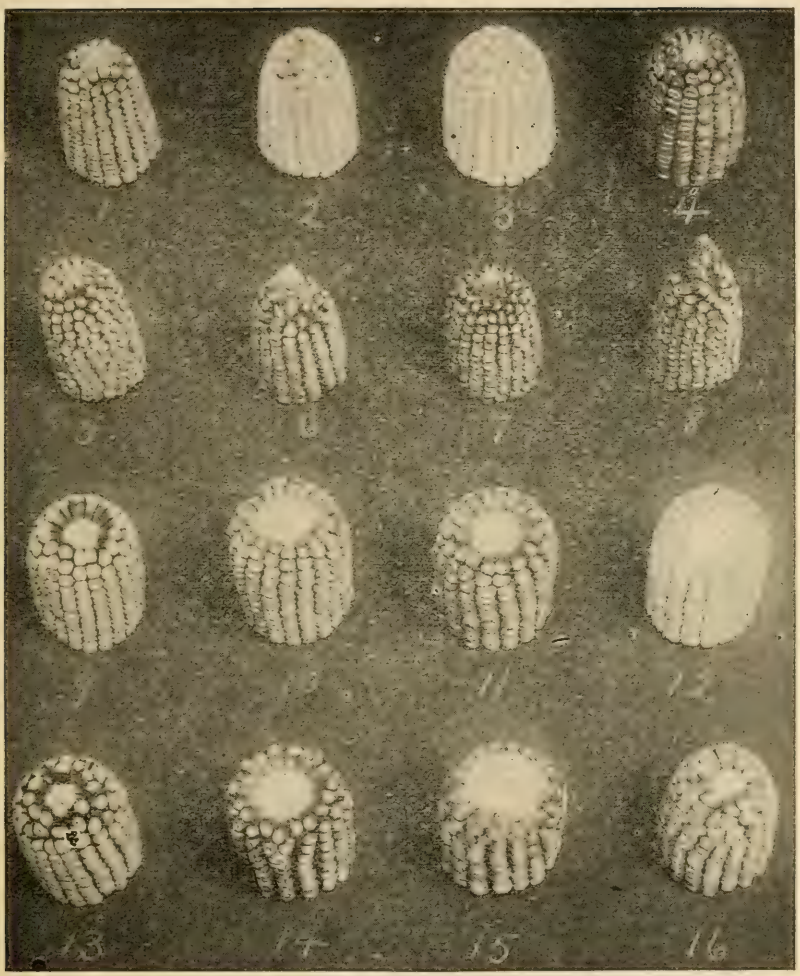
LESSON XIII

Title.—Scoring Seed Corn.
Season.—Winter or early Spring.
Object.—To learn how to judge ears of corn.
Material.—An ear of corn for each member of the class, paper and pencil.

SUBJECT-MATTER AND METHOD

Ten ears of corn are usually scored for each sample of corn judged, but in this case, perhaps one ear for each pupil will be sufficient for a lesson. If time and material permit, it would be well for each pupil to score ten ears.

The following score-card is used by the Indiana Corn Growers' Association. Let each pupil copy the score-card in the permanent note-book, and grade his ear of corn on each point. The number opposite each of the twelve points, represents the perfect grade.



TYPES OF BUTTS AND TIPS OF EARS OF CORN
No. 4 is a good tip. No. 11, a good butt.
(Courtesy of Purdue University.)

Name of variety ..... Table No.....

Name of Scorer..... Sample No.....

		1	2	3	4	5	6	7	8	9	10
1. Trueness to Type or Breed Characteristics	10										
		...	...	...	...	...	...	...	...	...	...
2. Shape of Ears	5										
		...	...	...	...	...	...	...	...	...	...
3. Color of Grain and Cob	10										
		...	...	...	...	...	...	...	...	...	...
4. Vitality or Seed Condition	10										
		...	...	...	...	...	...	...	...	...	...
5. Tips of Ears	5										
		...	...	...	...	...	...	...	...	...	...
6. Butts of Ears	5										
		...	...	...	...	...	...	...	...	...	...
7. Kernel Uniformity	10										
		...	...	...	...	...	...	...	...	...	...
8. Kernel Shape	10										
		...	...	...	...	...	...	...	...	...	...
9. Length of Ears	5										
		...	...	...	...	...	...	...	...	...	...
10. Circumference of Ears	5										
		...	...	...	...	...	...	...	...	...	...
11. Space between Rows and Kernels	10										
		...	...	...	...	...	...	...	...	...	...
12. Proportion of Corn to Cob	15										
		...	...	...	...	...	...	...	...	...	...
Total - - - - -	100										

Explanation of the Score-card.

1. Trueness to type or breed. Ten points perfect.

The ear should be true to the breed characteristics in size, shape, color, shape of kernel, etc.

2. Shape of ear. 5 points perfect.

The ear should be full and strong in the middle, and should not taper too rapidly towards the tip. Rows should be straight.

3. Color of grain and cob. 10 points perfect.

The color should be true to the variety, and free from mixture. White corn should have white cobs, and yellow corn, red cobs. Cut about one point for five or six colored grains.

4. Vitality or seed condition. 10 points perfect.

The ear should be well matured, firm, and sound. The germ should be large, fresh, and vigorous looking.

5. Tips of ears. 5 points perfect.

The tip should be regular and not too tapering. Tip should be well covered, with straight rows of of regular kernels. Cut one-half point for tips exposed one inch.

6. Butts of ears. 5 points perfect.

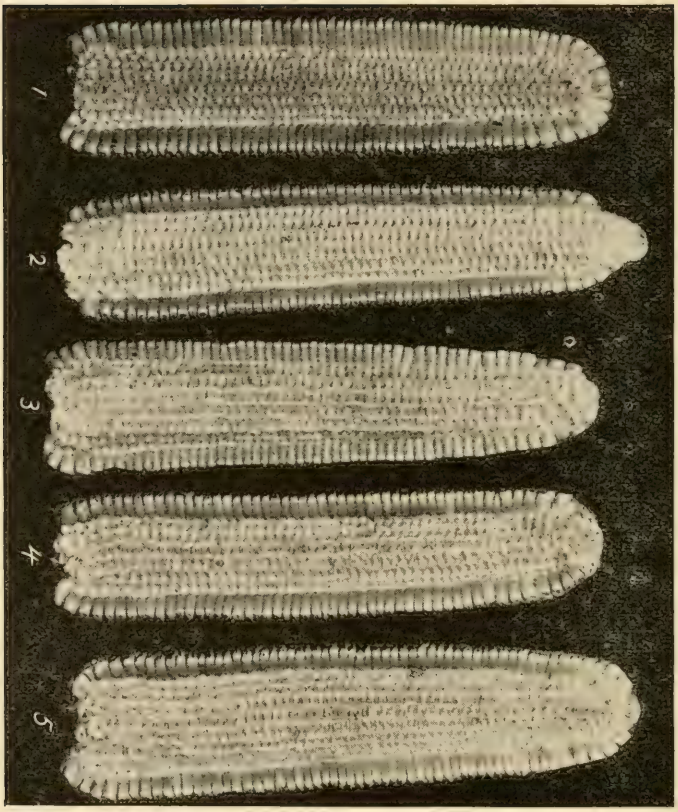
The rows of kernels should extend in regular order over the end of the cob, leaving a depression when the shank is removed.

7. Kernel uniformity. 10 points perfect.

The kernels should be uniform in size, color, shape, and indentation, and true to the variety type.

8. Kernel shape. 10 points perfect.

The kernels should be deep and so shaped that their edges touch from tip to crown. The tips of the kernels should be full and strong.



PROPORTION OF CORN TO COB
No. 1 is excellent.

9. Length of ear. 5 points perfect.

The length should conform to the standard for the variety used. From eight to ten inches is the usual standard length. Cut one-half point for each inch of deficiency.

10. Circumference of ears. 5 points perfect.

The circumference should be in proportion to the length, that is, about three-fourths the length, measured at one-third the distance from butt to tip. For each inch deficiency or excess, cut ½ point.

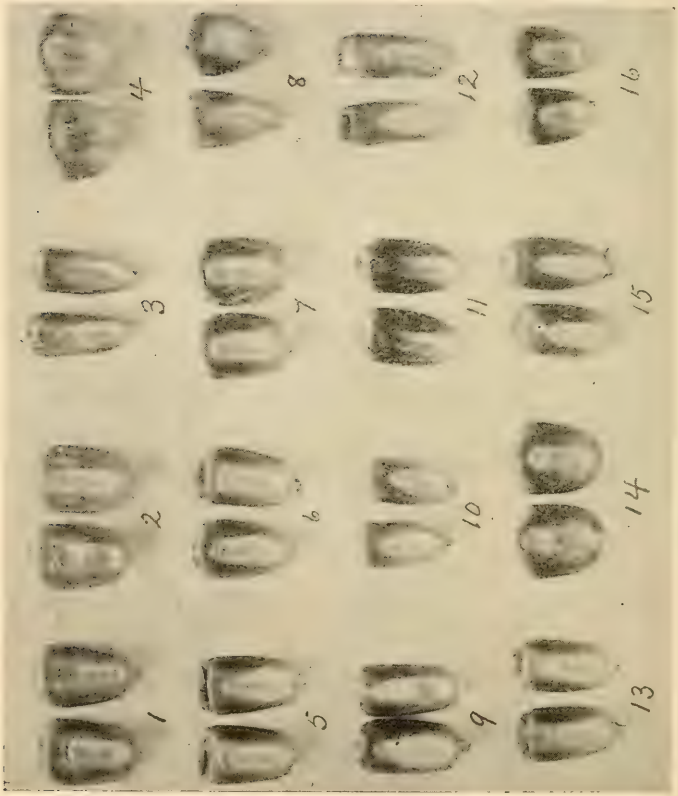
11. Space between rows and kernels. 10 points perfect.

The furrows between rows should be wide enough to allow the ear to dry out readily, but not so wide as to lose in proportion of corn to cob. Much space between kernels is highly objectionable.

There should be not less than 16 rows, and 6 or 7 grains to an inch in each row.

12. Proportion of corn to cob. 15 points perfect.

The proportion should be determined by weight. The proportion of corn to cob should not be less than 86%. Cut 1½% for each per cent below the standard.



TYPES OF KERNELS
Nos. 5 and 9 are good.
(Courtesy of Purdue University.)

LESSON XIV

Title.—Selecting and Testing Seed Corn.

Season.—March, April, or May.

Object.—To teach the student how to select the seed corn and make the germinating test.

Materials.—Ten or twelve ears of corn as true to the following standard as possible:

1. Good cylindrical shape, well rounded out at the tips and butts.

2. Length, about 8 to 12 inches, and circumference 6 to 9 inches, according to the type.

3. Uniform color and size of grain, straight rows of kernels, filling up the furrows solidly.

4. Cob, not too large in proportion to the ear.

A germinating box as described below.

SUBJECT-MATTER AND METHOD

The teacher should have before the class as many ears of corn as convenient for this lesson. A hundred ears would be the desired number.

Take a shallow box and partly fill it with fine sand. Thoroughly moisten the sand. Over the sand place a cloth which has been checked into 100 two-inch squares with an indelible pencil, or better, with ink. Number each square from 1 to 100, ten squares in each row, and ten rows.

Now take each ear separately and remove five

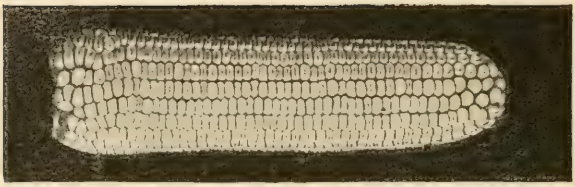
kernels, taking them from different parts of the ear. Take one from the butt, three from the middle, and one from the tip. Turn the ear each time so as not to get them from the same row. Place the kernels in the numbered square, a square for each ear, and lay the ear aside and number it to correspond with the square. Cover the kernels on the squares with a moist cloth. Over this place a layer of moist sand. Keep the sand moist and watch daily for the germinations. The ear that does not show all the five germinating in a few days, should not be planted in the field.

This is a very important and practical lesson, and one that every farmer boy shou'd work out.

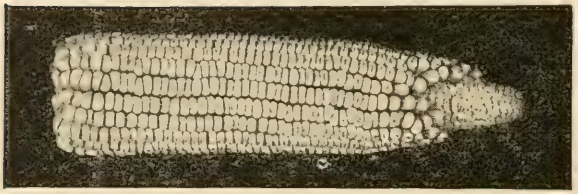
Have the pupils make a drawing of the germinating box, and write a record of the lesson and its results.

Emphasize the fact that this work could be done by the farmer at a time when he is not so busy with necessary work, and that this is the only sure test of germination. If all the farmers' seeds would germinate, their crops would be increased many fold.

A GERMINATING TEST BOX
(Courtesy of Purdue University.)

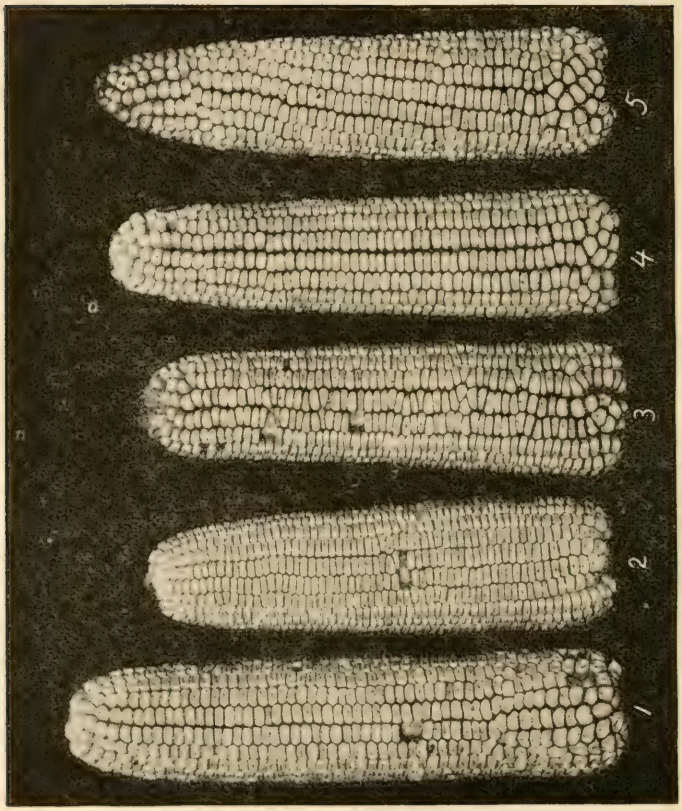


A GOOD EAR OF CORN
(Courtesy of B. F. Johnson Pub. Co.)

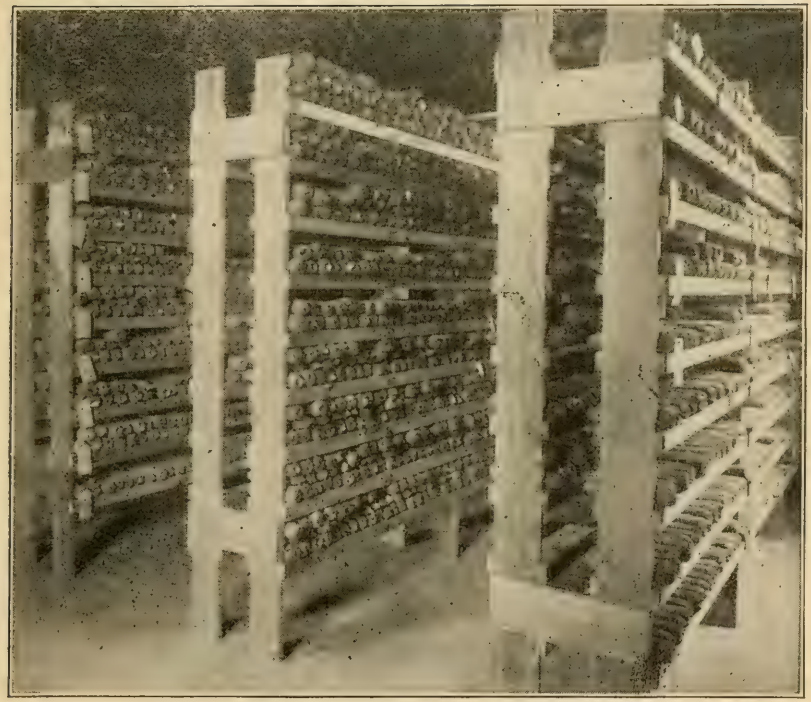


A POOR EAR OF CORN
(Courtesy of B. F. Johnson Pub. Co.)

GOOD EARS
(Courtesy of Purdue University.)



A POOR LOT OF EARS
(Courtesy of Purdue University.)



RACKS FOR STORING SEED CORN
(Courtesy of Purdue University.)

LESSON XV

Title.—Growing Musk-melons.
Season.—Spring months.
Object.—To learn how to grow good musk-melons.
Materials.—Good melon seeds, sod, spade, and boxes.

SUBJECT-MATTER AND METHOD

This lesson may be given in the school-room early in April. Have at hand melon seeds of the best quality. Before time for the agriculture class, send two boys out with a spade to cut several turfs of sod, about six inches square, as many pieces as you mean to have hills of melon. If the grassy side is firmly matted, slightly loosen the fibres, but not enough to allow the turf to fall apart. Place the sod, bottom side up, in a shallow box of wood or pasteboard; if the earth is not thick enough, add a few handfuls of good mealy soil. Plant about six or eight seeds in this soil. Place in a sunny window and keep warm and moist.

This will constitute the first part of the lesson, but the germinating seeds will keep up the interest in the experiment for many days. When the green seed-leaves have freed themselves from the shell, notice which are the thriftiest plants, and remove all but the best two. Care for these tenderly, and they will thrive well, free from frost and the striped beetle.

They may safely acquire three or four true leaves, and be five or six inches tall, before they are planted out of doors. If possible, the rest of this experiment should be done in the school garden. If there is no school garden, and school is to close before May, the children may take the boxes home, and set the melon plants in the home garden as follows:—

When the warm late May-days come, dig holes about eight inches deep and six feet apart in the sunniest part of the garden; put in the bottom of each hole a spadeful of old well-rotted manure; cover this with two inches of sand or fine soil; and on this place the sod with the growing melons, so gently that they will not know they have been moved. The sod should be level with the ground, and well firmed in place. See that the plants never suffer from thirst. Keep the weeds pulled, and stir the surface soil about the hill often, until the vines begin to run.

When each vine has set about a half-dozen melons, pinch off all blossoms that form, and also the tips of the branches, so that all plant food may go into the melons first chosen.

Squash, cucumber, pumpkins, and water-melons, may also be grown in the same way.

LESSON XVI

Title.—Garden Making.

"The garden is a lovesome thing, God wot;
Rose plot,
Fringed pool,
Ferned grot,
The veriest school of peace;
And yet the fool
Contends that God is not in gardens.
Not in gardens! When the eve is cool!
Nay, but I have a sign,
'Tis very sure God walks in mine."

Season.—April and May.

Object.—To teach children how to make a school or home garden, and to form the garden habit.

Material.—Spade, hoe, yard-rule, rake, and mixed fertilizer or compost.

SUBJECT-MATTER AND METHOD

If not practicable to have a garden with individual or group plots, select a space on the school grounds, or near by, on which to make a sample garden, as a demonstration lesson from which the pupils may learn how to make their home gardens.

Select a space of rich soil, about 4 feet wide by 16 feet long, and thoroughly clean away all weeds and trash from this plot.

Spade up the ground as deeply as possible. About a pound of commercial fertilizer may now be sprinkled over the plot, or a few shovelfuls of well-rotted manure may be worked into the ground. Rake over the plot and break up all the clods. It is a good plan to go over the ground with the hands, crumbling the soil as fine as meal. Level the bed up slightly higher than the rest of the ground. Stake the four corners and mark off a sharp, clean-cut edge for the bed, and make a neat clean path around it.

The garden is now ready for planting.

STUDENTS IN ELEMENTARY AGRICULTURE AT WEST VIRGINIA UNIVERSITY, IN THE SCHOOL GARDEN

LESSON XVII

Title.—Planting the Garden.
Season.—Spring.
Object.—To teach the pupils how to plant the seed in the garden.
Material.—Seeds, measuring-rule, and marker.

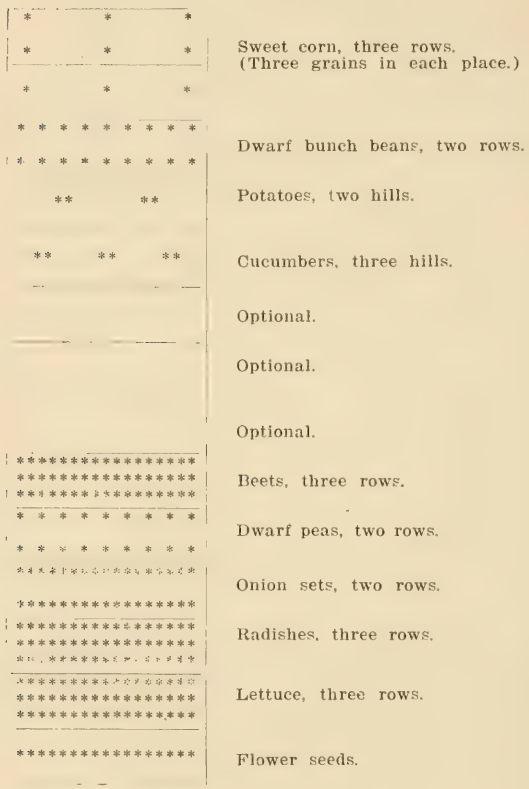
SUBJECT-MATTER AND METHOD

In plenty of time before these lessons are to be given, the teacher should take a penny collection from the pupils, and send to the Home Gardening Association, Cleveland, Ohio, and get seed packages. Many of the seeds might easily be obtained at the homes of the children. Under the direction of the teacher, two or three of the pupils should mark off the garden for planting, and assist in the planting, while all the rest of the children observe. They may then return to their home plots and do the work themselves more intelligently.

The accompanying diagram should be drawn on the board, and copied by the pupils, to a scale of inches, in their permanent note-books, before going to the garden for this lesson.

GARDEN PLOT.

Scale: One-fourth inch equals one foot.



Mark off the furrows about two inches deep across the bed as indicated by the diagram. Place the seeds in the furrow, as shown by the star marks in the diagram. Cover with the soil and press it down firmly with the hands. Now we are ready for

the seeds to grow. Many valuable nature-study lessons may be given in the school as the seeds begin to germinate. Try to create a spirit of appreciative interest in the growing plants and a personal pride in the care of the child's home garden. As the garden grows, weeds must be pulled, insects watched for, and replantings made if necessary. Upon the skillful presentation of these lessons, the pupils should be able to make home gardens and plant and care for them successfully.

There should be some instruction in the growing of plants in every school-room in the state. Gardening is recognized as one of the best all-round helps in the education of the child. There should be a well-organized school garden in every public school in the country. Gardening is a very excellent and healthful habit to form. It will make stronger and better men and women. It will be a resource for them through all the coming years.

School gardens teach appreciation of nature, respect for the property of others, self-reliance, helpfulness, patience, respect for labor, and habits of industry. They furnish useful employment as well as pleasant amusement for children who might seek diversion in idle haunts or questionable activities. In garden work, children learn to see what they look at, and understand what they see; they learn skill with their hands, systematic methods, business experience, and knowledge of gardening, plants, fruit, insects, and birds.

The following table is a good device to use in con-

nection with this lesson. Have pupils record observations made in their gardens under the following heads placed at the top of the page of the note-book:—

Plants	When Planted	How Deep	Distance Apart	When Appear	Injuries

SCHOOL GARDEN OF WEST VIRGINIA UNIVERSITY, NORMAL DEPARTMENT SUMMER SESSION

LESSON XVIII

Title.—Tree Planting.
Season.—Spring or Autumn.
Object.—To learn how to set out a tree.
Material.—A young tree, a spade, and a knife.

SUBJECT-MATTER AND METHOD

In a rural school all the classes may participate in this lesson.

The young tree, either a fruit or forest tree, having been procured, is on the ground, ready for planting. Have some of the pupils dig the hole, a little deeper than the one from which the tree came. Allow ample room for all the roots. While this is being done, the teacher may review all the reasons for the methods employed in digging out the tree. Before placing the young tree, trim away all the injured and broken roots. Place some fine surface soil in the bottom of the hole, and with the hands work fine soil about the smaller roots. Bring out the reason for all this. Fill the earth about the roots carefully, and pack down well. If the soil is too dry, a small pail of water may be poured about the roots before all the earth is put into the hole. Round up the surface so that no water will stand next to the tree, and cover with a fine mulch of dust. The inverted sod may be placed on top. Now the tree must be trimmed back so that the disturbed balance between roots and

branches may be restored. Make this point clear. Let the pupils do all the work. Have the pupils make a wish about the tree, and you have concluded a lesson that will be full of interest; and if you have been enthusiastic in this exercise, a real and permanent interest in trees will have been created among many in the class.

> "Who does his duty
> Is a question too complex for me;
> But he, I venture the suggestion,
> Does part of his who p'ants a tree."—Lowell.

LESSON XIX

Title.—Planting a Farm Wood-Lot.

Season.—April, May, or October.

Object.—To teach the pupils how to plant a small nursery for the wood-lot and to realize the possibilities of such plantings.

Material.—One hundred two-year-old seedlings of the Catalpa speciosa. These may be obtained from the Thos. Meehan and Sons Nursery, Dreshertown, Pa., at one cent a tree, and the necessary money could be easily raised in the school. A plot of ground near the school, size 30 feet by 30 feet.

SUBJECT-MATTER AND METHOD

This lesson can be done successfully if the teacher will send for the seedlings, and see to it that a plot of ground, as mentioned above, is plowed or spaded up in preparation for the planting. Lay off the ground in furrows three feet apart. Cross furrow these at right angles, the same distance apart. Where the furrows cross, a seedling is to be planted. Dig out a hole about six or seven inches deep for each seedling, and plant each one as directed for the single tree in Lesson 18. These little trees will now be three feet apart, and after about three years may be thinned to six feet apart by transplanting the trees

and extending the grounds. This lesson is entirely practical, and may be conducted in any country, village, or city school.

Have the pupils draw a plot of the grounds and write a description of the work of this lesson in their agriculture note-books.

LESSON XX

Title.—An Excursion to the Woods.
Season.—Fall or Spring.
Object.—To study some elementary forestry conditions, and to learn the names of some forest trees.
Material.—Note-books and pencils, with the pupils in the woods.

SUBJECT-MATTER AND METHOD

In this lesson the teacher may take the whole school for a walk to the woods. The smaller children will not lose any time that could be better spent, and the class in agriculture may make the following observations, under the teacher's directions:—

Note (1) the comparative temperatures within and without the forest.

2. The rich humus soil of the forest floor, and how the roots and leaf mould hold the moisture and prevent washing. Point out examples of washes where the forest has been cut away, and explain how the soil is carried to the streams, and its effects upon them.

3. Find trees of virgin growth and also the second growth. Note any dangerous fire-traps.

4. If a freshly cut stump or log can be found, count the rings of growth and determine the age of the tree.

5. Make a few estimations of the diameter and heights of the largest trees. Pupils might calculate the number of cubic feet of timber in a large tree, and by squaring the diameter in inches, minus 4, it becomes board measure, in a 16 foot log.

6. Make a list in the note-book of the names of all the trees you can.

When the pupils return from the woods, have them use the above points as topics to write of the excursion in their permanent note-books.

By referring to Roth's First Book of Forestry, or to Pinchot's Primer of Forestry, many valuable lessons may be continued in this work.

(See Appendix.)

LESSON XXI

Title.—Improving the Soil.

Season.—A lesson for winter text-book study or for spring observation.

Object.—To learn the different operations upon the soil, and the value of each.

Material.—Note-book and pencil. Fields for observation.

SUBJECT-MATTER AND METHOD

Copy the following table in the note-book, and learn to write it approximately from memory:—

SOIL IMPROVEMENT METHODS.

Operations.	Implements.	Value and Improvement.
1. Plowing.	Plows.	Puts land in fit condition for planting. Pulverizes soil so that plant food is available. Turns under manures, green-crops, and trash. Deepens soil, and increases capacity for holding water, and for root extension. Allows weather to act on the soil.
2. Tilling.	Hoes, rakes, cultivators, harrows, and clod-crushers.	Makes a bed for seeds. Covers the seeds. Pulverizes the ground. Establishes and maintains an earth mulch. Destroys weeds.

Operations.	Implements.	Value and Improvement.
3. Rolling.	Rollers, drags, or floats.	Crushes clods. Smooths the ground for seed. Hastens germination of seeds by firming the soil and bringing moisture to the surface through capillarity. Compacts the soil otherwise too loose and open. Puts the land in a condition so that other tools can act efficiently. Facilitates marking out the land.
4. Cover-cropping.	Clover, alfalfa, cow-peas, vetch, etc.	Checks growth of fruit plants in orchards. Prevents land from washing and puddling. Holds rain until it can soak into the soil. Causes soil to dry out early in the spring. Lessens injury from frosts. Adds available nitrates to the soil if a legume crop.
5. Fertilizing.	Manures, lime, ashes, potash, phosphate, nitrate, etc.	Manures supply both humus and plant food. Lime counteracts the acidity of the soil. Commercial fertilizers add available plant food where needed.

Note.—The best tillage of the soil consists of deep plowing, thorough harrowing, and pulverizing of the clods, and shallow cultivation. This renders the plant food available, and provides a mulch to retain the soil moisture. With proper tillage, the need of an artificial fertilizer is lessened.

A visit to the fields to see these operations, and to an implement store for first-hand information, is advisable in this lesson.

The teacher should discuss with the pupils all the values and improvements suggested in the table above.

LESSON XXII

Title.—Rotation of Crops.
Season.—Any season. May be a Winter study.
Object.—To learn methods and value of crop rotation.
Material.—Note-book and pencil. Field for observation.

SUBJECT-MATTER AND METHOD

It may not be feasible for the school to work out this lesson by actual experiment, but the class should make an excursion to fields where rotation of crops is practiced, and there understand the steps in the process.

If the students will memorize the two following methods of crop rotation, which have proven successful, they will have been well repaid for the study of this lesson:—

(a) 1. Sow clover seed in the wheat, March or April.

2. Harvest the wheat as usual, and allow the clover to grow all Fall. It may be used for pasture to some extent.

3. Plow up the clover sod in the following April.

4. Plant to corn.

5. Sow wheat in the corn in the Autumn season.

6. Sow clover seed in the wheat again, in March or April, and thus continue the rotation as before.

(b). If the land is much reduced, or of poor soil the rotation begins and proceeds as in (a), except at No. 3, instead of plowing up the clover for corn in the spring, allow it to stand another season. A hay crop may then be harvested in July, and a seed crop again in the Fall, after which proceed as in part (a).

Make a note-book tabulation as follows:—

ROTATION OF CROPS.

Series a.	Series b.	Series c.	Series d.	Values of Rotation.
Clover	Clover Hay and seed	Clover	Clover	Preserves food supply.
Corn	Corn	Corn	Corn	Increases food supply.
Wheat	Wheat	Oats	Potato	Eradicates weeds.
Clover	Clover	Wheat	Wheat.	Exterminates insects.
		Clover	Clover	Enlarges the resources.

Note.—There are two theories explaining the need of rotation of crops. One states that the plant returns a poison to the soil, rendering it unfit for the growth of that species, but that the soil is not exhausted of plant food. The other holds that a continuous growing of the same plant robs the soil of the elements necessary for the growth of that species, but not for a different species.

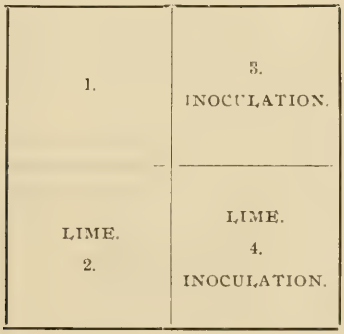
In either case, rotation of crops pays. It not only makes better farms, but better men. The fertility of the soil is maintained, and a profitable yield forthcoming at all seasons. A wise use of the soil does not rob it of its fertility.

LESSON XXIII

Title.—Growing Alfalfa.
Season.—March or April.
Object.—To learn how to grow alfalfa and to observe its relation to soil fertility.
Material.—Four square rods of ground, eight quarts of lime, one quart of oats or barley, and three-fourths pound of alfalfa.

SUBJECT-MATTER AND METHOD

If the required amount of land cannot be obtained on the school grounds, a farmer living near the school will probably be glad to furnish the land. Select the site in any plowed-up ground, lay out the following plats, each one rod square:—



Drive stakes at each corner of each plat.

Sow about eight quarts of lime on plats 2 and 4, four quarts on each plat, which is equivalent to about twenty bushels on an acre. Obtain some soil from a place where alfalfa or sweet clover is growing, and scatter a few quarts of this on plats 3 and 4, being careful not to get it on the other plats. This is inoculating the soil with the bacteria of the alfalfa. Then sow a light seeding of oats or barley over all the plats, a little more than a quart is sufficient. Then sow about ¾ of a pound of alfalfa over the four plats and rake it in. Be careful not to rake any of the soil from the inoculated plats into the others.

No further care need be given the plats until the barley or oats is headed out, when it should be mowed off above the tops of the alfalfa plants. The oats or barley should not be allowed to mature in the alfalfa. School may be closed before this experiment is finished; but the teacher should appoint a committee to study and report the observations of the summer, and all living near should be encouraged to watch the experiment. This is getting lessons from the real source and not from books alone.

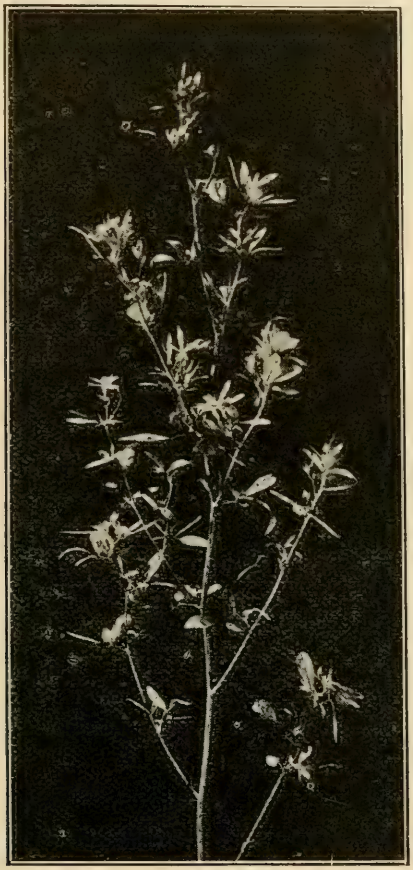
Draw the plats in the agricultural note-books, and answer the following questions:

How soon does the barley or oats come up? The alfalfa? In six weeks observe the roots of the alfalfa in each plat. In which plats are swollen nodules found on the alfalfa roots? What is the effect of the lime and inoculation? Observe the difference in growth in the four different plats.

The surest way to get alfalfa to grow on a poor soil is to manure the soil, cultivate it, and sow about

August the 1st, applying lime and inoculation, if necessary.

This work may be carried on at the students' home if there are no plats for it near the school. The home work of these lessons is to be greatly encouraged.



ALFALFA

LESSON XXIV

Title.—Treating Seed Potatoes to Prevent Scab.
Season.—April or May.
Object.—To learn how to rid seed potatoes of the scab.
Material.—Scabby, potatoes, tub or barrel, sack, and one-third pint of formalin (formaldehyde).

SUBJECT-MATTER AND METHOD

This lesson given at a country school, at potato-planting time, could be made a very beneficial one, both to the pupils and to the patrons who would be interested enough to co-operate.

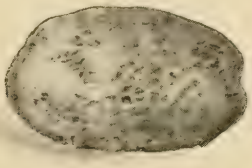
The day before the lesson is to be given, the teacher should ask some pupils to bring about a peck of the scabbiest potatoes that can be found. The teacher should see that the other materials are provided for the lesson.

Place the potatoes in a burlap sack. Into a tub or barrel pour five gallons of water. To this add about one-sixth of a pint of formalin. This can be purchased at any drug store at 40 cents a pint. Place the sack of potatoes in the tub of formalin solution. Allow them to soak one and one-half hour.

(Experimental work of this lesson will have to end here. If there is a school garden, the work as outlined below should be continued at school; if none,

THE ROOTS AND TUBERS OF POTATO
(Courtesy of B. F. Johnson Pub. Co.)

A GOOD POTATO



A SCABBY POTATO

the teacher should fully explain the rest, and call for volunteer pupils to complete the experiment at home and report upon it.)

Remove the potatoes from the solution, and cut into pieces for planting, about two eyes to each piece. Do not put the potatoes back into a receptacle that has had in it scabby potatoes. The vessel to be used should be washed with the solution in the tub.

Plant the treated tubers in rows by themselves, and mark with stakes the rows so planted. To show the comparative results of the treatment, plant the same number of scabby potatoes, and give both equal care and cultivation throughout the season.

When the potatoes are ripe, dig the treated and untreated separately. Count the increase in the treated potatoes. A careful record of this lesson should be kept, including the cost of treatment, the price of potatoes, and the total gain from the treatment, due to the increased value of the yield.

It would be a good service to the district if pupils would bring all their scabby potatoes to the school to be treated, before planting. Any helpful co-operation between the school and the home is of incalculable value to both institutions.

LESSON XXV

Title.—Biological Maps of Home Farms.
Season.—Any.
Object.—To teach the pupils how to map the farm and to make a study of biological and physical conditions there.
Material.—Pencil and note-book.

SUBJECT-MATTER AND METHOD

Assign to groups of two or three pupils who live near each other, plots of ten or twenty acres on their home farm, and require the following outside work of each group:

1. Make measurements of the tract of land allotted and draw a map of the same to an accurate scale. Place in this map the creeks, springs, buildings, etc.

2. Collect bottles of the different kinds of soil found on the tract, and bring to school.

3. Make a list of all the useful plants growing on the plot.

4. Make a list of all the weeds or useless plants known on the plot.

5. Make a list of all the domestic and wild animals seen.

6. Make a list of all the birds and insects observed from time to time.

This work may continue through many weeks, and the pupils should keep a neat and accurate record in their permanent note-books of the observations on their tracts of land.

LESSON XXVI

Title.—Spraying for Codling Moth and Fungous Diseases.

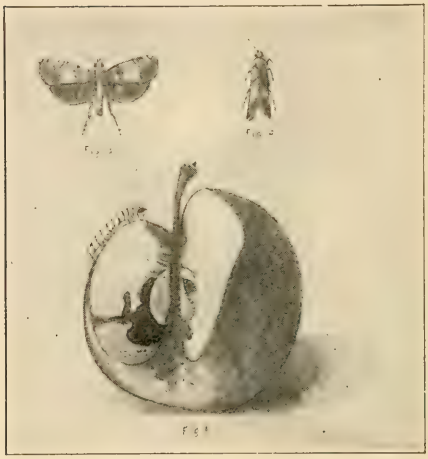
Season.—When the apple blossoms fall, and two weeks later.

Object.—To learn how to spray apple trees.

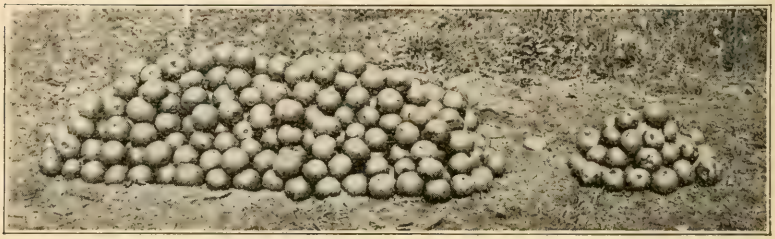
Material.—Spray pump, 3 lbs. copper sulphate (blue stone), 6 lbs. of unslacked lime, 1½ lbs. lead arsenate (disparene), and 50 gallons of water.

SUBJECT-MATTER AND METHOD

This lesson may seem impractical for school work, but it is so important that the teacher should make every effort to have a demonstration made at the school, before the class. If any farmer in the district has a spray pump, he no doubt would be willing to loan it for this lesson. The spray mixture can be bought for about 75 cents. If a five-gallon knapsack spray-pump can be borrowed, the proportions of the mixture given below can be reduced to one-tenth of the material. A bucket spray pump could be purchased at very little cost, and would be well worth the price to the school for experimental purposes, and encourage the practice of this very important work. Two good machines of larger and more expensive make are, the Pomona, and the Fruit-all. Allow the "blue-stone" to dissolve over night, hanging in a cloth



THE CODDLING MOTH
(Courtesy of B. F. Johnson Pub. Co.)



SPRAYED AND UNSPRAYED BRANCHES
(Courtesy of B. F. Johnson Pub. Co.)

sack in three gallons of water. Dissolve the lime in five or six gallons of water. After the two have dissolved, in their separate vessels, pour the two solutions slowly together into a barrel, and dilute to fifty gallons. Now dissolve the one-and-one-half pounds of lead arsenate, and slowly and thoroughly stir the solution into the barrel with the rest. The mixture is now ready for the spray pump.

Force the spray thoroughly into every leaf, stem, and fruit of the apple tree.

If this operation is repeated in about two weeks after the blossoms fall, the trees and fruit will be saved from codling moths and fungous diseases, and the apple trees will yield a hundred-fold. This has been proven most forcibly in the orchards of Mr. G. C. Starcher, of Berlin, Lewis, Co., West Virginia. Old and formerly barren trees, have yielded hundreds of dollars' worth of fine apples in a few years, and his fruit has taken first and second prizes at National and state exhibits. This same spray mixture can be used at any season upon any leaf-chewing insects that are defoliating the plants. Applications to the State Experiment Station should be made for the latest spray-calendars.

LESSON XXVII

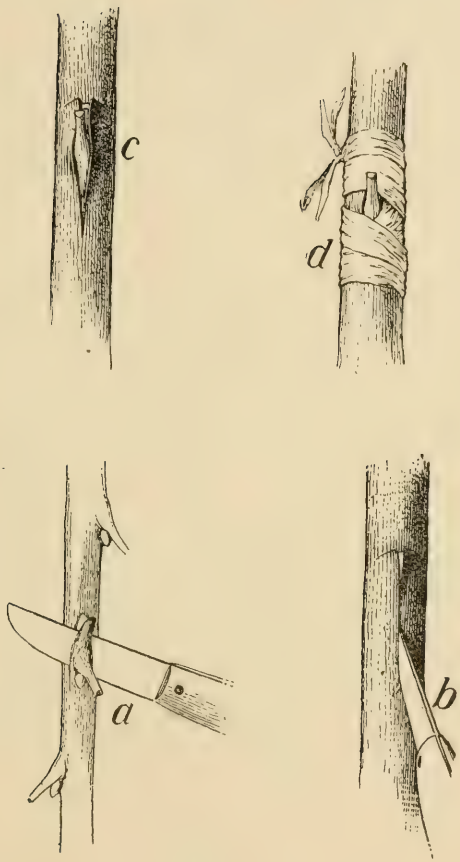
Title.—Budding.
Season.—Early Autumn or early Spring.
Object.—To learn how to propagate fruit trees by budding.
Material.—Sharp knife, raffia or string, and fruit trees.

SUBJECT-MATTER AND METHOD

Budding is such a simple and important farm operation that every boy and girl should know how to do it. Think of changing the little apple-trees in the orchard to any variety of apples you wish! This is exactly what budding is for. This change can be made on branches as small as lead pencils, or as large as the thumb. The nurseryman buds the little trees a few inches above the surface of the ground. The fruit grower top buds the little trees, two or three feet above the ground.

The class may go to a young orchard near the school for this lesson, or several branches of young trees may be brought into the school-room.

1. Choose the place for the bud. Make a horizontal cut across the stem, just through the bark. Then beginning in the middle of the horizontal cut, draw the knife straight down making a vertical cut. (See figure b). Twist the knife sidewise before drawing it out, in order to loosen the bark. The stock is now ready for the bud.



BUDDING
(Courtesy of Cornell Leaflets.)

2. Take the buds from bearing trees of the variety you wish. Cut twigs that have grown this year. The leaves are still on them. At the base of each leaf, and between the leaf and the branch, you will find a little bud. This is the bud to insert into the tree which has been prepared as above described.

3. Cut the leaf off about a quarter of an inch above the bud, thus leaving the leaf stock as a handle for the bud. The end buds should not be used. Beginning with a sharp knife below the bud, cut upwards just through the bark, beneath the bud and above it about half an inch. Be sure to cut through the bark, but not into the wood. (See figure a).

4. Push the bud down into the cut made into the stock, using the leaf stalk as a handle. Be sure that the entire bud is shoved into the incision. If a portion of bark should project above, cut it off. (See figure c).

5. The bud is now ready for tying. Raffia is the best material to use, but ordinary string may be used. Begin below the bud and wrap the wound entirely, except where the bud is. Wrap it snugly and tightly, and then tie securely. (See figure d)

6. In two or three weeks the bud will have "stuck", and the string may then be removed. The bud will remain dormant in the winter and begin to grow in the next spring.

LESSON XXVIII

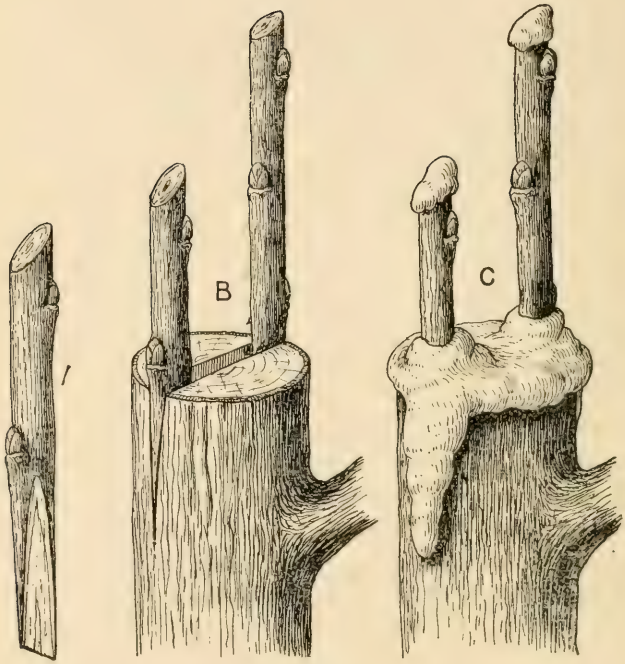
Title.—Grafting.
Season.—Spring or Autumn. A good Winter lesson.
Object.—To learn how to propagate fruit by grafting.
Material.—Sharp knife, grafting wax, strings, and fruit trees.

SUBJECT-MATTER AND METHOD

By a process known as grafting, you can force trees to produce whatever variety of apples you desire. There are two methods of grafting,—the tongue or whip graft and the cleft graft.

1. The tongue graft.

If the class can not plan to go to an orchard for this lesson, bring several branches of apple trees into the school room. Choose a stock upon which you intend to graft the desired variety. Then select from the variety desired, a twig that is about the thickness of the young tree at the point where you wish to graft. Be careful to select the shoot or scion from a healthy part of the tree. Cut the scion and stock as you would the mouth parts of a boy's whistle. Join the cut end of the scion to the cut end of the stock. When you join them, notice that under the bark of each is a thin layer of soft, juicy tissue. This is called the cambium. To make a successful graft, the cambium in the scion must exactly join the cambium in the stock.



CLEFT GRAFTING

A—Prepared scion; B—Scions in place; C—Graft waxed over.

After fitting the parts closely together, bind them with string that has been coated with grafting wax. This wax is made of equal parts of tallow, beeswax, and linseed oil. Smear the wax over the whole joint, and make sure that it is air-tight. February or March is perhaps the best time to do this work.

2. The cleft graft.

For the grafting of larger scions or for the grafting of scions of various kinds of apple-trees upon the branches of one stock, the cleft-graft method is used. The stock is cut squarely across, and the scions, either one or two, are cut into wedges at the end, and slipped into a cleft of the stock. The cambium of the scions must come in contact with the cambium of the stock, as in the former method. After the scions are forced into the cleft of the stock, the whole exposed surface, and the cleft left open, should be covered with the grafting wax. (See figure.)

Trees may be budded or grafted upon one another only when they are nearly related. There are some rare exceptions to this rule.

Have pupils write a description of these methods and make drawings of the grafts. Each pupil in the class should make these grafts for himself, and if possible, the work should be done in the orchard.

LESSON XXIX

Title.—Spraying for San Jose Scale and other Sucking insects.

Season.—During the dormant season of plants.

Object.—To learn how to spray for San Jose Scale and other sucking insects.

Material.—Spray pump, ½ pound of hard soap, 2 gallons of kerosen, water, and the fruit-tree with the scale.

SUBJECT-MATTER AND METHOD

With this lesson, as with a preceding one, it may not be possible in the rural school to demonstrate the actual work of spraying, but the teacher should make every effort to have the school officials purchase a spray-pump in order to demonstrate these important lessons.

The San Jose scale is one of the most dreaded enemies of the fruit-tree. It is an illegal act to sell fruit-trees affected with it. This insect is very minute, yet it spreads so rapidly that it soon covers the branches of the trees with a whitish scale, beneath which is the living pest, sucking the life from the tree. Probably the best thing to do when one finds that the scale has found his fruit-trees, is to promptly burn the tree affected. By vigorous spraying with kersone emulsion of 15% strength, one may keep them in check.

If possible the teacher may have the class help to mix up the emulsion, either on a large scale, as given in the formula below, or in small quantities with the same proportions. The usual formula is as follows:

Kerosene Emulsion.

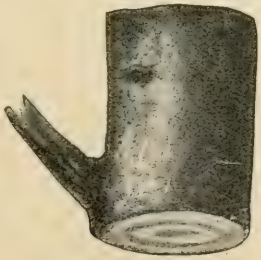
Hard soap (in fine shavings)	½ pound.
Water	1 gallon
Kerosene	2 gallons.

Dissolve the soap in boiling water, add kerosene to the hot water, churn the mixture to a creamy consistency, and in order to get a 15% oil emulsion, add 10 or 15 gallons of water. The mixture is now ready for the spray-pump.

For a school-room demonstration, the following proportions may be made up:

Soap	1 oz.
Water	1 pt.
Kerosene	2 pt.

This proportion, diluted with two gallons of water, will make a spray which may be used on house or garden plants to rid them of plant lice, or other sucking bugs.



SAN JOSE SCALE

LESSON XXX

Title.—Collections of the Products of the Neighborhood.

Season.—Autumn.

Object.—To learn and classify the products of the neighborhood.

Material.—All the material collected, bottles, strings, and labels.

SUBJECT-MATTER AND METHOD

Try to get small bundles of each of the grains raised in the community, viz., wheat, oats, rye, corn, cowpeas, clover, and any other crop raised for its seed. Have the pupils each bring a few culms of these and a collection will soon be made. Each bundle should be labeled as follows:

Name of plant. Date of collection. Name of collector. The collection should be acompanied by samples of the mature seed, put up in bottles of uniform size, and labeled as above.

All the grasses and clovers used as hay may be collected in the same way. Arrange the exhibit on the wall or in a frame in as artistic a manner as possible.

A day could be set apart when the fruits and vegetables, as well as the farm products of the neighborhood, can be exhibited. Awards and prizes might be

offered, thus making the school a new center of interest in the community.

As much of the collection as can be made permanent, should be made so and kept at the school during the term.

The collection and arrangement of this material will furnish a valuable lesson, and give opportunity to develop intelligent exhibitors.

LESSON XXXI

Title.—Habits of the Common Weeds.
Season.—Autumn.
Object.—To study the habits and methods of treating some common weeds.
Material.—A collection of weeds.

SUBJECT-MATTER AND METHOD

Weeds are everywhere, and their disadvantages are well known. Select some of the most troublesome weeds in your community, and make the following study, filling out the table below:

Name of the Weed.

1. Kinds of soil in which it thrives best.
2. Calculate number of seeds, if a seed-bearing weed.
3. How are the seeds scattered?
4. When ripe?
5. At what time in the growing season do they germinate?
6. Does the young plant grow rapidly or slowly?
7. What kind of roots does the plant have?
8. When you pull it up does a new plant come from the same place?
9. Does plowing through a patch of weeds increase their number?

FOUR COMMON WEEDS
a—Amaranth. b—Crab grass. c—Rag weed. d—Pigeon grass.
(Courtesy of Purdue University.)

10. Does the weed have any natural check, such as birds, insects or live stock eating the foliage?
11. Weeds can be killed out in one of two ways, either by preventing the formation of seeds, or by preventing the growth of the foliage. Which of these methods is best suited to the weed in hands?
12. What garden or field crop does this weed injure? How do they injure?

Answer these points for a half-dozen different kinds of weeds, and preserve your specimen in the school for reference. Learn the names of 12 or 15 common weeds.

Write to the Department of Agriculture at Washington, D. C. for Farmers' Bulletin No. 28, on Weeds and How to Destroy Them, and for a reprint from the Year Book of 1898, entitled, Birds as Weed Destroyers.

Note.—Some weeds are difficult to eradicate because they have large fleshy roots, that send up new sprouts as soon as the top is cut off. Others are fully as troublesome because they have underground stems that run along just beneath the surface. Still other weeds persist because they can ripen an immense amount of seeds. The way to kill the weeds of the first and second class is to cultivate so thoroughly as to kill the sprouts as they appear. If this is done thoroughly for about three months, all the substance in the underground storehouses will be used up and the weed must die. The way to destroy weeds of the third class is to prevent them from seeding. Determine to which class your troublesome weeds belong.

LESSON XXXII

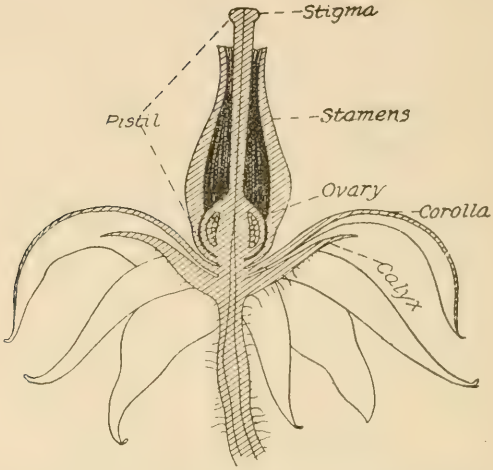
Title.—The Flower.
Season.—Autumn or Spring.
Object.—To study the flower and its life relation.
Material.—Any simple, complete flower, hand lens, note book, and pencil.

SUBJECT-MATTER AND METHOD

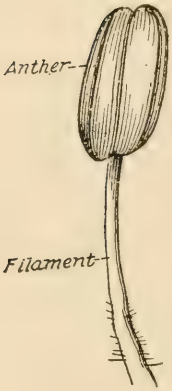
However much the flowers serve to beautify the world, and increase man's enjoyment, that is not their chief use.

The fruit of the plant bears the seed, and the flower produces the fruit. That is the chief duty of the flower. Every plant that produces seed has flowers.

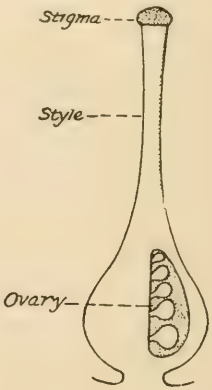
Let us see what a flower is. Take for example a buttercup, cherry blossom, or the violet. You will find on the outside a row of green leaves enclosing the flower when it is still a bud. These leaves are called **sepals**. Next on the inside is a row of colored leaves, or **petals**. Arranged inside of the petals are some threadlike parts, each with a knob on the end. These are the **stamens**. Examine one stamen closely. On the tip at its knob you should find, if the flower is fully opened, some fine grains of powder. This substance is called **pollen**, and the knob on the end in which the pollen is borne is called the **anther**. The



VERTICAL SECTION OF A TOMATO BLOSSOM
(From Burkett et al., Ginn & Co.)



A STAMEN



A PISTIL

pollen is very important to the flower. Without it there could be no seed. But there is another part to each flower that is of equal value. This part you will find in the center of the flower, inside the circle of stamens. It is called the **pistil.** The swollen tip of the pistil is the **stigma.** The swollen base of the pistil forms the **ovary.** If you carefully cut open this ovary, you will find in it very small unripe seeds.

In the corn and many others, the stamens and pistils are separate. In some plants these parts occur on separate individuals.

Now no plant can bear good seeds unless the pollen of the stamen falls upon the stigma. The wind and the insects help to carry the pollen to the stigma.

Fill out the following table for this lesson on flowers:

Name of Flower.	No. of Sepals.	No. of Petals and Color.	No. of Stamens.	No. of Pistils. Seeds many or few.
1.				
2.				
3.				
4.				

Make a drawing of each of the parts of the flower and of the whole flower.

LESSON XXXIII

Title.—The Wheat Crop.

Season.—Autumn or Spring.

Object.—To learn the nature and requirements of the wheat crop.

Material.—A wheat field for the class to observe some wheat culms, grains, and growing plant in the School-room.

SUBJECT-MATTER AND METHOD

Plan to take the class to a wheat field in late spring or early autumn. Let the following points be brought out by way of introduction:

Wheat has been cultivated from the earliest times. This crop ranks third in value in the United States. It grows in cool, temperate, and warm climates, and in many kinds of soil. It does best in clay loam, and poorest in sandy soils. Examine the soil of the crop before the class, if you are in the field. The soil must be well drained, and in a good physical condition,—that is it must be open, crumbly, and mellow. Hard clay soils can be made valuable for wheat by covering the surface with manure, by good tillage, and by crop rotation. Cowpeas or red clover make a valuable crop to precede wheat; for they add nitrogen to the soil, loosen the soil and allow free circulation of air, and add humus to the soil, when plowed under or decayed.

Pull up a single wheat plant and see the extent of the root system. From one to two inches is the most satisfactory depth for planting wheat. A mellow soil, with a compact subsoil, is the most desirable for wheat culture.

There are a great many varieties of wheat; some are bearded some are smooth; some are winter varieties and some are spring varieties. All may be improved by careful seed selection.

The seed drill is the best implement for planting wheat.

A study of the crop will show what sort of fertilizer is needed. If the straw is inferior and short, the soil is deficient in nitrogen; but if the straw be luxuriant and the heads small and poorly filled, the soil contains too little phosphoric acid and potash.

A few wheat seeds should be planted in pots in the school-room in time before this lesson, so that the growing plants may be observed.

Make a drawing of a wheat stem and its entire root system.

LESSON XXXIV

Title.—The Corn Crop.
Season.—Autumn or Spring.
Object.—To study the nature and requirements of the corn crop.
Material.—A field of corn for observation, or the growing plants in the school-room.

SUBJECT-MATTER AND METHOD

In former lessons the selecting and testing of seed corn has been studied and in this lesson the cultural requirements are to be noted. Take the class to a field of corn, either in the late spring or early autumn, and there discuss with the pupils the following points:

Corn is king of the cereals, and the most important crop of American agriculture. It is the backbone of farming in this country. The white man learned the value of this cereal from the Indians, and since then its culture has kept pace with the wonderful growth of our country.

A rich humous soil, loose, warm, and moist, will produce a better crop of corn than any other. The proper time to begin the cultivation of corn is before it is planted. Plow deeply. Harrow the surface mellow and fine. Plant with the horse planter, either in hills or in drilled rows. A few days after planting, the cornfield should be harrowed with a fine-toothed

harrow to loosen the surface soil, and to kill the grass and weed seeds that are germinating. When the corn plants are from a half inch to an inch high, the roller and narrow shoveled cultivator should be used.

Corn is a crop that needs constant cultivation, and during the growing season should be cultivated at least four times. This cultivation is for three reasons:

1. To destroy weeds that take plant food and water.

2. To provide a soil mulch to prevent evaporation.

3. Because tillage is a fertilizer. Constant stirring of the soil allows the air to circulate, and provides available plant food.

Deep culture of corn is not advisable.

While in the field, have the pupils examine the soil, the depth of cultivation, the corn roots, and the thriftiness of the crop.

The stalks ought always to be saved; for they make valuable food for horses, cattle, and sheep.

Have pupils write a paragraph on corn culture after the discussion of this lesson. Ask them to consult the farmers for additional points.

Report as follows:
When plowed?
How deep?
How prepared for planting?
How much seed used?
What kind of a seeder?
How harvested? When?

LESSON XXXV

Title.—The Roots of Corn and Clover.

Season.—Whenever available.

Object.—To learn the nature and habit of the roots of corn and clover.

Material.—Earthen pots with the growing corn and clover plants.

SUBJECT-MATTER AND METHOD

By growing the corn and clover in pots, the early stages of the root may be studied, and by going to the field in September, the matured roots may be seen.

Carefully wash the soil from the young roots, and spread them out upon a sheet of paper. Get a root from the mature plants and have it before you for comparison.

Note the following points of the corn root, and tabulate your answer below:

1. Length and number of principal roots.
2. Amount of branching from any one root.
3. Direction in which the roots extend from the base of the plant.
4. Amount of cubical space used as feeding ground.
5. How near the surface do the roots lie?
6. Difference between spur roots and the others. Reasons.

7. Can you find root-cap and root-hairs?

8. Does your observation lead you to any conclusions about the cultivation of corn? Explain.

Make a similar study and tabulation for the clover roots upon these points:

1. Do you find any nodules on the clover root?
2. Of what use are these nodules said to be?
3. Were there any nodules on the corn roots?
4. Which of these plants has a tap-root?
5. From this lesson can you see why crops should be grown in rotation?

Make a drawing in your note-book of the corn and clover root system.

(Adapted from Fisher, Purdue University.)

LESSON XXXVI

Title.—Suckers on Corn and the Stooling Habit of Wheat.

Season.—At any time.

Object.—To study the stooling habit of wheat, and the growth of suckers on corn.

Material.—Box of soil in which are growing the wheat and corn plants.

SUBJECT-MATTER AND METHOD

If it is not possible to make this study in the fields, the corn and wheat may be grown in rich soil in doors.

With a stiff knife or trowel, raise a wheat plant from the soil without breaking off many of the roots. Try to find the grain from which the plant started. Find the first joint above this grain.

Do you find more than one plant starting from this joint?

All but the central one of these are stools.

Do the stools seem to be as strong as the central plant?

Does the thickness of the stand seem to have anything to do with the amount of stooling?

Is the stooling greater in rich soil or in poor soil?

Is a large amount of stooling desirable? Why?

What are your conclusions as to the quantity of seed to be sown?

Are the suckers on the corn examples of stooling?

Are the suckers beneficial or harmful to the corn plant? Why?

Write answers to these questions in the permanent note-book.. Make drawings to show the stooling habit.

LESSON XXXVII

Title.—Plant Propagation from Cuttings.

Season.—Any season when plants are available.

Object.—To learn plant propagation by means of the "cutting" method.

Material.—A window box of rich soil in the schoolroom, and cuttings from begonias, wax plants, coleuses, geraniums, verbenas, etc.

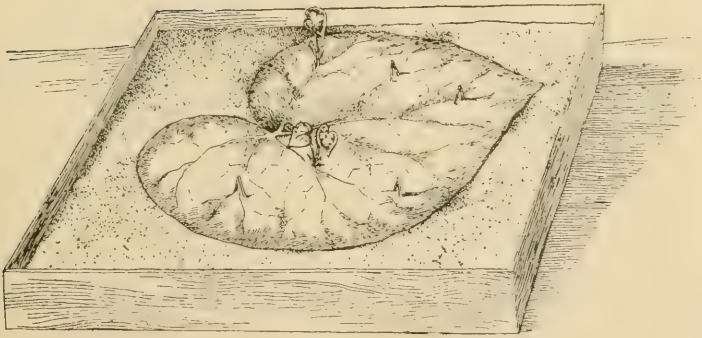
SUBJECT-MATTER AND METHOD

The teacher or the pupils may bring soft cuttings from the stem or leaf of house-plants at home, if none are available at the school. The window box, which should be a permanent fixture in all the course in elementary agriculture, should be supplied for this lesson with moist sand, and kept in a warm place

The leaves of the Rex begonia and wax plant may be propagated by inserting the edge of the leaf or even a piece of the leaf in sand and supplying it with plenty of moisture and warmth. A leaf may be laid flat, right side up, on the surface of the sand, and fastened down by splinters through the veins at intervals. Plants will spring up at the bottom edges of the leaf or at cut places in the veins.

Stem cuttings are easily made from the coleus, geranium, verbena, tomato, and numerous other herbaceous plants. Take thrifty shoots from any of these

STEM CUTTING, OR SLIP, OF COLEUS



LEAF CUTTING.—WHOLE LEAF

plants, and divide them into cuttings having at least two nodes and several leaves. Take off about half of the leaves, insert the cutting in moist sand about half of its length, and press the sand firmly about it.

Keep the sand warm and moist and watch the development from day to day.

Poplar and willow are trees that will propagate easily from cuttings.

Make drawings of the propagations after the roots and sprouts are well started.

LESSON XXXVIII

Title.—Plant Stems.

Season.—Any season. A good Winter study.

Object.—To study the growth and structure of the different kinds of plant stems.

Material.—Stems of corn-stalk, and branches of fruit-trees.

SUBJECT-MATTER AND METHOD

Give to each pupil a section of corn-stalk and of a tree stem about six inches in length.

Compare the cross sections of the two stems. Note that in the corn-stalk the woody fibres are scattered irregularly through the pith, while in the tree stem the wood is arranged in circles around the pith. Make drawings of the cross sections to show this.

Cut the stems into longitudinal sections, and make drawings to show the arrangement of the wood and pith.

These two kinds of stems represent the two great groups of flowering plants having closed seed vessels, —monocotyledons and dicotyledons. The corn stem belongs to the former, and the tree stem to the latter. The grasses, lilies, palms, etc., are monocotyledons, and the trees, most of the weeds and grains of this section are dicotyledons.

Fill out the table below with several examples of the kinds of stems indicated:

STEMS ON THE BASIS OF HABIT OF GROWTH.

Erect.	Twining.	Prostrate.	Underground	Condensed bulb stem.	Stemless.

1. What purposes do stems serve to the plant?
2. For what purposes do plant stems serve man?
3. Name the other parts of the plant attached to the stem.

LESSON XXXIX

Title.—Leaves.

Season.—Autumn or Spring.

Object.—To learn something of the structure and function of leaves.

Material.—Leaves of corn, trees, weeds, etc., glass tumblers, and water.

SUBJECT-MATTER AND METHOD

The main object to be brought out in the study of this lesson is the great work that leaves have to do, and the important relations they sustain to the life of the plant.

Pupils should copy and learn the following points:

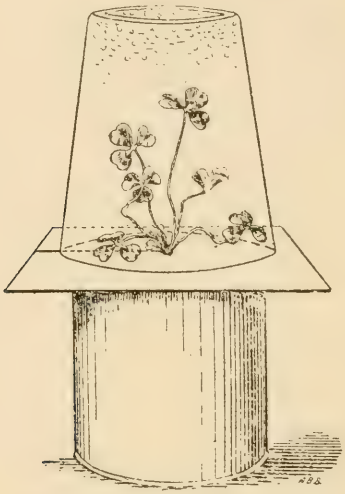
1. Leaves spread out a great surface through which the plant takes in oxygen, necessary for its life and growth.

2. Through this expanded leaf-surface the carbon-dioxide gas of the air enters, and in the sunlight the green leaf makes plant food out of the carbon-dioxide and the minerals brought up in solution from the soil. As one result of this process in the leaf, oxygen is set free.

3. After the leaf has used all the food-material needed from the sap-solution brought up from the soil through the roots and stem, the excess of water is thrown off by the leaf. This is called **transpiration.**

These are the three principal uses of the leaves to the plant. Plant food is manufactured in the leaf in the form of starch, and sent out to the various parts of the plant, there to be changed into root, stem, leaf, and fruit structure.

Make a drawing of a simple leaf, such as the maple leaf, and also of a compound leaf, such as the locust leaf.



TRANSPIRATION IN LEAVES

The following experiment will show that plants give off moisture:

Take a plant that is well started in a flower-pot, a piece of cardboard, and two glass tumblers large enough to cover the plant. Cut a slit in the cardboard and draw it around the plant. Seal the slit so that no moisture can come through

it from below. Cover the plant with the glass, and allow the roots to extend into the water of the glass below. Moisture will collect on the inner surface of the glass. Where does it come from? Is all the moisture absorbed by the roots given off in this way? How could you find out? Why do plants need water?

LESSON XL

Title.—A Study in Fruits.

Season.—At any time when the fruit can be had.

Object.—To learn the structure and classes of our common fruit.

Material.—For each pupil, two apples, two pears, and a few peach pits; some quince and plum pits if possible; a drawing pencil and a knife.

SUBJECT-MATTER AND METHOD

1. Let each pupil take an apple and a pear and observe the blossom end, opposite the stem. Here is a depression called the **basin.** This was the base of the apple and pear blossom. Compare with the blossom end of the peach or plum. Explain the difference.

2. Let each pupil cut the fruits through the center, in a plane perpendicular to the main stem. Examine the core, the cells and the seeds. How many cells are there? How are they arranged? Observe the parchment-like walls of the cells. How many seeds in each cell? Make a drawing of the cross section of the pear or apple.

3. Compare the structure of the plum or peach pits with the apple seeds. Note the hard shell-like covering of the pits. Crack the shell and observe the seed. In this meaty portion lies the embyro, which

will grow into a new plant under proper conditions of air, heat, and moisture. Draw cross section of the peach.

These fruits belong to the two classes which comprise our common fruit-trees.

1. The Pomaceous fruit:

   Apple, pear, crab apple, quince, etc.

2. The Drupaceous fruit:

   Plum, peach, cherry, etc.

Answer the following questions:

1. What fruits have a depression at the blossom end?

2. What fruits are more or less rounded at the blossom end?

3. What common fruits have seeds?

4. What three common fruits have pits?

5. How much space does the core take up in the apple?

How many cells in the core of the apple?

7. How do pits and seeds differ in structure?

8. What are the general differences between a pome fruit and a drupe fruit?

LESSON XLI

Title.—Decay in Apples.

Season.—At any time. May be a Winter lesson.

Object.—To show that apples should not be shaken from the tree and allowed to fall to the ground if they are to be kept. (Adapted from Davis).

Material.—Three ripe apples, and weighing scales.

SUBJECT-MATTER AND METHOD

Select three ripe apples of the same variety and of equal degree of ripeness and bring them before the class.

1. Strike against the side of one so as to bruise the surface but not break the skin.

2. Bruise the second apple so that the skin is broken.

3. Leave the third apple uninjured.

Place the three apples away somewhere in the room where they will not be disturbed, and observe the results from day to day.

1. Which apple decays first?

2. Of what use is the skin of the apple?

3. Take two apples of nearly the same size, and weigh both. Peel one and leave the other untouched. Weigh both apples again in twenty-four hours. Which has lost the most in weight? Explain the cause.

Note.—If there are no scales in the school, ask some pupil to bring this instrument from his home.

LESSON XLII

Title.—Judging Apples.
Season.—At any time. May be a Winter study.
Object.—To learn how to judge and score apples.
Material.—Apples, pencil, and note-book.

SUBJECT-MATTER AND METHOD

Ask the pupils to bring a number of apples to school for this lesson. If each pupil should bring four or five of the same variety of apples, they may be arranged on a plate before the class and scored as an entry exhibit. Use the following score points, adapted from Davis Agriculture:

SCORE CARD FOR JUDGING APPLES.

Onwer of the exhibit ..... Date .....

Points Noted.	Perfect Score.	Teacher's Score.	Pupil's Score.
Size of the exhibit	20		
Size of fruit.	15		
Color.	15		
Form.	15		
Quality.	15		
Freedom from Blemishes	20		
Total	100		

When single plates or apples are scored the first point may be graded the full 20 points.

LESSON XLIII

Title.—Pruning.
Season.—May be a Winter or early Spring lesson.
Object.—To learn how to prune fruit-trees.
Material.—Fruit-trees and a sharp knife.

SUBJECT-MATTER AND METHOD

Go with the class to an orchard. If this is not possible, bring into the school-room a large branch of a fruit-tree, and treat it as a small tree to be pruned.

Look about in the orchard and try to find places on the trees where branches have been pruned off. See whether those cut close to the main stem or those cut a little way from it healed over more readily. What does your observation teach you as to the place to cut a branch in pruning?

Would you use a saw or knife in pruning the branches?

How could you keep a large limb from splitting down as it fell?

How could you protect the wound, where a large limb was pruned?

Which is the best time of the year to prune? Why?

Note.—In pruning very young trees, two methods are usually pursued:—

First, the method of cutting off all the side

branches to one or two buds, leaving a single straight central stem.

Second, the method of cutting away all of the branches but three or four main ones which are left to develop into a more or less spreading growth.

It is best to leave the branches growing rather low, in order to afford a better shade for the trunk and ground beneath, and in order to facilitate the gathering of the fruit.

We prune for the following reasons:

1. To modify the vigor of the plant.
2. To produce larger and better fruit or flowers.
3. To keep the plant within manageable shape and limits.
4. To remove superfluous or injured parts.
5. To facilitate spraying and harvesting.
6. To facilitate tillage.
7. To make the plant assume a more desired form.

Mild pruning every year tends to maintain the balance of the tree and make it more fruitful.

Select a tree that needs pruning, and demonstrate before the class the proper method of pruning it. If the teacher does not wish to make this demonstration, perhaps the owner of the orchard or some other fruit-grower could be called into service.

LESSON XLIV

Title.—A Hotbed Garden.
Season.—Early Spring.
Object.—To learn how to make and plant a hotbed.
Material.—Spade, some boards, manure, and window sash.

SUBJECT-MATTER AND METHOD

The teacher may look at this lesson and think that it would be too much trouble to work it out; but the results of the experiment would justify the effort, and it can be successfully done.

As early as March select a place at the south side of some building for the hotbed. Dig an oblong space three feet wide, six feet long, and eighteen inches deep. Make a wall of posts and boards, fitting close to the sides of the bed. Make the back wall three feet high and eighteen inches above the surface of the ground. A piece of two-by-four joist set in from back to front across the middle, will make a support for the window sashes which are to cover the bed. When the bed is ready, put in a layer of strawed manure that has been piled for some time, fill in about nine inches of the manure and tramp it down firmly. Then add a second layer of nine inches, and tramp firmly as before.

Then spread four inches of rich garden loam over the manure, and the bed is ready. Perhaps some of the pupils can bring whole window sashes from home to cover the bed. Two sashes three feet square would make the necessary cover.

Early lettuce, radishes, Early Jersey Wakefield cabbages, the Earliana tomato, onions, and other vegetables may be sown thickly in rows about four inches apart, and by the time warm weather comes, the school will have plants to supply the neighborhood, the children will have seen many interesting things, and the school will have found a new source of co-operation with the home.

In the hotbed the manure warmed the soil, and the glass kept the heat in the frame. The soil should be watered every few days, and on the bright days the sash should be raised to admit fresh air to the little seedlings.

Have the pupils draw the plan of the hotbed, and describe the preparation and planting.

LESSON XLV

Title.—Field Study of the Common Grains.
Season.—Summer or Autumn.
Object.—To compare the common field crops.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Go to the field some evening at four o'clock with the class in agriculture. Have the pupils take the following table of directions for field work, and make the necessary tabulations in the field. Other points of the table may be filled in after the discussion of the lesson on the following day:

Name of the Grain.	Height.	No. of Blades.	No. of Kernels.	Joints in the Stalk.	Time of Planting.	Time of Harvesting.	Weight Bu.
Corn.							
Wheat							
Oats							
Rye							
Barley							

LESSON XLVI

Title.—The Best Corn in the Community.

Season.—At any time.

Object.—To find out who has the best corn in the community.

Material.—The corn and scales at home.

SUBJECT-MATTER AND METHOD

Have each pupil weigh out one bushel of corn in the ear at home and bring the weights to school. Let the pupils tabulate the results as follows

Let each pupil copy the weights and data of all the others.

Pupils' Names.	Weight of Bushel.	No. of lbs. Overweight.	Per cent Overweight.	Lbs. of Underweight.	Variety.

LESSON XLVII

Title.—Propagation of Raspberries.
Season.—Autumn.
Object.—To learn the method of propagation in the black and red raspberry.
Material.—Red and black raspberry plants.

SUBJECT-MATTER AND METHOD

Go with the class to a garden or field where the black and red raspberry grow. Call attention to the fact that the black raspberry bends over and that the tip takes root in the ground and propagates in this way. If none have taken root in this way, a stalk should be bent over and covered with earth to allow the tip to take root.

Notice that the red raspberry does not bend over and root at the tip as the black raspberry does, but that new stalks spring up at intervals from the root under ground. The red raspberry thus spreads rapidly and if left to itself will spend its energy in growing canes rather than producing berries. This can be prevented by cutting off all the new shoots but two or three for the next year's growth.

Show the pupils how to prune both varieties in the spring in order to have the canes produce the most and best berries.

Cut away the last year's canes. Cut the canes

of the black raspberries that have bent over and taken root, so that there shall be two individual canes instead of the single one rooted at both ends.

After the field lesson, have the pupils write a comparison of the two raspberries as to habits of growth and propagation basing their description on the observations in the field.

LESSON XLVIII

Title.—Raising Cucumbers in the Garden.
Season.—Spring or Summer.
Object.—To show how to prepare and plant a productive cucumber bed.
Material.—A barrel, spade, manure, and cucumber seeds.

SUBJECT-MATTER AND METHOD

If it is desired, this lesson may be demonstrated upon the school-grounds, or in a garden near the school, where permission is granted.

The boys of the class may do this work under the direction of the teacher and for the observation of the class. Select a fertile spot and dig a hole in the ground large enough to sink the barrel midway. Knock the bottom out of the barrel, and set it in the hole in the ground. Fill the earth in about the outside of the barrel, and mound the soil up to the rim of the barrel on the outside. Now fill the barrel with manure, packed firmly, and keep it covered to prevent the house flies from breeding in it.

The bed is ready for planting. Plant five or six hills of cucumber seeds in the mound heaped up about the outside of the barrel. Put about ten seeds in a hill, and when the plants get large enough to vine, remove half of them.

Pour several pails of water into the barrel of manure each day, and the water leaching through the compost, will furnish the best of fertilizer for the plants, and the necessary moisture for their thrifty growth. These few hills will furnish an abundance of cucumbers, and upon a very small space of ground.

If this lesson cannot be demonstrated at school, it is worth the study in order that it may be worked out at home by the pupil in the home garden.

LESSON XLIX

Title.—The Pea Family.

Season.—Spring or Autumn.

Object.—To learn the leguminous plants and their value.

Material.—Some hand lenses, blossoms or pods of beans, peas, and clover, and an entire clover plant showing nodules on the roots.

SUBJECT-MATTER AND METHOD

The group of plants most important to mankind is the great grass family, which includes corn, wheat, oats timothy, and others.

The second group in importance is the pea family. These plants are commonly called leguminous plants. Preceding lessons have referred to the great value of the clover and the cowpea. Their great value to the soil is in furnishing a congenial home for the bacteria, (which are microscopic plants) causing the nodules on the roots. In some way these bacteria take nitrogen from the air, so that it becomes available food for the growth of the plant. These bacteria do not live on the roots of any common plants except the legumes.

The reason why this is so important a subject, is because nitrogen is the most expensive thing that the farmer buys in fertilizers.

LEAVES OF LEGUMINOUS PLANTS

1, Bean. 2, Hairy or winter vetch. 3, Pea. 4, White clover. 5, Red clover. 6, Alsike clover. 7, Sweet pea blossom. 8, Peanut. 9, Black locust. 10, Sweet clover. 11, Alfalfa. 12, Soy bean.

(Courtesy of Cornell Rural Leaflet.)

If the bacteria are not in the soil where the legume is to grow, the soil may be inoculated by sprinkling it with soil from a field where the legume has formerly grown.

Specimen roots of the clover showing the nodules should be before the class for observation. Any text in Elementary Agriculture will explain the work of bacteria on the legume roots in further detail.

The important thing here is to learn to recognize the leguminous plants. If the class cannot be taken to the field for this lesson, the following plants may be brought into the school-room: clovers, alfalfa, peas, beans, vetch, black locust, and all plants available with pea-like flowers.

The following outline for study is suggested:

1. How are the leaves arranged?

2. Are the leaves simple (all in one piece), or compound (divided into several leaflets)?

3. What two kinds of compound leaves? Draw one of each, as the pea and clover.

4. Describe the flower, recalling the names and parts learned in a former lesson on the flower.

5. Make a drawing of the blossom.

6. Split a bean or pea pod. How does it open?

7. Make a list of the legumes of the neighborhood.

Write to Department of Agriculture, Washington D. C., for sample of inoculating bacteria.

LESSON L

Title.—No Two Plants Alike.

Season.—Autumn.

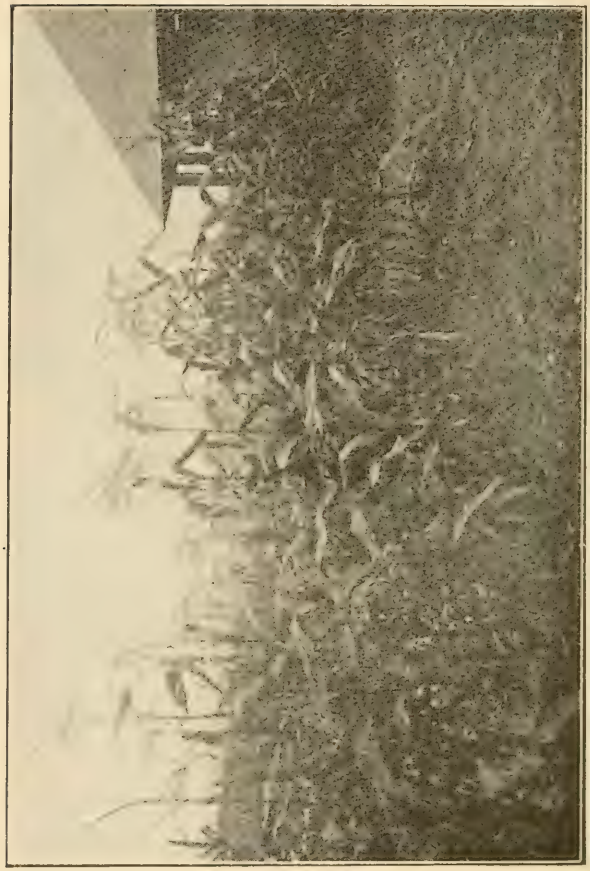
Object.—To show the great fact of variation, that no two plants or animals are alike.

Material.—Any two or more plants of the same kind. A number of stalks of corn, grass, wheat, or a number of trees. Any two plants anywhere give the facts.

SUBJECT-MATTER AND METHOD

The method is to see a plant accurately and then compare it with another plant of the sane kind. Let any two stalks of corn be held up before the class; or, if the pupils are in the field, each one may select two stalks for comparison. Allow no guessing. Measure and observe accurately. Look for the following points:

1. Height of the plant.
2. Does it branch? How many secondary stems or suckers from one root?
3. Shade or color.
4. How many leaves?
5. Arrangement of leaves on the stem.
6. Measure length and breadth of six main leaves.
7. Number and position of ears. Color of silks.



NO TWO PLANTS IN THIS ROW OF CORN ALIKE
(Courtesy of Cornell Rural Leaflets.)

8. Size of tassel, and number and size of its branches.

9. Stage of maturity or ripeness of the plant.

10. Has the plant grown symetrically, or has it been crowded by other plants, or been obliged to struggle for light or room?

11. Note all the unusual marks or features.

12. Note the comparative vigor.

These points may be used with any two plants with slight modification.

(Adapted from Bailey in the Cornell Rural Leaflet.)

LESSON LI

Title.—Transplanting.

Season.—Spring.

Object.—To learn how to transplant, and what plants are usually transplanted.

Material.—Some tomato-plants, cabbage-plants, pansies, or other plants in the school-room and a box of soil.

SUBJECT-MATTER AND METHOD

This lesson should be given in connection with the school garden if possible, but if there is no school garden, the transplanting may be done as a demonstration in a window garden indoors.

The plants usually transplanted are the tomato, cabbage, celery, pansy, and young trees.

If the hotbed has been made at the school there will be plenty of material available, and it is an important and practical lesson to learn. The following rules will guide to successful transplanting:

1. Transplant when the weather is cool and damp, preferable in the late afternoon.

2. Transplant when the plant is young.

3. Break the roots as little as possible in taking the young plant up, and keep them moist and shaded.

4. It is well to cut off some of the top in transplanting, in order to restore the balance between the

root and top, since some of the roots were probably lost in transplanting.

5. The plant should be dipped in water and have moist fertile soil packed firmly about the roots. If water is to be used it should be poured about the roots before all the soil is added.

6. The plant should have as large a space as that in which it originally grew. The soil should be put in first at the bottom of the hole in which the roots are to grow, and the subsoil, if any, at the surface. It is important to make the soil firm about the roots.

7. It is sometimes well to shade the young transplant a few days from the hot sunshine, or to protect the roots with a mulch of straw or grass.

The pupils in agriculture should by all means get some actual practice in transplanting, if in no other way than by going to the school yard and getting wild plants to transplant in pots or in out door plots.

LESSON LII

Title.—The Toad, the Farmers' Friend.
Season.—Any time when toads may be obtained.
Opject.—To learn the value of the common toad.
Material.—A glass tumbler, some mosquito netting, a screen cage and some insects.

SUBJECT-MATTER AND METHOD

The day before this lesson is to be given, the teacher, with the pupils' assistance, should have a box about a cubic foot in size, screened off on two opposite sides with common door-screening, and a little hinged door of some sort made, through which the toads and insects may be put into the box.

Place two toads in the box on the evening before the lesson, and they will be hungry enough to "show off" well for the class. Announce the plan beforehand, and ask the pupils to bring in flies, bugs, butterflies, caterpillars, worms, beetles, etc.

When the lesson is ready to begin, place the box before the class, put all the insects in with the toads, and watch them eat. Such an interesting sight the pupils seldom see. The insects disappear as if by magic, snapped in by the toad's long tongue with lightning rapidity. Have some pupil count how many insects the toad eats during the recitation time.

Place one toad in the glass tumbler, cover with a mosquito netting and pass it around among the pupils, so that all can see the beautiful eyes—, "the fabled jewel" in the toad's head.

While the observation is going on, the following points should be brought out:

The toad does more to rid the garden and field of noxious insects than any one species of bird, and he has solved the problem of insecticides better than man with all his bungling spray-machines.

The toad has a "homeing instinct," and should be placed in yards, gardens and fields, and become one of our most valued domestic animals. A little stone house, containing a shallow jar of water will furnish an attractive home for the toad in the garden, and he will go forth at night like the lubber fiend, to do our tasks while we sleep.

Laws should be passed preventing the small boy from killing all the toads he cares to. The toad is absolutely harmless, and the old wart superstition is mere "bosh," and its ugliness, so-called, becomes transformed into real beauty, when we see its great service in the economy of nature. The fact that the toad sometimes gets into wells, reflects on the thriftless methods of the man who leaves his wells open, rather than upon the thirst of the poor toad which falls in, in its search for the water, the man should provide for it.

In these days of increasing insect pests, it behooves us to encourage and protect all of the natural enemies of our plant destroyers, and a few toads in a

garden will go far toward controlling the cut worms, caterpillars, and the leaf-eating beetles.

The toad is an animal full of vital interest from its egg stage, through the tad-pole development, to the adult, and the horror and disgust with which this harmless beneficial friend is viewed by many boys and girls should be changed to intelligent sympathy and active appreciation in its behalf.

THE TOAD

LESSON LIII

Title.—Types of Horses. The Driving Horse.
Season.—May be a Winter lesson.
Object.—To teach the pupil to see a horse when he looks at him, and to recognize the driving type.
Material.—A driving horse before the class.

SUBJECT-MATTER AND METHOD

By comparing the horses we see on the street, we observe that there are different forms or types. Some have a form that enables them to draw a heavy load at a slow pace, while others have a form adapted to drawing light loads at a rapid pace. These represent two distinct types, and are called, **draft horses** and **driving horses.**

In this lesson we are to study the driving horse. You will observe that the driving horse has a long graceful neck, a narrow chest, long body and legs. In the driving horse weight is not so important as in the draft horse. Speed and endurance seem to be the principal points sought in the roadster. The driving horse varies widely in height and weight.

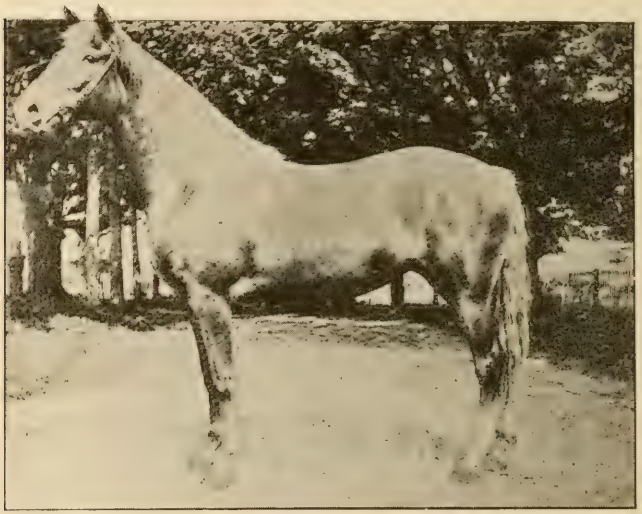
Professor Whipple of the West Virginia State University suggests the following points which any school boy should recognize in a good driving horse:

1. The color is not so important in this type of horses. The dark colors, bay or sorrel are always the most esteemed.

2. Geldings are to be preferred.

3. The horse should be fifteen to sixteen hands high at the withers.

4. **Conformation.** The horse should be harmonious, unblemished, withers rather low, and loins slightly weak, but powerful croup, thighs, buttocks, legs and hocks are essential.



THE DRIVING HORSE

5. The neck should be long, chest wide and deep, limbs clean and long, and muscles and joints showing graceful prominence.

6. The animal should have good life and not be afraid of ordinary objects.

The teacher should study the following score card for light horses, and if the proper explanations be made, pupils of the eighth grade will be able to mark the card and score the horse fairly well:

A WELL PROPORTIONED HORSE

a—Forehead; b—Muzzle; c—Withers; d—Breast; e—Arm; f—Back; g—Belly; h—Hip; i—Hock; j—Croup; k—Dock; l—Knee; m—Cannon; n—Fetlock; o—Pastern.

(Courtesy of Cornell Rural Leaflets.)

SCORE CARD FOR LIGHT HORSE.

Frame—Smooth, evenly proportioned	4			
Quality—Bone clean and hard, tendons well defined, veins prominent, skin and hair fine	5			
Temperament—Active but kind	3			
Head—Lean and symetrical	1			
Forehead—Full and broad	1			
Eyes—Large, clear, open, and bright	1			
Ears—Close together, medium in size, pointed to carry well forward	1			
Muzzle—Clean and fine, nostrils large, lips thin and even	1			
Neck—Muscular, crest high, windpipe prominent	1			
Shoulders—Long, oblique, well muscled	2			
Arms—Short, thrown forward	1			
Fore-arms—Long, wide	2			
Knees—Wide, straight, and clean	2			
Cannons—Short, wide, sinews large	2			
Fetlock—Wide, straight	1			
Pasterns—Strong, angle with ground 45 degrees	3			
Feet—Medium and even in size, horn dense, frog large, elastic, bars strong, sole concave, heel wide	6			
Legs—Viewed in front, a perpendicular from point of shoulder should cut the center of knee cannon, pastern and foot viewed from side, a perpendicular from center of elbow should cut the center of knee and pastern joint and the back of hoof	4			
Withers—Well finished and muscled at top	1			
Chest—Deep, low, large	2			
Ribs—Long, sprung, close	2			
Back—Straight, short, broad, well muscled	2			
Loin—Wide, short and thick	2			
Underline—Short, straight	1			
Hips—Wide, level	2			
Croup—Long, wide, muscular	2			
Tail—Attached high, well carried	1			
Thighs—Muscular, long, and spread	2			
Quarters—Deep and heavily muscled	2			
Gaskin—Muscular, long and wide	2			
Hocks—Clean, wide, straight	5			
Cannons—Short, wide, and clean	2			
Fetlocks—Wide, straight	1			
Pastern—Strong, sloping	2			
Feet—Same as fore feet	4			
Legs—From behind, perpendicular from point of buttock cuts center of hock, cannon, pastern and foot; from side, perpendicular from point of hip should fall on center of foot and divide gaskin in the middle and perpendicular from buttock should be parallel with cannon	4			
Action—Walk quick, elastic, trot rapid, straight, regular and high	20			

LESSON LIV

Title.—The Draft Horse.

Season.—At any time. May be a Winter study.

Object.—To learn, to know, and to judge the draft horse.

Material.—A draft horse before the class. A yard stick or tape line.

SUBJECT-MATTER AND METHOD

Arrange to have a draft horse in the school yard for this lesson.

Call attention to the short legs, heavy body, short, thick neck, broad, deep chest and shoulders, strong hocks and rather large joints and feet. With the draft type weight is one of the most important considerations. A draft horse may weigh from 1,500 to 2,000 pounds. The heavy horse in harness brings greater power into the collar than does the light one.

There are several different breeds of draft horses. The Percherons, Belgians, Clydesdale, and English Shires are the common breeds.

Professor Whipple of West Virginia University suggests the following points that any school boy should recognize in a good draft horse:

1. The best selling colors are: bay, chestnut, brown, roan, black, and iron grey.

2. Body conformation, massive low-set, ample,

very muscular, short-flanked, cylindrical, large and broad limbs, good feet, good face, ardor and endurance.

3. The horse should be at least sixteen hands high at the withers.

4. The animal should be sound, and the following blemishes should always be in mind in examining a horse:

Spavin, curb, thorough-pin, sidebones, splints, sweeney, sprung knees, faulty hoofs, poor eye sight, string halt, poor wind, parrot mouth, blindness, etc.

5. The horse should have good life but be gentle.

While the horse is present for this lesson, some interesting and profitable measurements may be made, which should teach the pupils to recognize good proportions in the horse.

Three important points for measurements are, **length of the head, total length of the body**, and the **total height of the body.**

Use an ordinary tape measure in this part of the exercise.

1. The height of the horse, from the top of the withers to the ground.

2. The height of the horse from the hips to the ground.

3. Length of the body from the point of the elbow to the back of the buttock.

4. The length of the head.

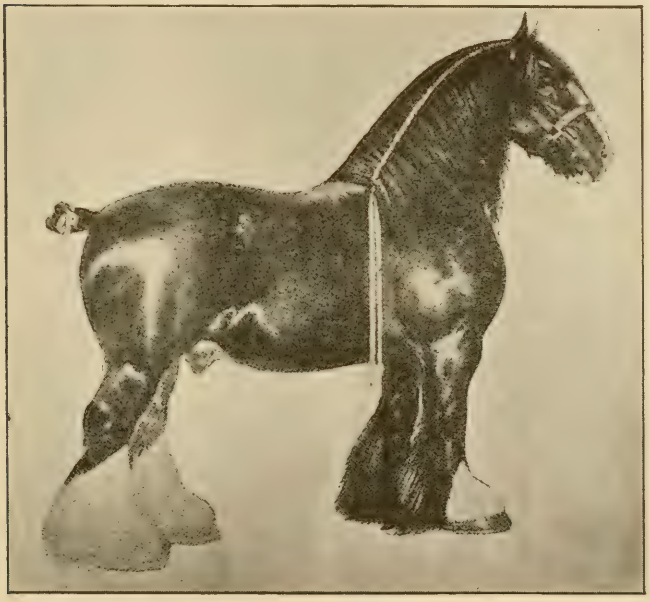
It will be found in a horse of good proportions that the first three measurements each equal about two and one-half times the length of the head.

If we take the total length of the horse's head, and compare it with the body of a well formed horse, we will find that there are four other measurements almost exactly equal to it as follows:

1. The length of the neck from the top of the withers to the poll. If there is much difference between these measurements, we say that the head is too long or the neck is too short.

2. The height of the shoulder from the top of the withers to the point of the elbow.

3. The thickness of the body from the middle of the abdomen to the middle of the back. If there is a



THE DRAFT HORSE

great variation in these measurements, we say the horse has a poor form.

4. The width of the body from one side to the other.

A better instrument for taking the measurements of a horse, as suggested by Mr. Harper in the Cornell Rural Leaflets, is as follows. A piece of soft white pine two inches wide, one-half inch thick, and four feet long; to one end of this, and at right angles to it, tack a similar piece of pine 18 inches long; to the other end strap loosely an ordinary carpenter's square so that it may slide back and forth. Now mark off the long piece into inches, beginning at the inside of the right angle at the end.

LESSON LV

Title.—The Dairy Cow.
Season.—May be a Winter study.
Object.—To learn to recognize and judge the dairy cow.
Material.—A dairy cow before the class.

SUBJECT-MATTER AND METHOD

For this lesson have a dairy cow brought into the school yard, and as the class observes the cow the teacher should speak briefly upon the following points.

Cattle are kept for two main purposes; for the production of milk and for the production of beef. These two purposes make different demands upon the energies of the animal, and thus through many generations of selection and development, there have arisen two types of cattle, the beef form or type, and the milk form or type. These two forms are not entirely distinct or separate, but they tend to merge into intermediate forms.

The chief differences that distinguish the beef and dairy types are:

1. Outline of body.
2. Depth and smoothness of flesh.
3. Size of udders.

In the dairy type the general outline of body is

"wedge-shaped from before backward. This is due to a large development of the hind quarters, and sometimes by low thin shoulders. The height of the animal at the hip is from one-half to one inch greater than at the shoulders. The wedge-shaped appearance is increased by a large and pendulous abdomen, and by a large and well developed udder. In the dairy type there is less muscular development and more spare angular appearance. The animal may be fat enough and still present this spare appearance. In the dairy type the udder is much larger and fuller than in the beef type, and the so-called "milk-veins" stand out prominently.

The dairy breeds are the **Jersey, Guernsey, Ayrshire, Holstein, etc.**

While the cow is before the class the pupils should each score the animal, using the following score-card, which explains how the points should be marked:

SCORE CARD FOR DAIRY COWS.

Student's Name..... Date.....

Breed ..... Age ..... Weight .....

General—			
Form—Wedge shaped, viewed from front, side and top.....	10		
Quality—Hair and skin fine and mellow, skin loose and thin.....	8		
Temperament — Nervous.....	6		
Head and Neck—			
Muzzle—Large and clean, nostrils large.....	1		
Eyes—Large, brilliant full and mild.....	1		
Face—Dishing and lean.....	1		
Forehead — Broad.....	1		
Ears—Medium in size, fine in texture, with no long, coarse hair.....	1		
Horns—Waxy, small, and fine in texture.....	1		
Neck—Fine, clean, with little or no dewlap....	1		
Forequarters—			
Withers—Short, lean and thin.....	2		
Shoulders—Light, lean and oblique.....	2		
Legs—Short, straight and fine.....	1		
Body—			
Chest—Deep, wide, girth large.....	12		
Bowel—Ribs arched, long, and wide apart; stomach large and roomy.....	12		
Back—Straight, lean; spines prominent and wide apart	2		
Loin — Broad.....	2		
Navel — Large.....	2		
Hindquarters—			
Hips—Far apart, level.....	2		
Rump—Long level	2		
Pinbones and Thurlis—High, wide apart, and prominent	3		
Tail—Reaching to hocks, fine.....	1		
Thighs—Thin, long	4		
Escutcheon—High and spreading	2		
Udder—High behind, extending well forward in front; quarters even; teats evenly placed; udder not fleshy.....	20		

THE DAIRY COW
(Courtesy of Cornell Rural Leaflets.)

LESSON LVI

Title.—The Beef Cow.
Season.—May be a Winter study.
Object.—To learn to recognize and to judge the beef type of cattle.
Material.—A beef cow before the class.

SUBJECT-MATTER AND METHOD

This lesson should follow lesson 55, so that the comparison of the two types may be brought out more clearly. Present to the class the chief characteristics of the beef cow as follows:

In the beef form the outline of the body approaches the rectangular. The general contour of the top and bottom line is straight and parallel, and the general dimensions of the body approximate those of a brick. In the best beef animal the whole body is thickly and smoothly covered with flesh, so that the angles of the bones are not prominent. The neck is short, and the whole body has a rounded appearance. In the beef type, not only is the udder small, but the veins leading from it are small and more or less embedded in the surrounding muscular and fatty tissue.

The principal beef breeds are:

1. Aberdeen-Angus.
2. Galloways.
3. Shorthorn or Durham.

THE BEEF COW
(Courtesy of Cornell Rural Leaflets.)

4. Hereford.
5. Sussex.

Use the following score card and judge the points in the animal before the class:

SCORE CARD FOR BEEF CATTLE.

Student's Name ..... Date .....

General—			
Weight—Score according to age.....	10		
Form—Broad, deep and massive; top line and under line straight; legs short.....	15		
Quality—Hair fine, skin pliable, evenly fleshed, deep meated, especially in the valuable cuts..	15		
Head and Neck—			
Forehead—Broad and full.....	1		
Eyes—Bright, clear and large.....	1		
Face—Short, quiet expression	1		
Muzzle—Mouth large, jaw wide, nostril large...	1		
Ears—Fine texture, medium in size.....	1		
Horns—Medium in size, fine in texture, waxy..	1		
Neck—Short and thick, with no loose skin....	1		
Forequarters—			
Shoulder—Well covered with compact flesh on top and bottom, and smooth; shoulder vein filled out so as to make a smooth connection with the neck	5		
Brisket—Prominent, showing well forward of the legs viewed from the side.....	1		
Dewlap—Should not have a surplus of loose skin.	1		
Legs—Short and straight, arms full and smooth.	2		
Body—			
Chest—Full, wide, deep, girth large.....	5		
Ribs—Arched, long, and thickly fleshed.....	6		
Back—Straight, broad, smooth, evenly and deeply meated	10		
Loin—Broad and thick.....	7		
Flank—Deep and full, making a straight underline	3		
Hindquarters—			
Rump—Long, wide and smooth, no bunches of flesh at tail.....	2		
Hips—Smooth and well covered with meat.....	2		
Pinbones—Far apart but not prominent.....	1		
Thighs—Deep, wide and full.....	2		
Twist—Deep and full	2		
Purse—Full, fleshy	2		
Legs—Short, straight and smooth.....	2		
Total	100		

LESSON LVII

Title.—The Composition of Milk.
Season.—May be a Winter study.
Object.—To learn some of the contents of milk, and to realize the importance of this subject for study.
Material.—A quart of fresh milk, thermometer, saucer, pan, bottle, and a few drops of vinegar.

SUBJECT-MATTER AND METHOD

Learn the following facts about milk:

Milk consists of about seven-eighths water and one-eighth substances in solution in the water or floating in it in very small particles. You may be surprised to learn that so large a proportion of milk is water. This is true not only of milk but of many of our most important foods.

The constituents of milk are often referred to as **Water** and **total solids**; fat casein, albumen, sugar and ash. A chemist can separate these substances with great accuracy, but by the following methods we can make a gross analysis:

1. Leave a little milk in a saucer for a short time in a warm place. The water will evaporate and leave the solids in dry form.

2. Separation of fat. Let a quart of fresh milk quietly stand in a shallow pan, in a cool place, until a rich layer of cream gathers at the top. This cream

is formed by the rising of tiny globules of butter-fat, which were distributed evenly through the fresh milk. The fat is so much lighter than the liquid in which it floats that it will rise in the cream layer in about twelve hours. This fat is the principal constituent of butter and cheese.

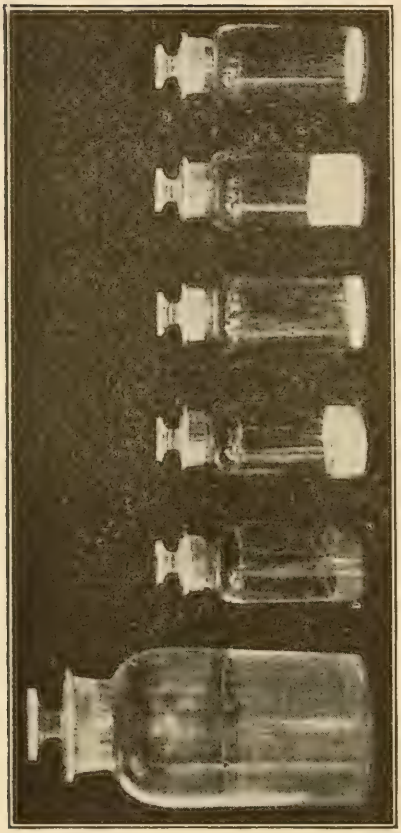
3. Separation of Casein. Add a few drops of acid, vinegar will do, to the skimmed milk. Soon it will thicken. Gently warm it now to about one hundred degrees, and carefully break the thickened surface with a knife, and the skimmed milk will be seen to separate into curd and whey. Now strain through a cloth, and the casein will remain in the cloth, while the whey passes through. This casein is one of the principal parts of cheese.

4. Separation of Albumen. Slowly heat the whey to 160 degrees F. It will become cloudy and soon a soft jelly-like substance will collect on the surface. This is the albumen. This can now be separated by straining.

5. Separation of sugar. Take a small quantity of the whey from which the albumen has been separated, place in a saucer and warm gently until the water has been evaporated. A dry substance remains. This is about seven eighths milk-sugar and one-eighth ash.

6. Separation of ash. It will not be possible to separate the ash and sugar in pure form. Heat the mixture on a piece of dish or on the stove cover, and allow to burn as long as it will. The small amount left is the milk-ash.

(Adapted from Cornell Leaflet.)



THE CONSTITUENTS OF A QUART OF MILK.

Water	Fat	Casein	Albumen	Sugar	Ash
87 per cent	4 per cent	2.6 per cent	7 per cent	5 per cent	7 per cent
29.93 oz.	1.38 oz.	.89 oz.	.24 oz.	1.72 oz.	.24 oz.

LESSON LVIII

Title.—The Souring of Milk.

Season.—May be a Winter study.

Object.—To learn how milk sours and how to care for it.

Material.—Text-book and note-book lesson.

SUBJECT-MATTER AND METHOD

Discuss with the class the following points, and for the note-book work of this lesson, require the students to write a paragraph on the care of milk, and copy the drawing as shown in the figure, into their note-books.

In another lesson we have spoken of the little plants called bacteria, which live at the roots of the legumes and take nitrogen from the air to help make the plant food. In this lesson we are to learn of another kind of bacteria living in milk and causing it to sour. In the first place, milk sours because bacteria from the air fall into it, begin to grow, and soon change the sugar of the milk to an acid.

These bacteria are in the air, in water, in barn dust, on bits of hay and on the cow. They are most plentiful in sour milk, and if we should pour a little sour milk into the fresh milk it would sour more quickly. The same thing happens when people put

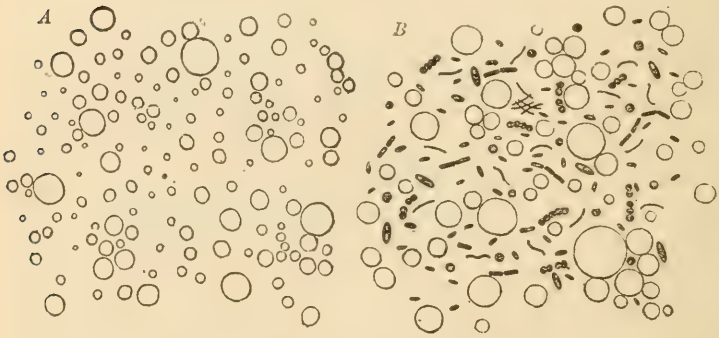
fresh milk into poorly cleaned pails. It follows that all utensils used in the dairy should be thoroughly scalded so as to kill all the germs that cause the milk to sour quickly.

Not only do these germs which cause the souring of the milk get into it, but the germs of consumption and typhoid fever will also thrive in milk, and thus endanger the health and lives of all who drink it. The following precautions in the care of milk should be known and learned by all who supply us with this valuable food:

1. Avoid pitching hay or making beddings in the barn soon before milking time, if the cows are to be milked in the barn, for more germs fall into the milk if the air is full of dust.

2. The milker should wear clean clothes, should have clean hands, and should never wet his hands with the milk.

3. For greater cleanliness and safety the milk-



a—Pure. b—Bacteria

PURE AND IMPURE MILK

(Courtesy of B. F. Johnson Pub. Co.)

man should curry the sides of the cow, and moisten the parts nearest him to prevent dust from falling from the cow into the milk.

4. The first few streams of milk from each teat should be thrown away, because the milk at the mouth of the teat has been exposed to the air, is full of germs, and will cause the rest of the milk to sour sooner.

5. Every vessel used in the handling of the milk should be scrupulously clean.

6. The surface of the milk should not be left exposed to the air of the cellar, living rooms, or any place where dust and germs may fall into it.

7. To test for formalin in milk, pour sulphuric acid into the milk, letting it run down the side of the glass. A purple color at the junction of the milk and acid, indicates the presence of formalin.

LESSON LIX

Title.—The Babcock Test for Butter-fat in Milk.

Season.—May be a Winter lesson.

Object.—To become familiar with the Babcock method of showing the richness of milk.

Material.—A hand-power Babcock tester, at least two milk test-bottles, one pipette to measure the milk, one acid measure, about one pint of sulphuric acid, a few ounces of milk and some hot water. A good tester can be obtained from D. H. Burrell & Co., Little Falls, N. Y., at small cost. Sulphuric acid is sold at all drug stores.

SUBJECT-MATTER AND METHOD

If the school can not be provided with a Babcock tester, this lesson will have to be omitted. The lesson is such an important one, and the ownership of a Babcock tester by the school would be such a valuable thing for the whole community, that the teacher should make every effort to get the material for this lesson.

Because of its simplicity, accuracy, and ease of operation, the Babcock test has become the standard test for determining the value of milk and cream as delivered to the cheese factories and creameries all over this country.

Complete directions for using come with every

machine, and it will not be necessary to give them here. Have some pupil bring a sample of milk from one of the cows at home. The sample should be taken soon after the milking is done, and the milk has been poured two or three times from one vessel to another so as to be thoroughly mixed. Take about a half cupful as a sample and put it into a clean bottle. From this bottle the sample is drawn for testing, after mixing the contents of the bottle thoroughly.

Having determined the per cent of butter-fat in the sample, an estimate can be made of the total amount of butter-fat in a gallon of milk. (A gallon is estimated at 8¼ pounds.)

Make many tests of the same cow's milk to determine its richness. A pound of butter-fat should make, in ordinary practice, about 1.1 pound of butter, and the pupils can compare the price paid for butter, and for the butter-fat, if sold at the creameries, and determine which method of sale is better.

If the school is in a dairy district, this lesson will furnish work for several weeks, and be profitable to patrons as well as to pupils.

LESSON LX

Title.—Sheep.
Season.—A Winter lesson.
Object.—To learn some facts about sheep, and to judge the types.
Material.—A sheep before the class.

SUBJECT-MATTER AND METHOD

Sheep raising is especially profitable in West Virginia, and in the schools of this State, it would be well to emphasize the study of this farm animal. Discuss with the class the following points about sheep:

1. Sheep are found in almost every latitude, and they can find sustenance and thrive where other animals can scarcely live.

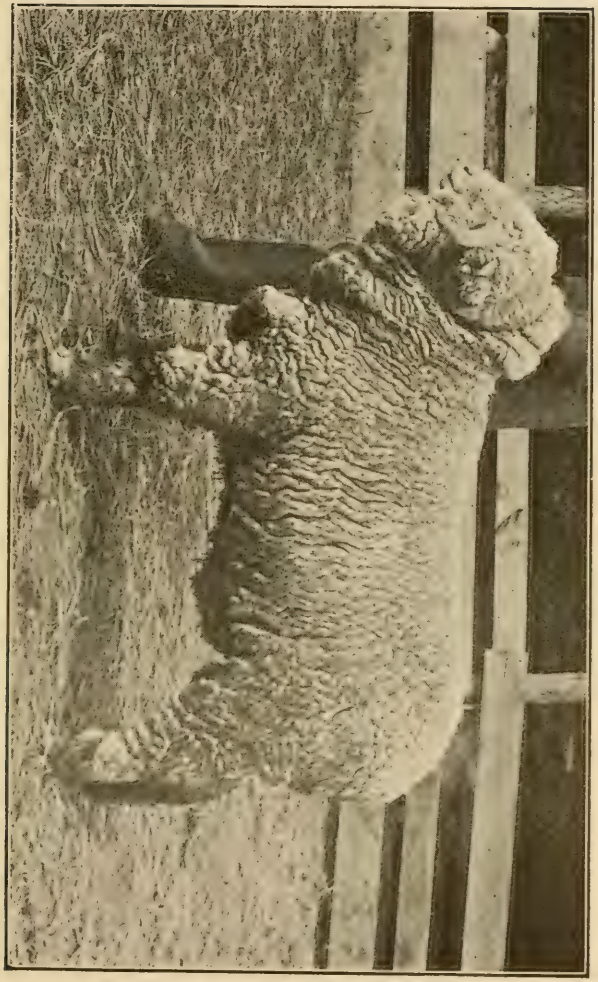
2. Sheep provide man with meat and clothing, and are among the most profitable of animals.

3. Sheep increase rapidly, mature early, furnish wholesome food, and improve the land on which they are pastured.

4. Sheep are docile, rather easily handled, live on a great diversity of food, and require less grain than any other kind of live stock.

5. Much food is wasted on the ordinary farm that would maintain a small flock of sheep.

6. Sheep may be divided into two classes, wool



FINE WOOL SHEEP
German Merino Ram.

breeds and mutton breeds. Of the wool breeds, American Merino, Delaine Merino, and Rambouillets are the standard types.

Of the mutton breeds, Southdown, Shropshire, Horned Dorset, and Cheviot are the standard types.

Open the fleece of the sheep and observe the clean skin in which the fibres grow. These fibres are so rough that they keep the dirt to the outside.

Wool is valuable in proportion to the length and evenness of the fibre and the density of the fleece.

Answer the following questions taken from Burkett, Stevens and Hill:

1. How many pounds ought a fleece of wool to weigh?

Which makes the better clothing, coarse or fine wool?

3. Why are sheep washed before shearing?

4. Does cold weather trouble sheep? Wet weather?

Use the following score card from Purdue University, Indiana, and mark the score for each sheep before the class:

STUDENTS' SCORE CARD—SHEEP.

SCALE OF POINTS.	Mutton Sheep. Standard.	Score. Students.	Score. Corrected.	Fine Wool Sheep. Standard.	Score. Students.	Score. Corrected.
A. Age ..... Teeth						
B. General Appearance						
Weight—Estimated ..... lbs.						
Actual ..... lbs. according to age	6	....	....	4	....	....
Form, low, compact, symmetrical..	6	....	....	5	....	....
Quality, bone and wool fine.....	7	....	....	9	....	....
Constitution, as seen in girth, skin, and fleece	10	....	....	10	....	....
C. Head and Neck.						
Muzzle, fine; mouth and nostrils of good size; lips thin	1	....	....	1	....	....
Eyes, bright, full, whites clear.....	1	....	....	1	....	....
Face, short	1	....	....	1	....	....
Forehead, broad	1	....	....	1	....	....
Ears, fine, erect	1	....	....	1	....	....
Neck, thick, short	1	....	....	1	....	....
D. Forequarters.						
Shoulders, smooth, well covered ...	6	....	....	4	....	....
Chest, wide, deep	6	....	....	5	....	....
Brisket, thick and carried well forward	4	....	....	3	....	....
Legs, straight, short, strong, well set, arm full, shank smooth.....	3	....	....	3	....	....
E. Body.						
Back and Loin straight and wide...	8	....	....	6	....	....
Ribs well sprung, deep.....	4	....	....	3	....	....
Flanks low, making straight underline	3	....	....	2	....	....
F. Hindquarters.						
Hips well apart, smooth.....	4	....	....	2	....	....
Rump long, level, wide	5	....	....	3	....	....
Thighs full	5	....	....	3	....	....
Twist plump, deep	4	....	....	3	....	....
Legs straight, short, strong; shank smooth	3	....	....	3	....	....
G. Wool.						
Quality fine, soft, clean, even.....	3	....	....	11	....	....
Density great	3	....	....	6	....	....
Length good	3	....	....	5	....	....
Yolk	1	....	....	4	....	....
Total	100			100		

Animal..... Breed.....

Owner..... Student.....

Date..... Grade of Student.....

MUTTON TYPE OF SHEEP
Oxford-down Ram.

LESSON LXI

Title.—The Hog.
Season.—A Winter lesson.
Object.—To study swine and learn to judge them.
Material.—A hog before the class.

SUBJECT-MATTER AND METHOD

For this lesson take the class to see some good breed of hogs or have a good specimen brought to the school yard.

The first point to mention is the hog's structural adaptation to the life he leads. The skeleton is heavy and low, allowing great accumulation of weight in flesh and fat. The snout is strong and tough for rooting, and the eyes are set below the ears, indicating his ground-feeding habits.

The chief value of the hog is its production of meat, and if properly cared for, will bring the farmer more money than any animal on the farm.

The most desirable type of hog has short legs, heavy shoulders, small dished head, straight back and straight under-lines, and heavy hams. "The razor back" hogs are very unprofitable, and will not gain so rapidly under feeding.

The following story is quoted from Burkett, Stevens and Hill:

"A boy whose parents were too poor to send him to college, once decided to make his own money and get an education. He bought a sow, and began to raise pigs. He earned the food for both mother and pigs. His hogs increased so fast that he had to work hard to keep them in food. By saving the money he received from the sale of the hogs, he had enough to keep him in college."

The following are some standard breeds of hogs:

1. Chester White	5. Poland-China
2. Yorkshire	6. Duroc-Jersey
3. Tamworth	7. Cheshire
4. Berkshire	8. Victoria.

Hogs will do better when kept as little as possible in pens. When hogs are kept in pens, cleanliness is most important to reduce the danger of disease.

Have the class score the hog, using the following score-card of Purdue University, and marking the points as they judge:

A BACON TYPE OF HOG
Roberta.
(Courtesy of C. S. Plumb, University of Ohio.)

LARD HOGS. MARKET.

SCALE OF POINTS.	Standard.	Students' Score.	Corrected.
GENERAL APPEARANCE—30 Points:			
1. Weight, score according to age	4		
2. Form deep, broad, low, long, symmetrical, compact, standing squarely on legs	8		
3. Quality, hair silky; skin fine; bone fine; mellow covering of flesh, free from lumps and wrinkles	8		
4. Condition, deep, even covering of flesh, especially in region of valuable cuts	8		
5. Temperament mild, quiet	2		
HEAD AND NECK—8 Points:			
6. Snout, medium length, not coarse	1		
7. Eyes full, mild, bright	1		
8. Face short, cheeks full	1		
9. Ears fine, medium size, attached neatly	1		
10. Jowl strong, nest broad, firm	2		
11. Neck thick, medium length, smooth to shoulder	2		
FOREQUARTERS—12 Points:			
12. Shoulder broad, deep, full, compact on top	8		
13. Breast advanced, wide	2		
14. Legs straight, short, strong, bones clean; pasterns upright; feet medium size	2		
BODY—32 Points:			
15. Chest deep, broad, large girth	4		
16. Sides deep, lengthy, full; ribs close and well sprung	8		
17. Back broad, straight, thickly and evenly fleshed	9		
18. Loin wide, thick, straight	9		
19. Belly straight, even	2		
HINDQUARTERS—18 Points:			
20. Hips wide apart, smooth	3		
21. Rump long, level, wide, evenly fleshed, straight	3		
22. Ham heavily fleshed, plump, full, deep, wide	10		
23. Legs straight, short, strong; bone clean, pasterns upright; feet medium size	2		
Total	100		

Animals ..... Date .....

Student .....

POLAND CHINA . .
A lard type of Hog.
(Courtesy of C. S. Plumb, University of Ohio.)

Questions:—1. At what age marketed?

2. Average weight then?

3. Present price?

4. Symptoms of hog cholera?

5. Good preventions?

6 At the present price of corn and hogs, would it pay best to feed it to hogs or sell it by the bushel?

LESSON LXII

Title.—Poultry.
Season.—May be a Winter study.
Object.—To learn some facts about farm poultry, and to learn to judge standard types.
Material.—Poultry for observation.

SUBJECT-MATTER AND METHOD

Arrange to have a specimen of a good breed of poultry before the class for this lesson. It would be better to visit some poultry farm.

Present the following facts about the fowls and discuss them with the class:

1. The domestic fowl is used for egg production, meat production, feather production, and pest destruction.

2. The last census showed that the farmers get about 150 million dollars annually from the sale of the eggs alone.

3. To increase egg production the hens should have an abundance of water, nutritious food, and dry, warm, well lighted houses.

4. Geese, ducks, and turkeys are not so generally raised as hens, but there is an increasing demand for these fowls.

5. The use of the incubator is extending each year to supply the large demand for chickens.

6. One important fact to learn is the proper feeding for egg production. This is best secured by

feeding mixed grains, green grass, cut and steamed hay, (clover), alfalfa hay, roots, sand, and some kind of meat. In the winter ground bone, meat-meal, beef scraps, etc., should be provided, since the hens can get no insects to make up the needed meat diet for egg production. It has been found that the nutritive ratio of the food for hens should be about 1:4. That means that they should have a large amount of protein foods in proportion to the carbon foods, i. e., more seeds, grass, and meats than corn.

7. The standard varieties of hens are as follows:

Egg-breeds—Leghorn, Minorca. Meat-breeds—Brahmas, Cochins. General purpose—Plymouth Rock, Wyandotte. Fancy breeds—Bantam, Polish.

Use the following score-card and have each pupil mark the points for the fowl before the class:

STUDENTS' SCORE CARD—POULTRY.

..... Exhibitor.

Breed ..... Sex .....

WEIGHT.	Shape.	Color.	Condition
Typical Carriage	.....	.....	.....
Weight	.....	.....	.....
Comb	.....	.....	.....
Beak	.....	.....	.....
Eyes	.....	.....	.....
Head	.....	.....	.....
Crest and Beard	.....	.....	.....
Wat. and Lobe	.....	.....	.....
Neck	.....	.....	.....
Wing	.....	.....	.....
Back	.....	.....	.....
Tail	.....	.....	.....
Breast	.....	.....	.....
Boyd and Fluff	.....	.....	.....
Legs and Feet	.....	.....	.....
Hardin's of F.....	.....	.....	.....

Defects ..... Score .....

COLONY HOUSE

LESSON LXIII

Title.—A Study of Feathers. (Adapted from The Cornell Leaflets.

Season.—May be a Winter lesson.

Object.—To study the use of feathers to the fowl, and to learn the different kinds of feathers on the different parts of the body.

Material.—A fowl of any kind brought to school in a coop. The same fowl used in the previous lesson could be used for this lesson. While it is kept at school it should be supplied with food and water.

SUBJECT-MATTER AND METHOD

Have the fowl in the school room a few hours before the lesson is given. Encourage the children to find out as many facts as they can for themselses before the school opens for work. Direct the observations of the pupils by a few questions, as: the kind of feathers; the location of the different kinds; any part of the body not covered with feathers. Suggest a little competition by asking which boy or girl can give the greatest number of facts from his observation of the feathers of the fowl.

At class time, the teacher should remove the fowl from the coop, and hold it firmly by the legs to pre-

vent fright and injury. Allow the children to come near.

1. Have the pupils feel the difference between the heat of the hen's body beneath the feathers and on the outside of the feathers. Explain. Bring out the point that the feathers are non-conducting, and ask what value this serves the fowl.

2. Spread the wings and tail so that the different feather sections may be seen. Note that in the wing and tail, one feather overlaps the other so that each feather braces the other in flight.

3. Observe the lighter wing feathers, (the secondaries) tucked under the heavier feathers, (the primaries). What kind of feathers are in the tail? Are they different from those of the wings? What use do the tail feathers serve?

BROODER HOUSE

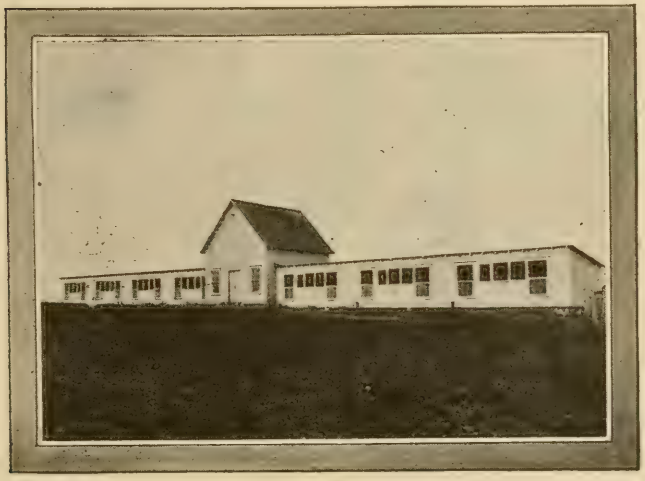
THE FEATHERS OF A HEN

Showing their relative size, shape and position. 1, Neck hackle; 2, Breast; 3, Wing shoulder covert; 4, Wing flight covert; 5, Wing primary; 6, Wing secondary; 7, Wing covert; 8, Back; 9, Cushion; 10, Main tail; 11, Fluff; 12, Thigh.

4. Notice how the back feathers overlap each other. Why this arrangement? If the feathers shed easily without pain to the hen, take one feather from each of the following places and fasten on a sheet of paper for comparison: 1. Neck feather; 2. Breast feather; 3. Wing shoulder covert; 4. Wing flight covert; 5. Wing primary; 6. Wing secondary; 7. Wing covert; 8. Back; 9. Cushion; 10. Main tail; 11. Fluff; and 12. Thigh. See figure for corresponding numbers.

4. Have pupils make drawing sketches of these feathers.

5. Make a drawing of a large primary feather, and name the parts: fluff, tip, quill, barb, and web



CURTAIN FRONT LAYING HOUSE

LESSON LXIV

Title.—A study of the Egg. (Adapted from the Cornell Leaflets.)

Season.—May be a Winter study.

Object.—To observe the variations in eggs, the characteristic types, and to learn something of the structure and composition of the egg.

Material.—A collection of eggs from as many different kinds of poultry as possible, a neat box with good cover, blow pipes or straw, and a pair of balances or scales, and saucers.

SUBJECT-MATTER AND METHOD

Ask each pupil in the school to bring one or two hen-eggs, turkey-eggs, or any other fowl eggs, for this lesson.

1. Tabulate in the note-book the record of the collection as follows:

(Number each egg with ink on the shell.)

The Breed.	Size.	Weight.	Form.	Pupil's Name.	Date.	No. of Egg.

2. After this data has been recorded, a small hole might be broken in each end of the egg, the blow pipe or straw inserted, and the contents blown out, so that the egg shell may be preserved in a neat box as an interesting collection. From time to time, pupils might be encouraged to get the shells from the eggs that are used at home, to add to the collection. The contents of the eggs, blown, should be held in saucers, one to each pupil.

3. Observe the structure of the raw eggs in the saucers. Find the "germinal disc" which appears as a light colored spot, usually on the upper surface of the yolk. This germ spot contains the life principle of the egg. Note the whitish cords of denser albumen which serve to keep the yolk properly suspended in the white of the egg.

Note the clear, watery appearance of the white of the egg. This is the albumen, the food in liquid form upon which the young chick lives while in the shell. (If the contents do not come out whole, another egg must be broken for this part of the lesson.)

4. The chemical composition of the dry substance of the inside of the egg is (Snyder: Poultry Book.):

	Protein.	Fat.
White (albumen)	88.92	.53
Yolk	20.62	64.43

5. Make a drawing of the egg shell obtained above.

6. If it is not possible to boil the eggs at the school, ask each pupil to bring a boiled egg for this part of the study.

Carefully remove the shell piece by piece. Observe the air space, and the two membranes beneath the shell. Cut the egg lengthwise through the middle, and make a drawing of the section, showing all the points mentioned in paragraph 3.

LESSON LXV

Title.—Food Studies.

Season.—A Winter lesson.

Object.—To learn the most important food compounds and the relative food values of common foods.

Material.—An egg, a potato, some nuts, fat meat, salt, and water. Cheese and crackers, bread, butter and sugar.

SUBJECT-MATTER AND METHOD

1. When one thinks of the study of foods he thinks at once of domestic science rather than of elementary agriculture. But intelligent endeavor in agricultural practices concerns itself with the use of food products, both for the farm animals and for the home table. It is an economic as well as a health factor that we cannot afford to overlook. Until the recent pure food law became effective, we were at the mercy of the manufacturers and the grocers in their practice of adulterating, substituting, coloring, and preserving much of our food-stuffs.

It would be an excellent part in the presentation of this lesson, for the teacher to get a few samples of properly labeled canned food-stuff, such as beans, bacon, berries, syrups, peas, etc., and show the pupils how to recognize the inspection stamp, under the pure

food law of June 1906. Emphasize the fact that only such approved goods should be purchased.

Thoroughly learn these facts—that food for man, and the higher vertebrate animals, may be classified into, **proteids, carbo-hydrates, fats, mineral matter,** and **water.** It is from these compounds that animals get life, heat, and energy.

The examples of food given above contain all the elements of nutrition. It would be well to have these samples before the class, and to explain which food element predominates in each one.

2. Have pupils copy into their note-books and learn the following table:

Proteid-food.	Carbo-hydrate food.	Fat-food.	Minerals.	Water.
Lean meat.	Starches.	Seeds.	Salt.	Water.
White of egg.	Sugars.	Nuts.	Mineral water.	Milk.
Curd of milk.	Potatoes.	Fish.		Vegetables.
Gluten of wheat.	Grains.	Butter.		
Cheese.	Vegetables.	Fat meats.		
Beans.	Crackers.	Oils.		
Bread.	Honey.			
	Green corn.			

Many of the foods mentioned above contain two or more of the food compounds given at the head of the table, but they are classed under the compound which they have in greater prominence. The human body has these five compounds in its make up, hence the food must contain them, if the body is to live and grow.

3. The following table, prepared from Bulletin 28, Office of Experiment Stations, Dept. of Agriculture, Washington, D. C., shows the composition of common

food materials. It should be copied into the pupils' note-books, studied and discussed by the teacher and class. This bulletin may be secured for five cents.

FOODS.	Per cent Refuse.	Per cent Water.	Per cent Protein.	Per cent Fat.	Per cent Carbo-hydrate.	Per cent Ash.
Sirloin steak	12.8	54.	16.5	16.1	.....	.9
Beef, dried	4.7	53.7	26.4	6.9	.....	8.9
Tomato soup	.....	90.	1.8	1.1	5.6	1.5
Mackerel	44.7	40.4	10.2	4.2	.....	.9
Oysters	.....	88.3	6.	1.3	3.3	1.1
Eggs	11.2	65.5	13.1	9.3	.....	.9
Whole milk	.....	87.	3.3	4.	5.	.7
Cheese (cream)	.....	34.2	25.9	33.7	2.4	3.8
White bread	.....	35.3	9.2	1.3	53.1	1.1
Soda crackers	.....	5.9	9.8	9.1	73.1	2.1
Honey	.....	.....	.....	.....	81.	.....
Beans (Lima)	.....	68.5	7.1	.7	22.	.7
Cabbage	15.	77.7	1.4	.2	4.8	.9
Potatoes	20.	62.6	1.8	.1	14.7	.8
Corn (green)	.....	76.1	2.8	1.2	19.	.9
Tomatoes	.....	94.	1.2	.2	4.	.6
Goose	17.6	38.5	13.4	29.8	.....	.7

LESSON LXVI

Title.—Food Proportions and Requirements.
Season.—Winter lesson.
Object.—To learn proper food proportions and some good dietaries.
Material.—Some butter, bread, sugar, cheese, crackers, and dried beef.

SUBJECT-MATTER AND METHOD

1. This lesson should follow immediately upon the preceding one, and before drawing any conclusion from the facts presented in the last lesson, we should bring out this point, that cooking changes the mechanical and often the chemical nature of the foods, that it improves the flavor and kills all germs. It ruptures the walls of the starch cells, softens the protein of the tissues, and tends to harden the albuminoids. There are serious defects in the process of cooking and preparing foods. For example, potatoes pealed and soaked for some time before cooking, loose 52% of nitrogenous matter; when pealed and put into cold water and boiled, they loose 16% of it; the ideal way of cooking potatoes is to boil them with the skin on. Domestic science will correct all such errors.

2. Food requirements.

It has been found that an adult at moderate muscular work, requires food daily in the following proportions:

*Protein—one-fourth pound; Fat—one-half pound; Carbo-hydrates—one and one-fourth pound.

It would be an interesting part to this lesson to weigh out the following foods before the class, that the pupils may see the amount and proportions, constituting good dietaries:

(a) butter, 8 oz.
bread, 24 oz.
sugar, 6 oz.

(b) cheese, 12 oz.
crackers, 24 oz.

These simple dietaries are approximate estimates of a fairly balanced daily food ratio for an adult doing medium labor. This does not include the water which should constitute a large portion of the food of a day.

3. In the business of farming the same principles apply to the feeding and managing of stock. The proportion of available protein to the other available nutrients, is called the nutritive ratio.

A cow should be fed a ration of 1 to 5.4; a horse, 1 to 7, under average conditions. Ten per cent of the food value is lost when a horse is required to stand in a cold stall or to fight flies. The science of stock feeding is a large and very important field for study.

The nutritive ratio for a growing boy and girl is 1 to 5.2.

It would be a good practice to make up several food dietaries with the proper ratios from the foregoing tables.

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* NOTE.—Later Yale experiments prove that an adult needs only 2 oz. of protein, daily.

LESSON LXVII

Title.—Tests for Food Compounds.

Season.—Winter lesson.

Object.—To learn how to make tests for the common food compounds.

Material.—Caustic potash, copper sulphate (blue stone), egg, corn or wheat, starch, iodine, potato, and nuts.

SUBJECT-MATTER AND METHOD

Pupils should become familiar with the terms, protein, starch, fat, etc., and they should know many facts about these nutrients. They may make tests for them in certain foods.

1. To test for protein. Prepare a solution of caustic potash, 1-5 oz. to 2 oz. of water (warm). Dissolve a piece of copper sulphate, about ½ inch in diameter in two ounces of warm water. Place a small quantity of white of egg on a plate and cover it with the caustic potash solution. Warm gently. Pour a small quantity of the copper sulphate solution over this, and stir with a clean splinter. The color will remain the greenish blue of the copper for ten or fifteen minutes, when a bright violet will spread through the solution. This shows the presence of protein which was in the egg. Wheat, corn, and all the grains may

be crushed and treated in the same way to show the presence of protein.

2. To test for carbo-hydrate (starch). Crush a piece of potato and partly dissolve in hot water. Introduce a splinter into the iodine bottle, and transfer the iodine adhering to the splinter into the potato solution and stir. The blue color that forms is the test for starch. Seeds of various kinds may be crushed and boiled in water, and the water tested for starch in the same way.

3. To test for fats. Nuts and small seeds may be crushed and heated on white paper. The grease spot that appears will indicate the presence of oils.

Tabulate and learn the above facts

LESSON LXVIII

Title.—Determining Rations for Farm Animals.
Season.—A Winter lesson.
Object.—To learn how to balance rations so as to keep the animal in good condition, and to use economy in feeding.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Animal food-stuffs contain the same elements used in human foods, that is, protein, carbo-hydrates, and fat. The percentages of these ingredients found in the standard animal foods are given in the table appended to this lesson. By the nutritive ratio is meant the proportion of protein to carbo-hydrates and fats combined.

The following formula illustrates the method of finding the nutritive ratio:

$$\frac{\text{Carbo-hydrates} + (\text{fat} \times 2.4)}{\text{protein}} = \text{nutritive ratio.}$$

For example, suppose we wish to find the nutritive ratio of the following ration: (Horse weighing 1,000 pounds, doing medium work.)

Timothy hay .....15 pounds
Corn .....10 pounds
Cotton-seed meal ..... 3 pounds

Solution:—

In 100 pounds of timothy hay there is 86.8 lbs. dry matter, 2.8 protein, 43.4 carbo-hydrates, and 1.4 fat.

In 15 pounds hay there are:

15-100 of 86.8 dry matter, 13.02 pounds.
15-100 of 2.8 protein, 42 pounds.
15-100 of 43.4 carbo-hydrates, 6.51 pounds.
15-100 of 1.4 fat, .21 pounds.

In 10 pounds corn there are:

10-100 of 89.1 dry matter, 8.91 pounds.
10-100 of 7.9 protein, .79 pounds.
10-100 of 66.7 carbo-hydrate, 6.67 pounds.
10-100 4.3 fat, .43 pounds.

In 3 pounds cotton-seed meal there are:

3-100 of 91.5 dry matttr, 2.74 pounds.
3-100 38.1 protein, 1.14 pounds.
3-100 of 16.0 carbo-hydrate, .48 pounds.
3-100 of 12.6 fat, .378 pounds.

	Dry matter	Protein	Carbo-hydrate.	Fat.
Timothy, 15 lbs	13.02	.42	6.51	.21
Corn, 10 lbs	8.91	.79	6.67	.43
Cottonseed meal, 3 lbs	2.74	1.14	.48	.378
Total	24.67	2.35	13.66	1.018

Substituting in the formula given above,

$$\frac{13.66+(1.018\times 2.4)}{2.35}=6+.$$ Nutritive ratio is 1 to 6.

This we see is a proper ratio for the horse re-

ferred to above. One-fourth for breakfast, one-fourth for dinner and one-half for supper would be the proper division of this ration.

Problem—Find the nutritive ratio for 15 lbs. of clover hay and 5 pounds of oat straw, and 10 pounds of oats.

STOCK FOODS—AVERAGE OF DIGESTIBLE NUTRIENTS.

NAME OF FOOD.	Dry matter in 100 pounds.	Digestive nutrients in 100 pounds.		
		Protein.	Fat.	Carbo-hydrates.
Green food and ensilage..				
Corn fodder	20.7	1.0	0.4	11.6
Rye fodder	23.4	2.1	0.4	14.1
Kentucky blue grass	34.9	3.0	0.8	19.8
Red clover	29.2	2.9	0.7	14.8
Cow-pea vines	16.4	1.8	0.2	8.7
Corn ensilage	20.9	0.9	0.7	11.3
Hay and dry fodders—				
Corn stover	59.5	1.7	0.7	32.4
Timothy hay	86.8	2.8	1.4	43.4
Red clover	84.7	7.6	2.0	38.4
Cow-pea vine hay	89.3	10.8	1.1	39.0
Oat straw	90.8	1.2	0.8	38.6
Wheat straw	90.4	0.4	0.4	36.3
Grain and other seed—				
Corn	89.1	8.0	4.6	65.9
Oats	89.0	9.2	4.2	47.3
Cow-peas	87.8	20.0	0.8	53.2
Mill products—				
Corn meal	85.0	5.5	3.5	63.8
Wheat bran	88.1	12.2	2.7	39.2
Cottonseed meal	91.5	38.1	12.6	16.0

LESSON LXIX

Title.—Feeding Standards for Farm Animals.
Season.—A Winter lesson.
Object.—To give data for calculating feeding rations.
Material.—Paper and pencil.

SUBJECT-MATTER AND METHOD

The teacher should give several problems similar to the one suggested in the last lesson, and also have the pupils make up their own problems for feeding rations of the different animals mentioned in the table below.

PER DAY FOR 1,000 POUNDS LIVE WEIGHT.

The Animal.	Dry Matter. Lbs.	Nutritive Ratio.
Fat cattle	30	1:6.5
Milch cows	27	1:6.
Horse (light work)	20	1:7.
Horse (heavy work)	26	1:6.
Sheep, growing wool	23	1:8.5
Fattening sheep	30	1:5.4
Fattening swine	32	1:6.

For assignment of work in this lesson each pupil should compound a maintenance ration having the amounts and nutritive ratios given above, for at least three of the animals.

Note—It should be remembered that protein builds flesh, bone, blood and internal organs, and may be used to serve as the fat. Fat furnishes heat, energy and body fat, so also does the carbo-hydrates.

LESSON LXX

Title.—An Outline of the Animal Kingdom.
Season.—At any time.. A good lesson to precede the study of insects.
Object.—To learn the divisions of the animal kingdom.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

All the animal life in the world may be classed in eight groups, represented by forms familiar to almost every one. It would be worth the effort for the sake of future studies in animal life to commit to memory the following outline of the animal kingdom:

1. Protozoa. Microscopic forms in stagnant water.
2. Porifera. The sponges.
3. Coelenterata. The coral.
4. Echinodermata. The star-fish.
5. Vermes. The fish-worm.
6. Mollusca. Snails and Mussels.
7. Anthropoda. Spiders and insects.
8. Vertebrate. The horse.

Each of these sub-kingdoms is divided into classes, orders, genera, and species. Two very important sub-kingdoms to agriculture are the Anthropoda and the Vertebrata. These are subdivided as follows:

Sub-kingdom,—Arthropoda—

Class 1. Crustaceans, the crayfish.

Class 2. Arachnida, the spider.

Class 3. Myriapoda, the centiped.

Class 4. Insecta, the insect.

- Order 1. Orthoptera, the grasshoppers.
- Order 2. Lepidoptera, the butterflies.
- Order 3. Diptera, the flies.
- Order 4. Hemiptera, the bugs.
- Order 5. Neuroptera, the dragonflies.
- Order 6. Hymenoptera, the bees.
- Order 7. Coleoptera, the beetles.

Sub-kingdom,—Vertebrata—

Class 1. Pisces, the fish.

Class 2. Aves, the birds.

Class 3. Amphibians, the frogs and toads.

Class 4. Reptilia, the snakes and turtles.

Class 5. Mammalia, the cows, horses, etc.

The mammals have nine orders represented by the sloth, sea-cow, whales, ground moles, bats, rabbits, minks, hoofed animals, and man.

It is an interesting fact that so many of these groups are represented by animals to be found in almost every locality. Pupils should make a list of all the animals they can think of in their neighborhood.

See how well the pupils can classify their lists into these large groups.

LESSON LXXI

Title.—The Orders of Insects.
Season.—Spring or Autumn.
Object.—To learn the different orders of insects.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Pupils should make an outline in their note-books, from the facts presented in this introductory lesson on insects.

Note—Insects are characterized by three segments of the body;—head, thorax, and abdomen; three pairs of jointed legs and usually two pairs of wings. The differences in the wings distinguish the different orders of insects. A few are without wings.

Insect bodies are covered with a more or less hardened skin, their eyes are compound, and their mouths are adapted for biting or sucking. There are usually four stages in the life history of the insect; the egg, the larva, the pupa, and the adult. The length of life history varies from a few hours to several years. There are more than 250,000 species of insects, grouped in the following orders, as given in the preceding lesson:

1. Orthoptera. Four wings, front pair thickened, the hind pair thin and folded. Hind legs usually devel-

oped for jumping. Mouths adapted for biting and chewing. The grass hopper, locust, cricket, etc.

2. Lepidoptera. Four wings, covered with overlapping scales; mouth parts modified into a long proboscis; the larva are caterpillars, butterflies and moths are examples.

3. Diptera. Two wings, thin and membraneous, rudamentary modifications in the form of balancer knobs; mouth of most species adapted for biting and piercing; the larva are footless maggots. The housefly, mosquito and blue bottle fly are examples.

4. Hemiptera. Four wings, usually half hardened and half membraneous, sometimes the wings are absent; mouthparts adapted for sucking; body flat, and legs slender. These are the true bugs. The squash bug, the bed bug, the louse, etc., are examples.

5. Neuroptera. Four thin, membraneous, nerve-veined wings; large eyes; slender bodies; mouth parts adapted for biting. The dragon fly and damsel fly are examples.

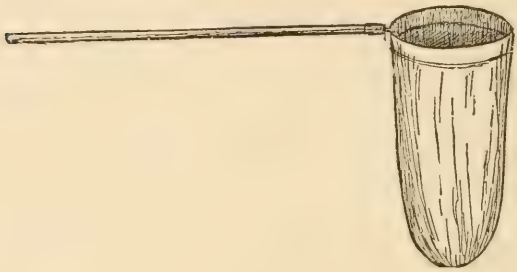
6. Hymenoptera. Four transparent wings; heavy bodies, usually provided with stings in the females; mouths adapted for biting and lopping. The bees, wasps, ants, etc., are examples.

7. Coleoptera. Four wings, the outer pair a horny sheath for the inner membraneous pair, partly folded beneath; strong legs; mouth parts adapted for for biting on pinching; the larva large and worm-like. Beetles are examples.

The teacher should return to this lesson after the series of lessons on insects has been completed, and

have the pupils make a list of as many insects as they can from each order.

It would be a good device to require each pupil to hand in a collection, consisting of one of each of the above orders of insects.



INSECT NET
(Courtesy of Orange-Judd Co., Davis Agriculture.)

LESSON LXXII

Title.—The Grasshopper.
Season.—Autumn.
Object.—To study the structure and habits of the grasshopper.
Material.*—A grasshopper for each pupil, note-book and pencil.

SUBJECT-MATTER AND METHOD

In making this study of the insects, the pupils should first draw a whole body view of the insect, and then make such notes and answer such questions as are asked in the lesson outlines. Determine all answers from observation.

(1). Observe in the field:

Its method of locomotion.

Its protective coloration.

Its enemies. Its sounds. Its haunts.

2. With the living insect, try to find the breathing spiracle, just above the base of the middle legs. Watch the opening and closing of the lips of this breathing pore. Put the grasshopper under a glass and see if it will eat grass or leaves. Perhaps it has spit "tobacco juice" on you. Why does he do this? How much further can he jump than the length of his body?

3. In what ways do the hind pair of legs differ from the others?

Of what advantage are the hooks and spines on the legs?

Count how many joints there are on each leg.

4. Study the wings. How does the front pair compare with the hind pair? How are the hind wings folded? By rubbing the upper and lower wings together, the grasshopper sounds are made. Make a drawing of the wings.

5. Study the mouth parts. These are the most difficult of all the external parts to see. Find the following parts:

1. The upper lip, a two-lobed labrum.

2. A pair of blackish horny mandibles, covered by the upper lip.

3. A pair of jointed maxillae below the mandibles.

4. A two-lobed lower lip, the labium. If the grasshopper is dead separate these mouth parts and draw them.

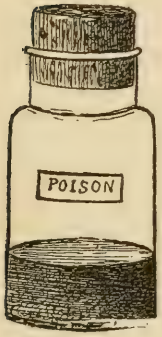
6 The female has at the end of the abdomen, four points called the ovipositor. These are used for making an opening into the ground to receive the eggs. Young grasshoppers are called nymphs and resemble the adults in every way except that their wings are undeveloped.

7. Count the segments of the abdomen. Observe on each side of the abdomen, a groove and just above it a row of breathing spiracles. Observe the thin membraneous depression on the first segment of the abdomen. This is supposed to be the ear.

8. Observe the eye. Perhaps you can see that it is made up of many divisions. The grasshopper has two compound eyes and three simple eyes. Try to find these.

9. What other insects belong to the grasshopper family?

*Note—For killing insects prepare a cyanide bottle as follows: Break potassium cyanide into small pieces and put into the bottom of a wide mouthed bottle. Avoid the **deadly poisonous** fumes. Pour over the pieces, just enough water to cover them. Add plaster of paris, until the water is absorbed. Leave unstoppered until the contents are dried, then cork tightly. Insects dropped into the bottle will die. **Keep the bottle from children.**



KILLING BOTTLE.

GREEN STRIPED LOCUST

(Courtesy of Orange-Judd Co., Davis Agriculture.)

LESSON LXXIII

Title.—The Butterfly.
Season.—Spring or Autumn.
Object.—To study the butterfly.
Material.—A cabbage butterfly for each pupil. Notebook and pencil.

SUBJECT-MATTER AND METHOD

Every country boy or girl knows the white cabbage butterfly, and its associate the sulphur butterfly. With freshly killed specimen take up the study as follows:

1. Make a drawing of the whole body, showing the characteristic markings.

2. How many segments to the body? What are the appendages from these segments?

3. How do the legs compare with those of the grasshopper?

4. Write a descriptive sentence about each of the following points of the wings: action; shape; overlapping; scale-covering; and vein-structure.

5. How many segments to the abdomen? Are they like those of the grasshopper?

6. Examine the mouth of the butterfly. Find the coiled tube which it uses to obtain the nectar from the flower. With a pin uncoil it and note its length.

7. Answer the following points on the observation of a live butterfly:

1. Its manner of flight.
2. The kind of food, and the manner of feeding.
3. The natural enemies of the butterfly.
4. The position of the wings when at rest.

8. What is the damage done by the cabbage butterfly?

It should be remembered that the common toad is the best friend we have in the garden to rid the cabbage of this pest.

9. What is the life-history of the butterfly? This question will be asked in connection with all the insects we shall study, therefore a general answer should probably be given to make this point clear. The cabbage butterfly lays its eggs, attached singly, usually to the lower surface of cabbage leaves. They are small, and are pale-yellowish in color. These hatch into **larva**, the so-called cabbage worms. After these have fed upon the cabbage leaves for some time, they spin from their mouths a silken pod around themselves; this pod is called the **pupa**. The pupa is usually

CABBAGE BUTTERFLY
(Courtesy of Orange-Judd Co., Davis Agriculture.)

found on old fences or posts. In a short time the pupa ruptures, and a full grown cabbage butterfly walks out, dries its wings and flies away to begin the life history of a new generation.

10. If you can get a moth compare it with the butterfly as follows:

1. Difference in the feelers. (Antennae).
2. Manner of folding the wings when at rest.
3. Time of flying, day or night.
4. Comparative size of bodies.

Note—Butterflies and moths belong to this family of insects.

LESSON LXXIV

Title.—The Fly.
Season.—Autumn.
Object.—To learn of the fly and of the dangers of the house-fly.
Material.—A house-fly for each pupil of the class.

SUBJECT-MATTER AND METHOD

1. Make a drawing of the common house-fly.

2. Write a sentence on each of the following points, based upon your own observation of a live fly:

   1. The rapidity of the wing motion.
   2. Its manner of eating.

3. Their favorite haunts.

4. How many wings has the fly? Look under the wings and try to find the little white knobs, called the balancers.

5. Note how rough and hairy the legs and feet of the fly are.

Would they hold filth and dirt so that it could be carried?

6. How does the abdomen of the fly compare with other insects we have studied? Count the segments of the abdomen.

7. The life history of the fly family may be studied easily in the school-room. Expose out of doors a bit of lean meat, so that the eggs may be laid upon

it. The blue-bottle fly will lay eggs upon meat. Fill a tin-can or box with sand, and on a chip in the center of it place the bit of meat with the eggs on it. Invert a glass tumbler over it, and push the rim of the tumbler down into the sand to prevent the escape of offensive odors. In a few hours the eggs will hatch, and in a few days the larva will be fully grown. They will probably crawl under the chip to change into pupae. They may come out soon as adult flies, or they may remain over winter in this stage. The house-fly lays its eggs in manure and filth and is transformed through the same stages of life history.

Rules Against Flies.

1. Flies are very dangerous in the spread of disease, therefore we should not allow any decaying organic matter to accumulate, in which they can breed.

2. If the cellar is damp, clean out the dark and damp corners and apply lime.

3. Pour kerosene into the drains and also treat with kerosene all waste materials not intended for fertilizers.

4. If kitchen waste is deposited in large cans, it should be removed at least once a week.

5. Kitchen waste intended as food for hogs should be removed and used daily.

6. Haul out the manure and spread it on the soil every day, or put it in a screened box to be emptied over the fields or gardens at least once a week.

7. If inconvenient to haul the manure at short intervals, treat it with kerosene or gypsum.

8. Keep up the work of destroying adult flies by the usual methods and judiciously screen against them.

9. Flies are born and breed in filth; they are among the worst agencies in the spread of typhoid fever, and every means possible should be used to banish them from our homes.

THE FLY
(Courtesy of Orange-Judd Co., Davis Agriculture.)

LESSON LXXV

Title.—The Bugs.
Season.—Autumn.
Object.—To become familiar with the bug family.
Material.—A squash bug, or "stink bug," or harvest fly for each pupil in the class.

SUBJECT-MATTER AND METHOD

If it is possible to catch a two-year cicada, sometimes called "dog-day harvest fly," or improperly, the locust, this will make the best specimen for the study of the true bugs. If none of these can be got, a squash bug will illustrate the characteristics of all bugs.

1. Draw the view of the whole body.

2. How many wings are there. Note in the squash bug that the front half of the wing is horny and that the back half is membraneous.

3. Note the triangular prominence of the thorax on the back.

4. Observe the mouth parts. Describe their structure. What does the bug's mouth show as to his manner of eating.?

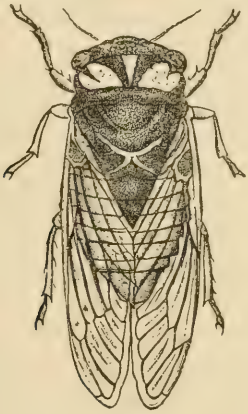
5. For what kind of locomotion are the legs adapted?

6. Find the eyes and feelers. Write a sentence describing each.

7. What is the life history of the squash bug and cicada?

8. All the bugs belong in this family, together with the plant lice, tree hoppers, scales, etc.

9. This is an injurious family of insects, and the kerosene emulsion spray is the means of combatting in most cases.



DOG-DAY HARVEST FLY
(Courtesy of Orange-Judd Co., Davis Agriculture)

LESSON LXXVI

Title.—The Dragon Fly.
Season.—Autumn.
Object.—To study the form and life of the dragon fly
Material.—A dragon fly for each member of the class.

SUBJECT-MATTER AND METHOD

1. Dragon or damsel flies will have to be caught with a net. They are usually seen flying about the ponds or streams of water.

2. Answer the following questions from the observation of a living specimen:

1. What is their habit of flight?
2. What is their food?
3. How do the dragon fly and damsel fly differ in habits?
4. What is the position of the wings at rest?

3. After killing the dragon fly in the cyanide bottle, straighten its wings and legs and draw the whole body view.

4. How do the legs compare with those of the grasshopper?

5. How many wings are there? Write a descriptive sentence about them.

6. Note the enormous development of the eyes What would this indicate as to their habit of life? Find

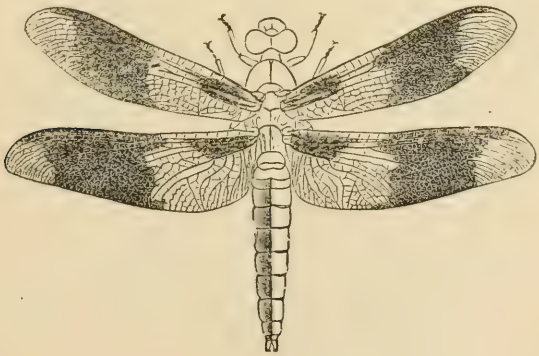
the three small simple eyes, and tell where they are located.

7. Write a descriptive sentence about the abdomen. How many segments?

8. Does the dragon fly have a sting?

9. The life history:—The eggs are laid in the water. They hatch into a nymph, a form resembling the adult without wings. In this stage they live in the water, and eat greedily upon small water insects. At this stage they are beneficial in eating mosquito larva. When the nymph is fully grown it crawls out of the water, upon some convenient rock or reed, fastens its feet firmly, splits down the back, and the adult dragon fly crawls out, dries itself, and is soon ready for aerial life.

10. The dragon fly is a beneficial insect because it preys upon other insects that are pests to us.



A DRAGON FLY
(Courtesy of Orange-Judd Co., Davis Agriculture.)

LESSON LXXVII

Title.—The Bee.

Season.—Autumn.

Object.—To study the structure and life of the bumble bee.

Material.—A bumble bee for each member of the class.

SUBJECT-MATTER AND METHOD

1. Answer the following questions on the bumblebee based upon field observation.

1. What kind of flowers do they feed upon?

2. Are they shy while feeding? Will they sting then?

3. Do they stay long at each flower?

4. What do they gather from the flower?

5. Explain how they help the flower.

6. How does its manner of flight compare with that of the butterfly?

2. Kill the bee in the cyanide bottle, and make a drawing of the body.

3. Note the large body in comparison to the wings. Do you think that the wings easily wear out? How many wings are there?

4. Are the legs of the bee all alike? Explain.

5. Try to find the mouth parts and the tongue. Write a descriptive sentence about them.

Worker.

Drone.

Queen.

HONEY BEE

6. Can you see any value in the hairy covering of the bee's body?

7. Find the sting of the bee, and remove it. There is a poison gland at the root of the sting, which pours a fluid into the wound made by the sting, causing the painful sensation with which every boy is familiar.

8. Where does the bumble bee make its nest? What is it made of?

9. Life history:—The eggs are laid in the cells. The second stage is the wormlike creature, the larva, lying inactive in the cell. It must be fed and it is a big eater. When it is fully grown it spins a silken coccoon about itself and enters the next stage. The third stage is the pupa. Here it remains quietly concealed within its coccoon, over which the workers spread a thin layer of wax, making a cell of it. After a time it cuts its way through the top of the cell, and comes forth a fully developed bumble bee.

10. To this family belong the wasps, hornets, sawflies, gallflies, ants, and honey bees.

Note—If it is desired to make an extended study of the honey bee as an insect for farm use, write to Mr. Frank Benton, of the Division of Entomology, Dept. of Agriculture, Washington, D. C., for his Bee Book and other circulars.

Drone.

Queen.
HONEY BEE

LESSON LXXVIII

Title.—The Beetle.

Season.—Autumn.

Object.—To learn something of the structure and life habits of the beetles.

Material.—A beetle for each pupil in the class. Any species will answer the purpose. Blister beetles may be found on goldenrod in autumn. The black ground beetles are also common.

SUBJECT-MATTER AND METHOD

1. Make a drawing of the beetle.

2. How many wings has the beetle? With a freshly killed specimen in hand, extend the two horny, sheath wing-covers, which meet by smooth edges along the middle of the back, completely covering the thin membraneous wings beneath. Spread out all four of these wings and make a drawing to show the wing arrangement.

3. Write a descriptive sentence about the mouth parts. Are they made for sucking or chewing and biting?

4. Write a sentence telling of the size and position of the eyes.

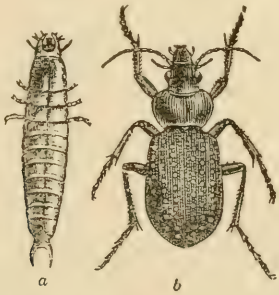
5. How many joints in the beetle's leg? Describe the claws.

6. How many segments in the abdomen? Compare the upper and lower surfaces.

7. Where do beetles live? Find as many different kinds as you can.

8. Life history:—The beetle has all the four stages: egg, larva, pupa, and adult. The egg of the beetle hatches into grubs, wire worms, borers, etc. In this stage they do great damage to the crops, trees, and other vegetation. From the grub stage they pass into a pupa stage similar to all other insects. The pupa is usually in the ground from which they emerge as adult beetles.

9. Most of the beetles are very injurious insects, the tiger beetles and lady beetles excepted, and since they are usually chewing insects, the treatment is a lead arsenate or Paris green spray.



GROUND BEETLE
a, Larva; *b*, Adult.
(Courtesy of Orange-Judd Co., Davis Agriculture.)

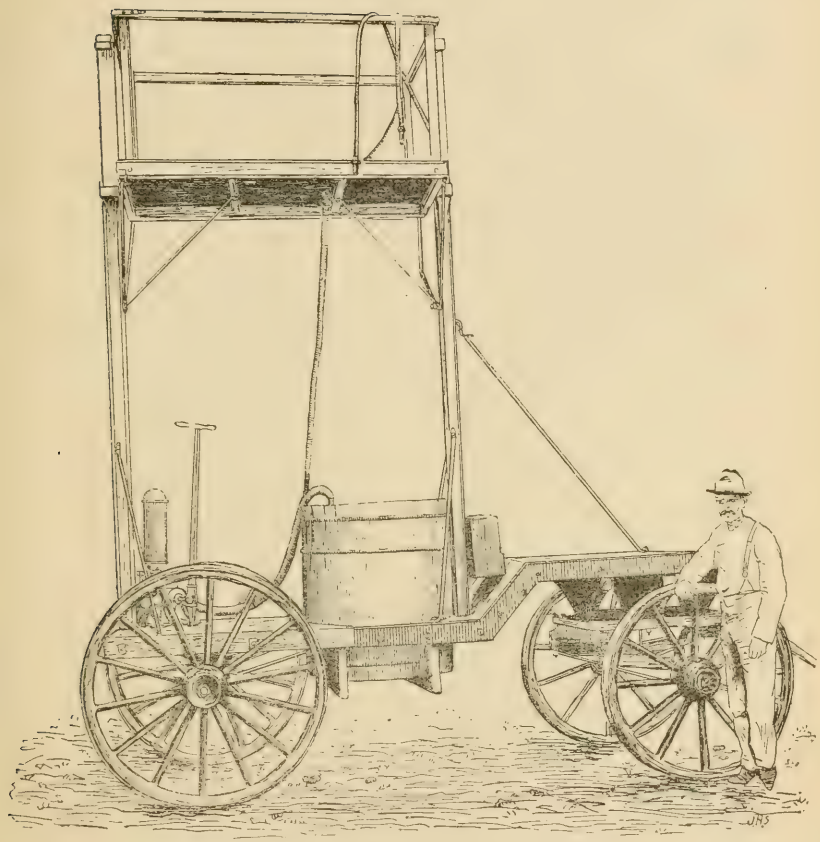
LESSON LXXIX

Title.—Spraying Calendar.
Season.—At any time.
Object.—To learn how to combat insect and fungous pests.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Copy the table given below into your note-book, and study it so that you can write it from memory when the first column is given you.

Insect Pest or Fungous Disease.	When to Spray.	With What to Spray or Treat.
Leaf-eating insects	When insect appears.	Paris green or lead arsenate.
Sucking insects	When appearing.	Kerosene emulsion or miscible oils, if no foliage.
Scale insects	Before buds open in spring.	Lime-sulphur wash.
Coddling moth and fungous injury	Just after apple blossoms fall.	Bordeaux mixture and lead arsenate combined.
Potato scab	Treat before planting.	Two per cent solution of formalin.
Striped melon beetle	When young plant appears.	Tobacco dust or lime.
Fruit rot, leaf curl and blight	Before buds open.	Bordeaux mixture.
All borers	Spraying not effective.	Dig out with wire and coat tree trunk with tar or lime wash.
Slugs	Whenever they appear.	Hellebore.
Peach yellows	Spraying not effective.	Cut down all diseased trees and burn.



SPRAYING APPARATUS

LESSON LXXX

Title.—Value of Birds to Agriculture.

Season.—May be a Winter lesson.

Object.—To learn something of the value of the birds to the farmer.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Some Facts About Birds.

The native birds are one of the nation's most valuable assets. If the birds were destroyed, in a very few years the insects will have mutiplied to such an extent that our trees would be defoliated, and our crops destroyed. This is not fancy but plain facts.

It has been found by observation and dissection, says Chas. K. Reed, that a Cuckoo consumes daily from 50 to 400 caterpillars, and that a Chickadee will eat from 200 to 500 insects or up to 4000 insect eggs. One hundred insects a day is a small estimate of the quantity consumed by insect eating birds, and most of our birds are insect eaters. Not only do they destroy great numbers of insects but they eat great quantities of weed seeds as well. The State of Illinois loses annually about $20,000,000 by the ravages of insects.

It is the duty, and it should be the pleasure of

every citizen, to do all in his power to protect these valuable birds, and to encourage them to remain about our homes.

Practical Problems.

1. Suppose that the damage from insects in your State is 25c an acre. How much would that be for the whole State?

2. If there were three birds on every acre, how many birds would there be in this State?

3. If each bird eats 25 insects a day (a very low estimate), how many insects would be destroyed in this State during the months of June, July, and August?

4. If 120,000 insects fill a bushel basket, how many bushels of insects would the birds eat during the summer from the above estimate?

5. Suppose that one-fourth of the birds in this State, as calculated above, would eat one-fourth of an ounce of seed daily, how many pounds of weed seeds would our birds destroy in three months?

The forces that work against the increase of bird life are: man; the climatic elements; accidents; cats; other animals; birds of prey, and snakes. How can we help the birds in their struggle against these enemies? Each one of us can do something, and every time we save the life of one bird, we have not only done a kindness to the creatures we should love, but we have rendered service to the cause of agriculture.

LESSON LXXXI

Title.—A Comparison of the Agricultural Products of Your State with Those of Other States. (Adapted from Davis Agriculture.)

Season.—A Winter lesson.

Object.—To teach pupils how the products of their state compare with the products of other states.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Take the data from the Year-book of the Department of Agriculture for 1905, and fill out the tabulation below:

STATES	CORN		WHEAT		OATS		HAY	
	Acres	Value	Acres	Value	Acres	Value	Acres	Value
West Virginia								
Ohio								
Indiana								
Illinois								
Pennsylvania								
Virginia								
Georgia								
Alabama								
Iowa								
Kentucky								
Maryland								

Construct a similar table for the data on live stock.

1. Horses: number, and value.
2. Mules: number, and value.
3. Milch cows: number and value.
4. Sheep: number and value.
5. Hogs: number and value.

The Year-book may be secured free from the Department of Agriculture, Washington, D. C., through your Congressman or Senator.

LESSON LXXXII

Title.—Crop Records. (Adapted from Davis Agriculture.)

Season.—At any time.

Object.—To teach pupils how to keep records of crops in a field.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

It is an important business matter for the farmer to keep year by year a record of the production of each field. This lesson should impress upon the pupils the importance of keeping such records neat and accurate. Use the form below, and require each pupil to keep a record of one of the fields at his own home. Neatly fill out the form in the agricultural note-book, and add the data from time to time as the field is farmed.

Name ..... P. O. .....

Crop ..... Previous Crop .....

Kind of Soil ..... No. of Acres .....

Preparation of the Soil.

Date of plowing ..... Date of Cultivation .....
Depth of plowing ..... Implement used .....
Cost of plowing ..... Cost of prep. seed bed .....

Seeding and Cultivation.

Date of seeding	Cost of fertilizer .....
Amount of seed	Dates of cultivation .....
Cost of seed	Implements used .....
Fertilizer used	Cost of cultivation .....

Harvest.

Date of harvest	Quality of the harvest .....
Cost of harvest	Yield, grain .....
Total cost of the crop.....	Yield, fodder .....
Insect injury	Yield per acre .....
Fungous injury	Net profit per acre .....

LESSON LXXXIII

Title.—An Estimate of the Cost and Receipts of a Good Crop Rotation.

Season.—A Winter lesson.

Object.—To calculate the net proceeds of a ten acre field in a crop rotation of two years with clover, corn and wheat.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Have pupils compare the data given in the ten acre rotation below, with prices and conditions in their home vicinity. The figures below are the actual record of an Illinois field under standard cultivation conditions:

1.	Clover sown in wheat in March—	
	Number of bushels	1
	Cost of seed	$6.50
	Cost of labor	$1.25
2.	Wheat cut in July. Threshed and marketed—	
	Yield	200 bushels
	Value of yield	$160.00
	Total cost of labor	$17.50
3.	Pasture in clover in the Fall—	
	No. of head	5
	No. of months	2
	Income from pasture	$12.00
4.	Clover hay harvested next June—	
	No. of tons	12
	Price per ton	$5.00
	Cost of labor	$12.00
5.	Clover seed crop in the Fall. Husked and marketed—	
	No. bushels yield	15
	Value of yield	$90.00
	Cost of labor	$20.00

6. Plow for corn the following Spring, and plant—
   Cost of labor $10.00
   Cost of seed (1½ bushels) $1.00
   Four cultivations..... Cost of labor for cultivation $7.50
7. Seeding wheat in the corn in September—
   Cost of seed, 1½ bushels per acre $12.00
   Cost of labor $4.00
8. Corn harvest in the Fall—
   Number of bushels 500
   Value of the yield $200.50
   Cost of labor $15.00

Let the students calculate the total cost, and receipts of this rotation, and the net gain on one acre for one year.

The last census shows that the average annual crop per acre in this country is valued at $11. How does this annual crop compare with the average?

LESSON LXXXIV

Title.—Preventing Grain Smut.
Season.—Previous to planting any grain.
Object.—To learn how to treat grains to prevent smut.
Material.—Bacteria cultures and the seed.

SUBJECT-MATTER AND METHOD

Smut has been quite prevalent in the grain fields throughout the country, and there are still a number of farmers who have not learned the simple formalin method of preventing it. If the school will make simple demonstration lessons upon grains brought in by the pupils from the farms, much good can be done, and great injury prevented among the grain fields.

In time before the corn, oats or wheat is to be planted, get about a pint of formalin, and have it on hand for this lesson. Ask some pupil to bring a bushel of oats or wheat to the school for this demonstration. Mix about one-half ounce of formalin in two gallons of water. Spread the seed thinly upon the floor, (if not on the school floor, a barn floor nearby might be used), and sprinkle the seeds with the mixture until they are all thoroughly moistened. Cover closely with a blanket of some kind for a few hours, and the seeds are ready for planting. Try this and the percent of smut at the next harvest will be materially lessened.

If this work be done for all those who bring seed to the school, or if it be done at the homes of the community because of the demonstration at the school, it will be an instance of service which will prove new lines of helpfulness for a school in a community.

LESSON LXXXV

Title.—Treating the Legumes for Bacteria.
Season.—Previous to planting the seed.
Object.—To learn how to get a "catch" of clover or cow peas.
Material.—Bacteria cultures and the seed.

SUBJECT-MATTER AND METHOD

Few farmers have realized the value of treating the seeds of clover and other legumes before planting to insure the presence of nitrogen-fixing bacteria. The school should treat such seeds as a demonstration for the farmers of the community, and as a valuable lesson for the pupils.

Send to the Secretary of Agriculture, Washington, D. C., for the bacteria cultures for legumes, and directions for using. These bacteria will come from Washington in a dried condition, resembling yeast cakes. Dissolve them in water and supply with nutrient salts. Two of the Sach's plant-food tablets to a pint of water, referred to in a former lesson, will furnish the nutrition for the bacteria. After the water solution becomes milky with the growth of the bacteria, pour the legume seeds into this solution and leave for a few hours. Then dry the seeds carefully and they are ready for sowing.

Some very marked results have been shown by the "catching" of clover on soils which would formerly not grow that crop.

LESSON LXXXVI

Title.—Roads and Road-making.
Season.—Autumn or Spring.
Object.—To learn something of the value of good roads, and some of the principles of road-making.
Material.—Note-book and pencil. Team of horses, wagon, plow, spades and gravel.

SUBJECT-MATTER AND METHOD

In the presentation of this important lesson the teacher should attempt to do two things: First, to have a regular text-book recitation upon the values and principle of roads; and second, to direct the work of real road construction, if no other than a properly made path from the school-house door to the main road.

Part I.

1. Our life in the country will never be as attractive as it ought to be until we have good roads. Bad winter roads that pen the young people in their homes for many months, cause them to grow to dislike the country, and to join that throng of restless humanity moving steadily toward the cities. Will not the young people who love their country homes enter into this crusade for better roads?

All industrial interests are affected by the nature and condition of the country roads, over which the products of the farm are transported to market, but it is the farmer who suffers most from the inferior roads which constitute so large a percentage of the road system of the United States. Over our country roads there are annually hauled at least 250,000,000 tons. A system of better roads would reduce the cost of hauling this volume of freight one-half or two-thirds of what it now costs them. Lead the class to see the following values of good roads:

1. The direct saving in dollars and cents.
2. A saving of time.

A BAD ROAD
(Courtesy of B. F. Johnson Pub. Co.)

3. Makes country life more desirable.

4. Makes school and church attendance more convenient.

5. More humane to horses.

6. Helps every industry of the city.

As a part of the preparation of this lesson each pupil should write a brief essay upon one of these topics.

2. **Points in the construction of a good road:**

1. A level road or gradual grade whenever possible.

2. The road bed, highest in the middle and sloping to each side, having a fall of one inch to three or four feet.

3. Under drains in wet places, and side ditches to carry off surface water should furnish the drainage necessary for good roads. Water, standing or running in roads is the great destroyer of good roads.

4. The surface should be hard and smooth. A good surface is made by putting a layer of larger stones at the bottom, a layer of smaller stones next, and crushed stone or gravel as the top layer.

5. Ordinary earth roads can be improved by proper grading and drainage. The best time to do this is in the Spring after the ground is settled.

6. Drains should be kept open, and all depressions filled.

Pupils should write a paragraph on one of these topics, in their note-books.

Part II.

For the second part of this lesson it might be possible at the school, to construct a path from the school house to some desired point a few rods away, according to the best principles of road-making.

If some of the larger boys or some school patron would furnish a few loads of coarse stone, a few loads of gravel, a plow and a team for a few hours, an inter-

A GOOD ROAD
(Courtesy of Orange-Judd Co., Davis Agriculture.)

esting and profitable demonstration of good road-making could be made at the school.

1. Select the line for the road or walk.

2. Measure off a space six feet wide, the entire length of the walk to be constructed, and mark it with stakes.

3. Plow up the whole area, turning it toward the middle. Then with spades or a scraper, if the space is large, grade it up from the sides to the center, so that the center is about one inch higher than the level of the ground where it is not plowed.

4. Place a layer of coarse stones over this surface next, and a layer of gravel or finer stones over the coarser stones. Smooth it all over so that the walk gradually slopes from the center to the ditch, left at the side by the plow's furrow.

5. The walk is now ready for use. The side ditch or drain should be kept open, and the road bed properly graded.

LESSON LXXXVII

Title.—An Assessment of Farm Values.
Season.—May be a Winter study.
Object.—To learn how to assess the property for tax on the home farm.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Have each pupil make a list of the real and personal property owned by his parents, with values such as could be received from sale. Use the form given below, and make a neat record of the assessment in the note-book:

Assessment Record.

Name of Farm ..... Date .....

	PROPERTY.	Number	Valuation
1.	Acres of land		
2.	Buildings		
3.	Horses		
4.	Cattle		
5.	Sheep		
6.	Hogs		
7.	Poultry		
8.	Farm machinery		
9.	Oats		
10.	Wheat		
11.	Corn		
12.	Household furniture		
13.	Hay		
14.	Money in bank or notes		

Total .....
Rate of taxation .....
Total tax .....

LESSON LXXXVIII

Title.—Farm Work-shops and Experimental Laboratories.

Season.—A Winter lesson.

Object.—To learn something of the value of a work-shop and laboratory to the farmer.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

1. Every farmer should have a building, or room in some building, in which he can do experimental work with plants, soils, etc., and in which he can do wood working, forging in iron, and general shop work. A shop well equipped with carpenter's tools, a forge and anvil, work-bench and its equipments would save the farmer many dollars and much time in the repairing of his implements and buildings. This same work-shop might be provided with apparatus for seed testing, fruit pruning and grafting, soil testing and analyzing, and various other chemicals and apparatus used in experimental work with plants and animals. It is through intelligent experimenting and careful reading that the farmer of the future is to take his place successfully among the industrial peoples of the country.

2. A room so equipped on every farm would furnish interesting and profitable work during the winter

months, and the results of the experiment in these laboratories might be profitably applied on the farm.

The following is a list of materials and furnishings that might be useful in the farm laboratory:

1. Work-bench and carpenter's tools.

2. Forge and anvil, with necessary tools accompanying.

3. Medicine case with drugs for animals; and chemicals, such as, formalin, sulphuric acid, ammonia, copper sulphate, lime, sulphur, lead arsenate, Paris green, hellebore, phosphoric acid, potash, sodium nitrate, etc., etc.

4. Tight case for various seeds.

5. Boxes of clay, sand and humus soils.

6. Table for general experimental work.

7. Water supply and means of heating the room.

The pupils and teacher may add other materials to the above room, and as a part of the work of this lesson, the pupils should draw the ground-floor plan of such a room as described above, and indicate in their plan, where they would place the different furnishings of the shop.

LESSON LXXXIX

Title.—Farm Machinery.

Season.—A Winter lesson.

Object.—To learn some facts regarding farm machinery, to encourage the use of improved machinery, and to understand the importance of caring for and repairing farm machinery.

Material.—Note-book and pencil. Various farm implements.

SUBJECT-MATTER AND METHOD

1. The drudgery of farm life is gradually being reduced by the invention and improvement of farm tools and machines. The following comparisons show the great development in farm implements:

THE OLD WAY.	THE NEW WAY.
The hoe.	The horse-drawn cultivator.
The grass cycle.	The horse mower and rake.
The grain cradle.	The steam-drawn harvester.
The single plow.	The steam gang plow.
The corn knife.	The corn reaper and husker.
The "up and down churn."	The "quick coming" churn.

2. Points in the care of farm machinery:

1. The farmer must know how to manage his machine.

2. Farm machine must not be left in the field to rust and rot.

3. As soon as any tool or machine has fin-

ished its work for the season it should be carefully cleaned and housed.

4. Every machine, implement, and vehicle should be properly oiled.

5. All needed repairs should be promptly made.

6. "Such care which is neither costly nor burdensome will add many years to the life of a machine."

3. If the school is in a town, the teacher should go with the class to an implement store and observe the different farm machines, tools, and implements.

4. Make a list of the different kinds of plows, harrows, reapers, planters, and grain separators that you know of.

5. Each pupil should make a list of the different farm implements at his home, and the make of each implement.

LESSON XC

Title.—The Water Supply.

Season.—At any convenient time.

Object.—To learn some facts about water and to appreciate the value of pure water and the dangers of impure water.

Material.—Clean test-tubes or bottles, sulphuric acid, potassium permanganate, nitric acid, silver nitrate, barium chloride, ammonium oxalate, impure water from a pond, and pure water.

SUBJECT-MATTER AND METHOD

1. There is nothing of more importance to the health, comfort, and convenience of a farm and household than an abundant supply of pure water. It is not easy to find absolutely pure water. Some of the impurities in drinking water are harmless; others are very injurious. The most dangerous impurities in water are the minute plant forms, called **bacteria.** One kind of bacteria occasionally found in drinking water, causes the typhoid fever. It is impossible to judge by the appearance or taste, whether water contains these dangerous bacteria. It may be perfectly clear and have the finest taste, and yet be unsafe to drink.

2. Sources of drinking water are:

1. Springs. Spring water is almost always

pure if the spring is deep and a good distance from foul places such as barnyards and open drains.

2. Lakes and reservoirs. Water supplied to cities is often taken from rivers and lakes, and purified to a certain extent and stored in reservoirs. If there is any doubt about the purity of the city water, people are advised to boil it in order to kill all the dangerous bacteria.

3. Wells. If wells are on a lower level than the barns or outhouses, they are likely to contain water with the dangerous bacteria in it. If any surface water can drain into the well it renders the water impure and unfit to drink. The land should not slope to the well from any house or barn, and the well cover should be perfectly tight to prevent animals from getting into it.

3. Good rules for drinking water:

1. If there is any doubt about the purity of drinking water it should be boiled.

2. Allow no standing water about the farm premises, for it may be the source of contamination for the drinking water.

3. Do not drink out of the cup at public drinking places, nor from the common cup or dipper often used in the school-room, for many disease germs are carried from one mouth to another, through the common drinking vessel. Pupils should have their own individual drinking cups.

4. Always have clean fresh water for the farm animals, for their health and growth depends as much on the water supply, as does our own.

4. Simple tests for mineral and organic impurities in water:

If this lesson is given in a school that has the material named above, the following tests will prove interesting and valuable:

1. Test for animal or plant matter—

Fill a clean test-tube half full of the drinking water. Add a drop or two of concentrated sulphuric acid, and sufficient potassium permanganate solution to color the water. Heat gently to the boiling point. If the color changes to a brownish tint, it indicates the presence of organic matter.

2. Test for chlorides—

To a test-tube half full of water, add a few drops of nitric acid, and then a few drops of silver nitrate solution. If there is any cloudiness, it shows that the water had traces of chlorides in it.

3. Test for sulphates—

To a test-tube half full of water add a few drops of barium chloride solution. If there is a whitish precipitate, it indicates the presence of sulphates in the water.

4. Test for lime compounds—

To a test-tube half full of water add a few drops of fresh solution of ammonium oxalate. A white precipitate indicates the presence of calcium or lime compounds.

As a note-book record of this lesson, the pupils should write an essay on the Water Supply, bringing out the facts they have learned, and showing the attitude they have toward the subject.

LESSON XCI

Title.—Cultural Requirements for Vegetables.
Season.—Spring.
Object.—To learn some requirements for vegetable culture.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Have pupils copy the following table in their note-books and learn it so that they can fill it out from memory when the column of vegetables is given:

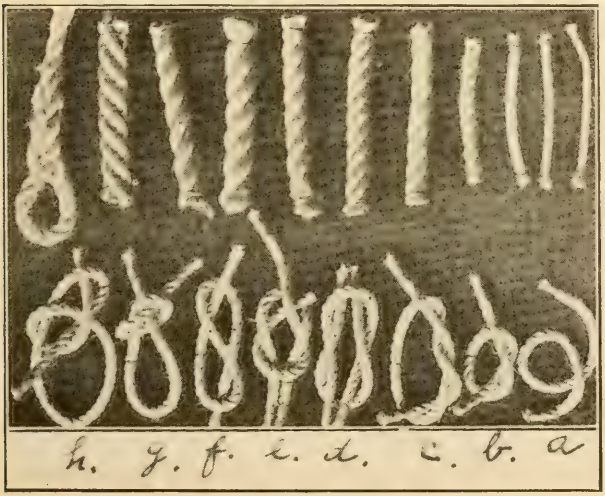
The Vegetable.	Soil Requirement.	Season Requirement.	Care Requirements
1. Radish.	Sandy loam soil, loose and rich.	Short season crop.	Clean cultivation. Protect from maggot.
2. Beet.	Loose, deep, cool, rich soil.	Full season.	Good tillage. Weeds kept down.
3. Turnip.	Cool moist soil.	Short season.	No care after sowing.
4. Potato.	Deeply pulverized, cool soil, rich in potash.	Early planting, full season.	Level culture, frequent tillage, spray against beetles.
5. Sweet potato.	Loose, warm soil, sandy loam.	Long season. Sunny.	Clean tillage, wood ashes fertilizer.
6. Onion.	Moist rich soil with loose surface.	Cool season. Early and late.	Good surface tilth. Good seed needed.
7. Cabbage.	Cool deep soil.	Full season.	Frequent tillage. Destroy the worm.
8. Spinach.	Cool moist soil.	Spring and Fall crop.	Grow in drills.
9. Lettuce.	Mellow, moist soil.	Short season.	Good soil preparation.
10. Celery.	Cool, rich, moist soil, well prepared.	Full season.	The best surface tillage, blanching.
11. Pea.	Light soil.	Short season.	Grown in drills. Easy culture.
12. Bean.	Light, sandy loam.	Warm season; partial.	Clean tilth. Poles for tall varieties.
13. Tomato.	Rich, "quick" soil.	Long, warm season.	Hill planting. Careful pruning, and frame supports.
14. Cucumbers, Melons, etc.	Loose, rich, well prepared seed-bed.	Long, warm season.	Frequent tillage until vines run. Combat melon beeltes.
15. Asparagus.	Deep, rich, moist, cool soil. Fertilize often.	Full season. Perennial.	Cut in fall and top dress with manure. Cease cutting in early summer.

LESSON XCII

Title.—Knot-tying in Ropes.
Season.—A Winter lesson.
Object.—To learn how to tie useful knots in ropes.
Material.—A few feet of rope for each pupil in the class.

SUBJECT-MATTER AND METHOD.

1. The tying of useful knots, rope splicing, making of hitching ropes, halters and other useful things



USEFUL KNOTS
(Courtesy of G. A. Allen, Manual Training School, Indianapolis, Ind.)

of this kind, are industries that belong to the farm, and should be included in a course of agriculture for the schools. The teacher should provide a rope and make models of each of the eight knots shown in the figure, and hang them up before the class.

2. Each pupil should have a piece of rope about one yard in length, and practice making these knots until he can do it with ease.

3. Names of the useful knots:

a. The single loop.

b. The overhand knot.

c. The overhand knot repeated. Used to keep the rope from slipping before making the square knot in tying bundles.

d. The square or reef knot. A strong knot which will not untie by pulling, but which can be easily broken and untied.

e. The loop knot. Used in making a halter that will not slip.

f. The figure of 8 knot.

g. The slip knot. Commonly used in hitching horses to racks.

h. The bowline knot. Used in tying the anchor of ships.

LESSON XCIII

Title.—Fences.

Season.—At any time.

Object.—To learn something about fences, their material, construction, and care.

Material.—Note-book and pencil. Fences for observation.

SUBJECT-MATTER AND METHOD

1. The construction and care of the farm fences are indications of the thrift or shiftlessness of the farmer. If the fences about the yard, gardens, and fields are neatly kept, not allowed to fall into ruin, and the weeds and bushes be cut from the rows and corners, it is a sign that the farmer takes a pride in his home and farm, and that he is successful in all the details of his business. The scarcity of timber is necessitating the use of wire, and hedging for fencing purposes. The various wire fences, supported by the locust or catalpa posts are perhaps the best fences to construct at the present time.

2. Have the pupils make a list of all the kinds of fences they have on the home farm. Explain how they are made, tell how long they have been constructed, and in what condition they are at present.

3. Teacher and class should go, at the conclusion of this lesson, to observe some fences in the neighborhood, and record the observations as follows:

Kind of Fence.	Materials Used.	State of Repair.	Needed Attention.

4. If there are any fences needing repair about the school yard or in the immediate neighborhood, it would be an excellent thing as an application of this lesson to have the pupils repair the fence and put it in as good a condition as they can.

5. Problems:

1. How many rods of fence will it take to fence a 160 acre farm?

2. How many locust posts would be required to fence the 160 acre farm with wire.

3. What would be the cost of woven wire fence for this farm?

4. How long should such a fence last?

LESSON XCIV

Title.—Wood Working.

Season.—Winter.

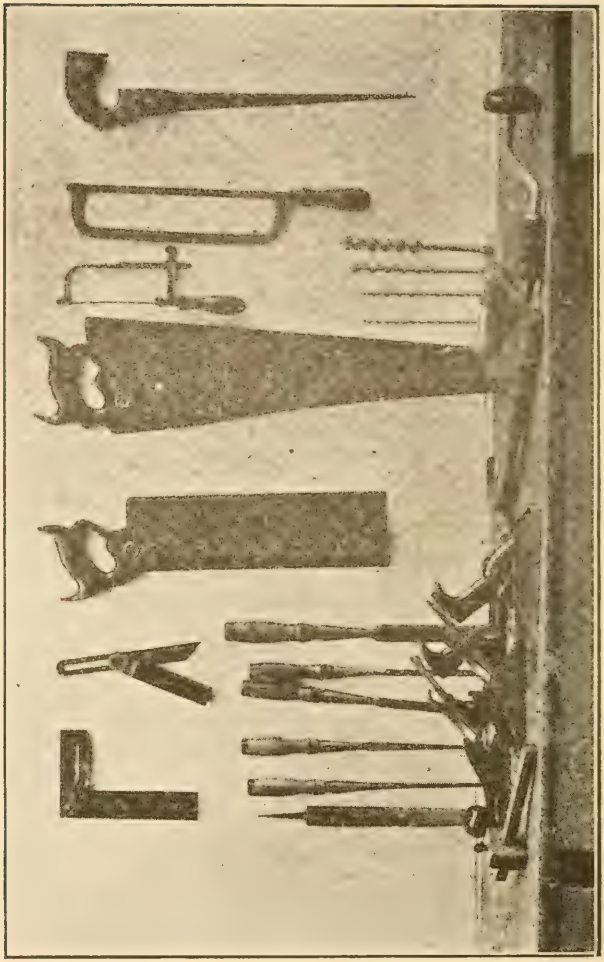
Object.—To learn how to handle tools and make some simple forms in wood.

Material.—A saw, chisel, brace and bits, a plane, a square, a marking gauge, hammer, nails, etc., and some pieces of lumber, and work-bench.

SUBJECT-MATTER AND METHOD

Note—This lesson is meant more for a suggestion of what may be done in the course in agriculture, than to give any explicit work for an extended development of wood working. It is very important that any farm boy or girl should know how to use tools, and to be able to make the necessary repairs and simple constructions needed on the farm. If the few tools can be provided, and the class in agriculture is willing to remain a few minutes after the regular school hours, a good beginning can be made in this line of industrial work, even in the country school. Perhaps two pupils at a time could remain to use the tools and do this work each evening until the series of articles suggested are made.

1. To saw a block, exactly four inches square. Do not be satisfied until the block is exactly square,

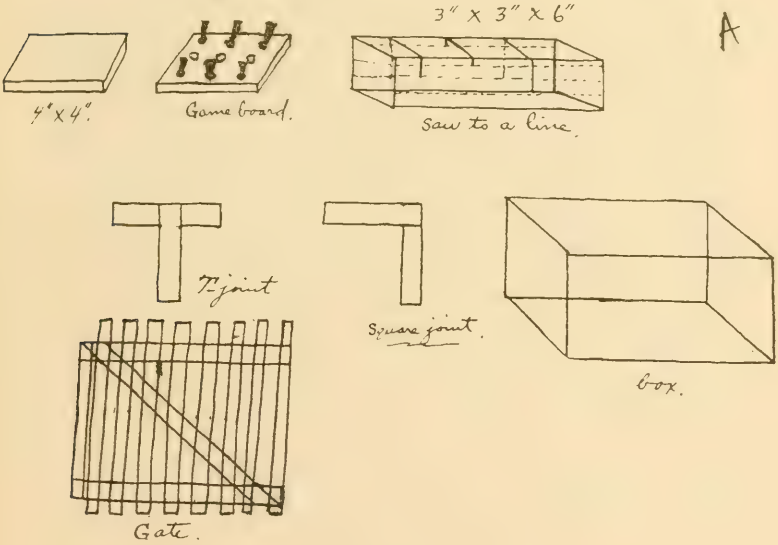


TOOLS FOR WOODWORKING
(Courtesy of G. A. Allen, Manual Training School, Indianapolis, Ind.)

and exactly four inches square by one inch in thickness.

2. To make a game board. Use the same block prepared above. Use the brace and bits and bore nine holes in the block, each hole one inch from the other, three rows of holes and three in a row. Now make six pegs to fit these holes. Color three of the pegs black with ink, and leave three unstained. The game board is now ready for use.

3. Sawing to a line. Take a block, 3″x3″x6″, mark lines on the six by three inch faces, parallel, one-half inch apart. Saw across the block, once to the one-half inch line, once to the inch line, and once to



the one and one-half inch line. Saw exactly to the line and stop.

4. The square and T-mortise joint. Take blocks of wood about 1"x1"x3" and plane them off smooth and clean. With the chisel and saw cut out a notch in the middle of one block to allow the end of the second to fit exactly into it. Make the joint even and neat. This is the T-joint. To make the square joint, bore and chisel out a hole near the end of the block, and cut a tongue in the end of the second block to fit exactly, and neatly into this hole.

5. To make a box. Pupils might make a pencil box, dimensions about 3"x3"x9". This would necessitate an accurate use of the saw, plane, square and hammer.

6. To make a gate. This piece of work would be a good practical application of all the pupils had learned in the more elementary practices. It would be worth while to try to have this article made at the school. Sample gates could be used as models.

The figures accompanying may help in some of these exercises.

The teacher should provide models for all the articles to be made.

LESSON XCV

Title.—The Outlook in Agriculture in West Virginia.
Season.—At any time.
Object.—To learn what agricultural operations would pay best in West Virginia.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Geographical and climatic conditions seem to indicate that there are three principal agricultural operations which would pay the farmers of West Virginia to develop.—

1. Fruit growing. Many hillsides, poorly adapted to grain cultivation, would produce profitable orchards of apple, peach, cherry, and other smaller fruits. Some of the best fruit plantations of the United States are in West Virginia, and what has been done in one place can be done in many other parts of the State, for the conditions of successful fruit culture are similar in many parts of the State. It would be better for the soil of many farms, and for the purses of many farmers were their hillsides planted to fruit trees, rather than to grain fields with weed-filled washouts.

2. Dairying, grazing and stock raising. West Virginia has ranked among the first states in the production of fine-wooled sheep, and there is no reason

that this rank should not be maintained. The hills will produce the finest of blue grass, timothy and clover, and there are many natural advantages which may be used in the winter protection of the flock. The increased demand for dairy products should encourage grazing and cattle raising. With the improvement of country roads, and the extension of the railroads and trollies, the sale of milk, butter and live stock will be greatly facilitated, and the dairy business become a profitable agricultural operation in the State.

3. Truck gardening. As the mines, and wells of oil and gas are developed throughout the State, more and more laborers leave the farm and become consumers of farm products rather than producers. In the many mining towns which have sprung up in all parts of West Virginia are thousands of laborers who do not even have a kitchen garden. The homes of these men must be supplied with the vegetables and products of the farm. If West Virginia farms and gardens do not furnish these, those of other states will. There are many fertile valleys and fields near these industrial centers that could produce far more than they now do, toward supplying the demand for food products.

4. After the discussion of this lesson in class, the pupils should write an essay on one of the above mentioned industries, and copy it neatly in their notebooks.

LESSON XCVI

Title.—The Rural Free Mail Delivery.

Season.—At any time. Should probably be given early in the year.

Object.—To learn something of the great service of the rural free mail delivery to the farmer.

Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

1. There is no modern convenience of greater importance to the country people than the rural free mail delivery. Although it is not self-sustaining, and costs the government large sums of money, it has come to stay, for the farmer sees that its service is a great necessity in the promotion of his welfare. In order to promote the greater efficiency of the rural delivery service, and at the same time render effective aid in the improvement of roads throughout the United States, the Post Office Department, and the Office of Public Roads have entered into a plan of co-operation looking to the betterment of all roads where the rural service is extended. Through this co-operation, recently a county in Indiana spent $85,000 for the improvement of the rural mail routes. Upon the advice of the Post Office Department, the Office of Public Roads sends its engineers to inspect and advise as to the construction of local roads.

2. Let the pupils find out from the local carrier the following points of information, and write it up in the record of this lesson:

1. How many miles does the carrier travel in a day?

2. What is the carrier's salary?

3. What is the condition of the roads?

4. How many daily, and how many weekly papers are delivered on the route?

5. What is the average, daily, first-class mail on the route?

6. Does the postage of this route pay expenses?

3. As another part of this lesson the teacher should have each pupil write a letter to the Department of Agriculture, addressed to the Secretary of Agriculture, Washington, D. C., asking for at least twelve of the following Farmers' Bulletins: Have this letter copied neatly in the note-book record of this lesson.

FARMERS' BULLETINS. (FREE.)

No. 22. The Feeding of Farm Animals.
No. 28. Weeds, and How to Kill Them.
No. 35. Potato Culture.
No. 41. Fowls: Care and Feeding.
No. 42. Facts About Milk.
No. 43. Sewage Disposal on the Farm.
No. 44. Commercial Fertilizers.
No. 49. Sheep Feeding.
No. 51. Standard Varieities of Chickens.
No. 54. Some Common Birds.
No. 55. The Dairy Herd.
No. 59. Bee-keeping.
No. 62. Marketing Farm Produce.
No. 66. Meadows and Pastures.
No. 77. The Liming of Soils.
No. 80. The Peach Twig Borer.
No. 86. Thirty Poisonous Plants.
No. 91. Potato Diseases and Treatment.
No. 95. Good Roads for Farmers.
No. 99. Insect Enemies of Shade Trees.
No. 109. Farmers' Reading Courses.
No. 111. Farmers' Interest in Good Seed.

No. 113. The Apple.
No. 126. Practical Suggestions for Farm Buildings.
No. 127. Important Insecticides.
No. 128. Eggs and Their Uses as Food.
No. 132. Insect Enemies of Growing Wheat.
No. 134. Tree-planting in Rural School Grounds.
No. 136. Earth Roads.
No. 141. Poultry Raising on the Farm.
No. 154. The Home Fruit Garden.
No. 155. How Insects Affect Health in Rural Districts.
No. 156. The Home Vineyard.
No. 161. Practical Suggestions for Fruit Growers.
No. 170. Principles of Horse Feeding.
No. 173. Primer of Forestry.
No. 184. Marketing Live Stock.
No. 185. Beautifying the Home Grounds.
No. 187. Drainage of Farm Lands..
No. 192. Barnyard Manure.
No. 196. Usefulness of the American Toad.
No. 198. Strawberries.
No. 199. Corn Growing.
No. 203. Canned Fruits, Preserves, and Jellies.
No. 208. Varieties of Fruits Recommended for Planting.
No. 213. Raspberries.
No. 215. Alfalfa Growing.
No. 218. The School Garden.
No. 220. Tomatoes.
No. 228. Forest Planting and Farm Management.
No. 229. The Production of Good Seed Corn.
No. 231. Spraying for Cucumber and Melon Diseases.
No. 235. Cement, Mortar, and Concrete.
No. 240. Inoculation of Legumes.
No. 241. Butter Making on the Farm.
No. 252. An Example of Model Farming.
No. 243. Fungicides and Their Use.
No. 245. Renovation of Worn-out Soils.
No. 247. The Control of the Coddling Moth and Apple Scab.
No. 248. The Lawn.
No. 250. The Prevention of Smuts in Grain.
No. 255. The Home Vegetable Garden.
No. 256. Preparation of Vegetables for the Table.
No. 260. Seed of Red Clover in Its Impurities.
No. 265. Game Laws for 1906.
No. 266. Management of Soils to Conserve Moisture

Note.—The first rural route ever established was from Charles Town, West Virginia, by W. L. Wilson, Postmaster General.

LESSON XCVII

Title.—Beautifying Home Grounds.
Season.—Autumn or Spring.
Object.—To learn something of the principles of landscape art, and how to map and design the home and school grounds.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

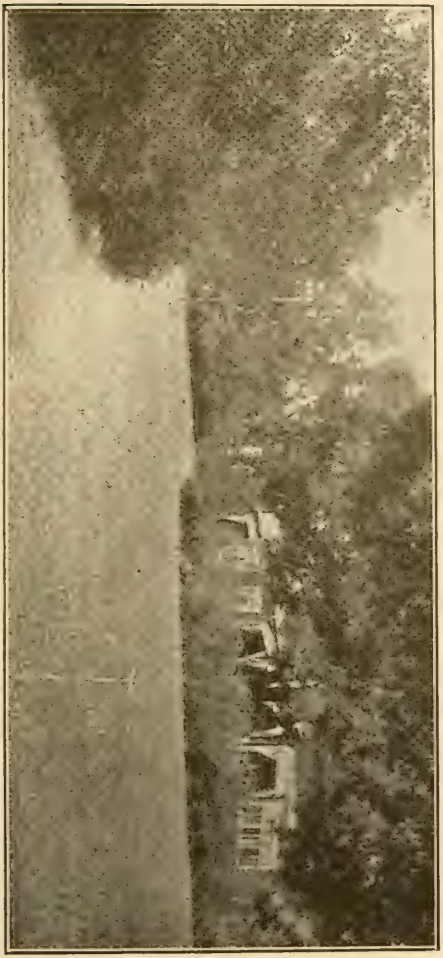
1. Learn the following rules which should guide in every effort to beautify the school and home grounds:

(a) Keep the lawn space open and green.

(b) Plant in masses at the background, against buildings or on the borders, hiding objectionable views and opening up pleasing vistas.

(c) Avoid the straight line in tree planting and walk making.

2. It does not require wealth nor rare plants to beautify the home or school grounds. With little expense, good taste, a knowledge of the above principles, and a willingness to work, the homes and schools of our country could be made more attractive and more natural. The woods are full of wild shrubs and flowers, that could be growing on our home and school grounds, if we would only transplant them there. On arbor day every school should revive the interest of



BEAUTIFUL HOME GROUNDS

the community in tree-planting and other means of beautifying the home grounds. Back-yards with barren ground covered with old tin cans and broken down chicken coops are not the surroundings in which boys and girls can grow up into beautiful and useful characters. Our minds are influenced by what we continually look upon, and if we must look upon ugly landscapes, we tend to grow sordid and ugly in spirit; on the other hand, if we grow up in a home and school surrounded by beautiful natural scenes, our lives must grow more refined and appreciative.

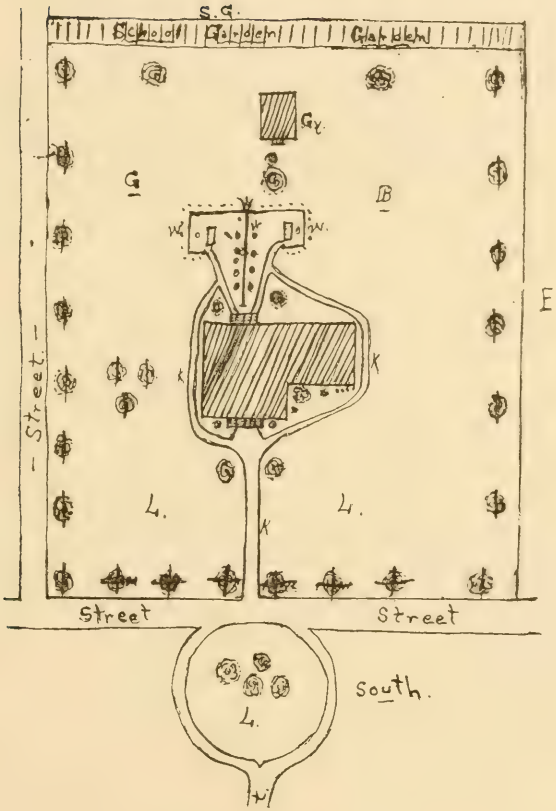
3. Draw a map of the school grounds, locating all buildings and plants. Indicate in the drawing the planting design you would advise.

4. Draw a map of your home grounds, showing the location of all buildings and plantings. Criticize the plan of the planting.

5. Make a list of all the trees, shrubs, and flowers that are growing as ornaments on your home ground.

6. Have a "cleaning up" week, in which the school yard is cleared of all trash and ugly objects. Carry this move to the homes, and have the pupils enter competitive home- ground cleanings. This could be done in preparation for arbor day, and the planting of flowers, shrubs, and trees would be a fitting climax to the whole work.

7. List of annual flowers: Seed to be sown after the danger of frost is over. The best results are obtained if the plants are started in the house in April and set out after the tenth of May. Aster, Cockscomb, Cosmos, Dahlia, Mignonette, Myosotis, and Salvia.


S.G.
School
Gardens
Gardens
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B
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Street
Street
Street
South.
L.
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8. Annuals: Seeds to be sown early. April or early May. Ageratum, Alyssum, Amaranth, Candytuft, Carnation, Chrysanthemum, Dianthus, Larkspur, Marigold, Nasturtium, Petunia, Phlox, Poppy, Sweet Pea, Verbena, and Zinnia.

9. List of popular perennials: Plants to be grown the previous summer. Columbine, Campanula, Canna, Hollyhock, Poppy (hardy), Rudbeckia, Sunflower, Sweet William, Delphinium, and all hardy pinks.

10. List of shrubs for borders: Flowering Almond, Dwarf Cornus, Elder, Forsythia, Bush Honeysuckle, Hydrangea, Japan Quince, Lilac in variety, Privet, Roses in variety, Snowball, Spirea, Sumac, Weigelia, Deutsia, Norway Spruce, and other evergreens.

11. List of trees for home and school grounds: Sugar Maple, Norway Maple, Box Elder, White Elm, Silver Maple, White Birch, Catalpa bungei, Tulip tree, Mulberry, White Oak, etc.

12. In planting trees about our homes and schools, we should not forget to plant a few such as the Serviceberry, Hackberry, Wild Cherry, etc., which furnish food for the song birds and attract them to our homes to add their life and cheer to the natural surroundings.

LESSON XCVIII

Title.—The Farm Home.
Season.—At any time.
Object.—To try to picture the ideal farm home.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

1. Our lessons in agriculture would not do justice to rural life if we did not refer to the country home, and its work and influence. The development of the material and industrial side of the home life has not kept pace with the progress of men's work on the outside. Many of the industries of the early homes have been wisely taken from them and given over to the factories and shops. Two industries yet remain; cooking and cleaning. These are not much further advanced in their development than they were a thousand years ago. The time may come, it is to be hoped that it will, when women of the home will be relieved from most of the drudgery of cleaning and cooking, and these industries be turned over to specialists who will do them better and cheaper than they are now done, and that the home may become a place of rest and culture for the lives within. It will be long years before such ideals can be realized in the country, yet much can be done in the country home to lighten the

labors of the mother, and enlighten the members of the household.

2. Some conditions making for the betterment of the farm home:

1. Beautiful natural sourroundings, as brought out in a former lesson.

2. Absolute cleanliness from cellar to garret.

3. The absence of all carpets, lace curtains, and bric-a-brac, and their places supplied with smooth, hard-wood finish of window and door casings; hard-wood, waxed floors; and furniture of plain, uncarved, smooth type.

4. Few pictures, well selected, in plain, modest frames, placed upon walls of restful tints.

5. Good books, daily papers, magazines, and farm journals in the library.

6. Musical instruments and members of the family who can appreciate good music.

7. Ample, shady porches, screened doors and windows, and well ventilated rooms.

8. Pure, clean food, well prepared and cooked, and cool, clean kitchen and dining rooms in which to prepare and eat the meals.

9. A bath-room, with hot and cold water supplied.

10. A telephone, and rural free mail service.

11. All the labor saving machines that can be afforded.

12. Good roads, good schools, good churches, good markets available, and good people to live in the homes.

3. A stronger and better country home! That is what we want. That is what we must have. The "New Earth" that is coming, will bring its rural homes of good cheer, of culture and education. In these homes will be strong men, sensible women, and happy children. Love will be law and wisdom chief ruler, and the child that is born in them is sure of all that the highest thought can secure for him in body, soul and spirit.

"This is the stronger home, and in that home must be seen all the graces and gentleness in thought and word that make the happy illumination which, on the inside of the house, correspond to morning sunlight outside, falling on quiet dewy fields. Out of such homes neither knaves in politics, nor tyrants in business competition can ever come. With such homes, the golden age already dawning as the new century opens hastens its steps.

And for the woman in that home:—

"A woman, in so far as she beholdeth
Her one Beloved's face;
A mother,—with a great heart that enfoldeth
The children of the race;
A body free and strong, with that high beauty
That comes of perfect use is built thereof;
A mind where reason ruleth over duty,
And justice reigns with love;
A self-poised, royal soul, brave, wise, and tender,
No longer blind and dumb;
A human being of unknown splendor,
Is she who is to come." —(Helen Campbell.)

LESSON XCIX

Title.—The Grange.
Season.—At any time.
Object.—To learn something of the work and purpose of the Grange, the greatest farmers' organization in the world.
Material.—Note-book and pencil.

SUBJECT-MATTER AND METHOD

Some facts about the Grange, submitted to the author by Prof. T. C. Atkeson, Master of West Virginia State Grange, and Overseer of the National Grange.

"The idea of a farmers' fraternal organization originated in the mind of Oliver H. Kelley, a Minnesota farmer, while on a trip through the southern states in 1867, soon after the close of the great Civil War, where he had been sent by President Johnson to see what might be done to rebuild the devastated agriculture of that great agricultural region. Mr. Kelley was a high degree Free Mason, and naturally his idea of a farmers' organization took the form of a secret society. Soon after his return to Washington, where he reported to the Department of Agriculture, he paid a visit to his niece, Miss Carrie A. Hall, who resided in Boston, and outlined to her his proposed farmers'

organization. Miss Hall suggested that farmers' wives and daughters be admitted on full equality with the men, and from the first, the organization which followed has made no distinction on account of sex. Mr. Kelley unfolded his plans to a number of gentlemen in the Department of Agriculture and elsewhere, who became interested in the matter.

The first meeting was held in the office of William Saunders, the horticulturist of the Agricultural Department at Washington, on the evening of December the fourth, 1867, which has ever since been known as the birthday of the order. The organization was named, "Patrons of Husbandry," and the word, "Grange," which means a farm home, was substituted for "lodge" as used by other organizations.

There are Subordinate, Pomona, State, and National Granges, each one of which is represented by delegates in the next highest body up to the National Grange which is the supreme authority. All Granges have the same officers as follows: Master, Overseer, Lecturer, Stewart, Assistant Stewart, Chaplain, Treasurer, Secretary, Gate Keeper, Ceres, Pomona, Flora, and Lady Assistant Stewart.

The purpose of the organization is to promote the interest of agriculture in every legitimate way possible, educationally, legislatively, co-operatively, and socially, with a view to develop a better manhood and womanhood on American farms. In its forty-one years of history, the Grange has accomplished a vast amount of good for American farmers, and practically every advancement made by agriculture in that time originated with the Grange or has been effectively pro-

moted by it. The Grange was an important factor in the establishment of agricultural colleges, and high schools, and originated the idea of teaching elementary agriculture in the public schools. Experiment stations are mainly the product of Grange advocacy. Rural mail delivery, the Department of Agriculture, the Interstate Commerce Commission, and hundreds of other measures of state or national legislation originated with the Grange or were promoted by it. Its value to agriculture is beyond computation."

The Grange is a live institution. It is satisfying a great need in rural society. It is based on correct principles: organization, co-operation, education. It is neither a political party nor a business agency. It is neither ultra-radical nor forever in the rut. Its chief work is on cultural lines. It includes the entire family. It is now growing, and its growth is of a permanent character.

"The Grange is ambitious to take its place beside the school and the church, as one of the trinity of forces that shall mold the life of the farmer on the broadest possible basis,—material, intellectual, social, and ethical. Is there any good reason why this ambition is not worthy, or why its goal should not be won?" (President Butterfield of the Mass. Agricultural College, from his Chapters on Rural Progress.)

Why Farmers Should Join the Grange.

(By the authority of the Master of the National Grange.)

1. Because it is inexpensive.
2. Because it is the farmer's only organization,

national in character.

3. Because it has stood the test for forty-one years, and has never been found wanting in any respect.

4. Because it has exerted greater influence in securing state and national legislation in the interest of agriculture than any agency in the country.

5. Because it is officered by those engaged in agriculture, who know from experience the needs of farmers, and are sincere in their desire to aid them in every possible way.

6. Because it is the duty of farmers to co-operate with one another, if they would successfully meet the influence of organization in every direction, and secure for wife and home a fair share of what the harvest yields.

7. Because it has exerted the greatest influence known in breaking up the isolation of farm life, and in making farm life attractive to the boys and girls, bringing sunshine and happiness into the farm home to such an extent as has never before existed.

After the teacher has discussed this lesson with the pupils, all the text-book should be laid aside, and the pupils asked to write a brief essay in their note-books on the Grange, its history, plan of organization, purposes and work.

LESSON C

Title.—Juvenile Agricultural Societies.
Season.—At any school term.
Object.—To learn how to organize and conduct an agricultural club or society among boys and girls.
Material.—The school house may be the meeting place of a permanent organization. Such other materials as any organized body needs.

SUBJECT-MATTER AND METHOD

This subject is here treated as a lesson in order to be in harmony with the plan of the series. In the agriculture class, on the day preceding the organization of the society, the teacher should announce the plan and try to awaken an interest in the organization, and its purposes.

A Friday afternoon quarter may be devoted to this work, and the pupils above the age of eight included. All boys and girls should know how to organize themselves, for in this way is learned that great lesson of co-operation, so vital today in rural life.

Let one of the older boys, at the suggestion of the teacher, call the meeting to order. Then let some boy rise and say:

"Mr. Chairman, I nominate John Reihle (for example) for President." Another rises and says:

"Mr. Chairman, I second the nomination."

Then let some one rise to say:

"Mr. Chairman, if there are no other nominations, I move that John Reihle, be declared elected President of this Society."

Some one says, "I second the motion," then the boy who is acting as chairman says:

"It has been moved and seconded that John Reihle be declared President of this Society. Are there any remarks?" Hearing none, he says, "All those in favor say, 'yes' ". He estimates the vote. "All those opposed say, 'no' ". . If he receives more for than against, the chairman declares that John is elected.

John then takes the place of the Chairman, and conducts the meeting. A secretary is then elected as above, preferably from among the girls. The following Constitution and By-laws should be read by one of the pupils, and adopted by the Society as a tentative working plan:

Constitution and By-laws of the Pre-juvenile Grange Club.

Article 1.

The name of this society shall be the Pre-Juvenile Grange Club.

Article 2.

The objects of this society shall be, as the name signifies, to grow into the Juvenile Grange with all its plans and purposes; to encourage the study of

Agriculture in the school and home; to promote contests in plant growing, animal raising, literary work, etc.; and to cultivate a love for the farm and home.

Article 3.

All the boys and girls of the school over eight years of age are eligible for membership. Any person over eight and under fifteen, in the district and not in school, may be elected to membership by a majority vote.

Article 4.

The membership fee shall be ten cents, and the annual dues, five cents, payable at the beginning of the school year.

Article 5.

The officers shall consist of President, Vice-president, Secretary, Treasurer, Speaker, and Usher.

Article 6.

It is the duty of the President to preside at all meetings, preserve order, and command obedience to all rules. His emblem is a red ribbon worn on the lapel of his coat. The Vice-president assists the President and presides in his absence. His emblem is a blue ribbon. The Speaker will assist the President and Secretary in arranging the literary program for the reg-

ular meetings. His emblem is a green ribbon. The Secretary will keep a record of all meetings, receive the fees and dues of the members, and pay the same to the Treasurer, take and keep his receipts therefor. His emblem is the white ribbon.

The Treasurer shall take charge of and keep all the money of the society, and pay out the same only upon orders signed by the President and Secretary. His emblem is the yellow ribbon.

The Usher guards the door, shows members and visitors to seats, and helps the President preserve order. His emblem is a blue rod.

Article 7.

This society shall meet every two weeks at the school house, either in the afternoon or evening as the teacher decides. Meetings may be held at the homes of members.

Article 8

The order of business at the regular meetings shall be as follows:

1. Roll call.
2. Reading of minutes of last meeting.
3. Report of committees.
4. Proposals for membership.
5. Voting on new members.
6. Literary program.
7. Miscellaneous business.
8. Adjournment.

By-laws.

1. The literary program prepared by the Speaker, President and Secretary, shall consist of music, recitations, readings, essays, orations and debates. The program shall be announced by the Speaker, two weeks in an advance.

2. An annual exhibit should be arranged, perhaps best in the Autumn, in which the boys will exhibit field or garden products they have grown, and the girls flowers, vegetables or cookery. In preparing for this exhibit, the boys should each select in the spring the plat of ground, not to exceed one acre, nor less than ⅛ acre, prepare, plant or sow any crop he may desire. Send for the best seeds, either to the Department of Agriculture at Washington, D. C., or to the State Agricultural College. From either of these places the pupil may get bulletins on any crop he chooses to grow for the exhibit.

3. The teacher and society shall organize committees to solicit prizes to award at the exhibit for the best vegetables, grain, animals, cookery, etc., brought by the pupils.

4. The Society shall take an annual excursion, visiting the farms and homes of the district. This may take the form of a picnic, and be the happy ending of the school term.

5. This constitution and by-laws may be amended at any meeting by a two-thirds vote, provided the proposed amendment is posted in the school rooms two weeks before adoption.

To the teacher: This society may be, and should be, if a Grange is in the district, developed into the Juvenile Grange, a national order, recognized by the Patrons of Husbandry.

The Juvenile Grange is a most excellent organization for young people of the country. It has just enough secret work about it to make it attractive to young folks, and the ceremonies are beautiful and full of good lessons which every boy and girl should heed. In changing the above society to the Juvenile Grange, write to Prof. T. C. Atkeson, Morgantown, W. Va., Overseer of the National Grange, or to C. M. Freeman, Tippecanoe City, Ohio, Secretary, for the Manual of the Juvenile Grange. Juvenile Granges must be organized under the special charge of a Subordinate Grange.

APPENDIX

SAMPLE LESSON, "WRITTEN UP," TO SHOW PUPILS HOW EACH LESSON SHOULD BE RECORDED IN THEIR PERMANENT NOTE-BOOKS.

LESSON I

TITLE.—Composition of Soils.

SEASON.—(State the time when the lesson is studied.)

OBJECT.—To study the composition of soils.

MATERIAL.—A cupful of ordinary soil, some humus, three one-quart fruit-jars, and water.

SUBJECT-MATTER AND METHOD.

1. A cupful of ordinary soil was placed into one of the quart jars and allowed to soak for a few hours in water that just covered it. The jar was then filled two-thirds full of water, the contents thoroughly stirred, and allowed to settle for one minute. The water and suspended soil was drained off into the second jar, leaving *sand* and *gravel* in the first.

2. The contents of the second jar settled for five minutes, and the water was then drained off into the third jar. *Silt* was left in the second jar.

3. The contents of the third jar settled three days, after which the water was drained off. *Clay* was left in the third jar.

NOTE.—A similar record of each lesson should be made in the Agricultural Note-book, at the conclusion of the experimental or observational work. A few of the most important facts should always be noted under the heading, "Things Learned from This Lesson."

Things Learned From This Lesson.

4. Sand originated from the crumbling of silicon rock, clay from feldspar rock, and humus from decayed plant or animal life. The particles of clay are the smallest and stickiest of all soil particles. Humus will burn, but sand and clay will not. Sand is the heaviest soil by weight, but clay is usually referred to as heavy soil, and sand as light soil. Clay soils ought not to be worked while wet, because they will puddle and bake into hard clods when dried out. A loam is a mixture of sand, silt, clay, and humus.

5. Make drawings of the three jars used.

PRACTICAL INFORMATION.

Contents of Fields.

10 rods×16 rods=1 acre.
8 rods×20 rods=1 acre.
10 yds.×484 yds.=1 acre.
40 yds.×121 yds.=1 acre.
220 feet×198 feet=1 acre
120 feet×363 feet=1 acre.

Quantities of Seed Required to the Acre.

Wheat, 1½ to 2 bushels.
Oats, 2 to 4 bushels.
Rye, 1 to 2 bushels.
Corn, ⅛ to ¼ bushel.
Potatoes, 5 to 10 bushels.
Timothy, 12 to 24 quarts.
Red Clover, 6 to 12 pounds.

Weights of Grain Seed in Majority of the States.

Wheat, 60 pounds per bushel.
Corn, 56 pounds per bushel.
Oats, 32 pounds per bushel.
Clover Seed, 60 pounds per bushel.
Timothy Seed, 45 pounds per bushel.
Rye, 56 pounds per bushel.
Blue Grass Seed, 14 pounds per bushel.
Potatoes, 60 pounds per bushel.
Fine Salt, 50 pounds per bushel.
Corn Meal, 50 pounds per bushel.

To Find the Number of Bushels in a Bin.

Multiply together the length, breadth, and thickness in feet, and multiply this product by 8. (After Goff & Mayne.)

To Find the Number of Tons of Hay in a Mow or Rick.

In Mow. Multiply together the height, length and breadth in feet, and divide the product by 450 for timothy, and by 600 for clover hay.

In Rick. Multiply the length by the breadth, and that product by one half the difference between the breadth and the distance over. This will give cubic feet. Divide as above to find the number of tons. (Goff & Mayne.)

SPRAY MIXTURES.

For Fungous Diseases.

Bordeaux Mixture.

3 lbs. copper sulphate,
6 lbs. lime.
50 gallons water.

For Chewing Insects.

3 lbs. to 10 lbs lead arsenate (disparene).
100 gallons of water.

For Sucking Insects.

2 gallons kerosene.
1 gallon water.
½ pound whale-oil soap.
15 to 20 gallons water.

ELEMENTS OF FORESTRY.

In connection with the lessons on trees in this text, the following outline from Circular 130 of the Forest Service, will furnish some excellent subject-matter for the teaching of the elements of forestry:

A. The forests of the locality in which you are teaching.
  1. Economic value.
    1. As sources of useful products.
    2. For conservation of water. (Irrigation, water power, town and city supplies, etc.)
    3. For protection. (Floods, hot, cold, and drying winds.)
    4. Influence on erosion and soil protection.

II. Location, extent, and character of these forests.
  1. On what kind of land (hilly, rocky, sandy, swampy, or agricultural).
  2. Character and use.
    a. Softwoods or hardwoods.
      Virgin or lumbered.
      Dense, thin, or open.
      Mature or immature.
    b. How utilized—conservatively or destructively, for saw timber, fuel, or other purposes.

III. Protection of forests.
  1. Forest fires.
    a. Season of the year they occur. What are the causes?
    b. State legislation concerning forest fires. Methods of protection — State, National and private.
    c. Precautions individuals should take against fires.
  2. Grazing.
    a. Damage to forest.

B. The forest of your state.
  I. General.
    1. Approximate proportion of State forested.
    2. Principal forest products.
    3. Relation to important industries of the State.
    4. Forest planting in the State—public and private.
  II. Forest reserves.
    1. Location and size of State reserves and National forests.
    2. Purposes of the reserves.

C. The forests of the United States.
  I. General.
    1. Approximate proportion of the United States forested.
    2. Principal forest regions.
    3. Principal forest products.
    4. Relation to important industries of the country.
  II. National forests.
    1. General location.
    2. Purposes.

CORNELL UNIVERSITY SCORE-CARD FOR FARMS.

	Standard Score	Students' Score
1. Kind of Farming—		
Adaptation as affecting value	3	
2. Size—		
As adapted to kind of farming to be used.	2	
3. Shape—		
As affecting shape of fields	2	
As affecting nearness of farmstead	3	
4. Topography—		
As affecting production	1	
As affecting ease of cultivation	3	
As affecting loss of soil fertility	2	
5. Fertility—		
Natural	15	
Condition	5	
6. Physical Properties—		
As affecting economy of cultivation	1	
As affecting number of days of labor	1	
As affecting loss of soil fertility	2	
7. Drainage—		
Natural or artificial	5	
8. Condition—		
Freedom from stumps, stones, weeds, waste land, etc.	3	
9. Climate—		
As affecting production of live stock	3	
As affecting number of days of labor	2	
10. Healthfulness—		
As an economic factor	5	
11. Water-supply—		
Running water and wells	5	
12. Location—		
Local markets	5	
Neighbors	5	
Shipping facilities	5	
Roadways	5	
13. Improvements—		
Location of farmstead	3	
House as adapted to farm needs	5	
Other buildings as adapted to size of farm and kind of farming	5	
Fences, character, condition, arrangement	2	
14. Timber, orchards, vineyards, etc	2	
Total	100	

The above score card, worked out for the pupils' home farms, would make valuable lessons in Elementary Agriculture.

President Roosevelt appointed recently a commission to study and report upon the conditions of American country life. This commission, of which L. H. Bailey is chairman, has submitted the following important questions to farmers, teachers, ministers, business men, and others interested in country life:

1. Are the farm homes in your neighborhood as good as they should be under existing conditions?

2. Are the schools of your neighborhood training boys and girls satisfactorily for life on the farm?

3. Do the farmers in your neighborhood get the returns they reasonably should from the sale of their products?

4. Do the farmers in your neighborhood receive from the railroads, trolley lines, etc., the service they reasonably should have?

5. Do the farmers in your neighborhood receive from the United States postal service, rural telephone, etc., the service they reasonably should expect?

6. Are the farmers and their wives satisfactorily organized to promote their mutual interests?

7. Are the renters of farms in your neighborhood making a satisfactory living?

8. Is the supply of farm labor in your neighborhood satisfactory?

9. Are the conditions surrounding hired labor on the farms in your neighborhood satisfactory to the hired men?

10. Have the farmers in your neighborhood satisfactory facilities for doing their business in banking, credit, insurance, etc.?

11. Are the sanitary conditions of the farms in your neighborhood satisfactory?

12. Do the farmers and their wives and families in your neighborhood get together for mutual improvement, entertainment, and social intercourse as much as they should?

Note.—Accompanying each question are the subordinate questions: "Why?" "What suggestions have you to make?"