A Unit in Agriculture

ELLIFF

A UNIT IN AGRICULTURE

AN OUTLINE COURSE OF STUDY AND STUDENT'S LABORATORY MANUAL, FOR TEACHERS AND STUDENTS IN SECONDARY SCHOOLS

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INTRODUCTION.

"The most significant fact in the educational world to-day is the demand that agriculture be taught in the public schools. * * * I do not believe in that philosophy of education which would establish separate schools for the various industries and occupations of life." * If we accept these statements, the conclusion is obvious: we should teach agriculture in existing high schools and we should do it now.

We should teach this subject in existing schools because:

1. We are not ready to establish separate industrial or trade schools in this country. Such schools, if maintained at state expense, smack of European conditions and class distinctions.

2. We could not meet the expense of a dual system of secondary schools, even if we were willing to do so. Most districts find some difficulty in providing adequately for existing schools. To divide our energies and resources between two systems of high schools, would mean the ultimate failure of both.

3. The existing high schools can easily be made to fill the demand. When agriculture is put on an equal footing with other subjects, when teachers are employed who know and can teach the subject, and when they are given time and equipment to teach it, the problem will be solved.

4. Measured by any standards of educational aims and educational values, courses in agriculture will compare favorably with other courses taught.

We should introduce this subject immediately, for the very excellent reason that the demand must and will be met. Some states have

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* From an address by Dean E. Davenport, College of Agriculture, University of Illinois.

already waited too long and as a result now face the problem of a dual system of high schools. Certainly no greater misfortune than this could befall the public schools of any state.

It seems to me that the growing demand of our people that the schools be brought into closer relationship with the life of today; that the courses of study take into account, in some measure at least, the dominant interests of the community; that, among other standards of selection, we give some attention to the immediate interests and future prospects of our pupils; is not only fair and just, but is eminently sound pedagogy. If so, then the immediate problem confronting all of us who are interested in secondary education is, how to organize this course, how to fit it into the curriculum and how to teach it so as to secure its maximum educational value to our pupils. It is in the hope that I may contribute something to the solution of this problem, that this book is written.

In the preparation of the book many sources of information have been drawn upon, but the plan is original. I am especially indebted to Dean F. B. Mumford, Professor J. C. Whitten and Mr. C. B. Hutchison, of the College of Agriculture, for valuable suggestions and corrections; and to Professor J. H. Coursault, of the School of Education, for reading the proof.

J. D. ELLIFF.

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PURPOSE AND PLAN.

The teaching of agriculture in the high schools is beset with many difficulties, among which are the following:

1. Scarcity of trained teachers.
2. But few good high school texts.
3. A frequent misconception of the purpose and value of the course on the part of teachers and parents.
4. Confusion of pupils and teachers due to the wide variety of suitable topics that may be studied and the great abundance of illustrative material.
5. The still too common notion that agriculture is essentially a book study which can be taught independently of laboratory and field.
6. Lack of definite form and content of the course.

This book is an attempt to obviate some of these difficulties by:

1. Planning a course that any wide awake, progressive teacher who has had any scientific training can teach successfully.
2. Referring throughout to the best standard authors in order to give the student a broader and clearer view than is possible where only one book is used.
3. Securing the coöperation of parents by bringing them into direct contact with the work of the pupils in the home garden and field.
4. Making the best possible use of illustrative material in the laboratory, garden, and field, in order to give the students an opportunity to observe and study the fundamental processes at first hand.
5. Confining the work to a comparatively few essential topics and providing a definite amount of laboratory work on each.

The bulletin consists of two parts. Part I is for the use of the teacher and contains:

1. Suggestions concerning equipment.
2. General suggestions.
3. Outline course with lists of readings.

Part II is a pupils' laboratory manual.

A UNIT IN AGRICULTURE

PART I.

I. SUGGESTIONS CONCERNING EQUIPMENT.

A. Material to Be Collected by Teacher and Students at the Beginning of the Year.

1 bushel clean sand.
1 bushel sandy loam soil.
1 bushel clay.
8 quarts leaf mold (well rotted).
1 bushel rich soil for use in growing house plants.
Samples of commercial fertilizer, with analysis and prices given.

Collection of economic seeds.

(These may be secured free of U. S. Department of Agriculture. In ordering this collection, address U. S. Dept. of Agriculture, Seed Laboratory, Washington, D. C. When you order, send $1.50 to Mackall Bros., 9th and H Streets, N. E., Washington, D. C. This is to pay for the tray and vials used in packing the collection. Notify the Department that you have sent the money to pay for tray and vials.)

Collections of economic seeds prepared by teacher and students.

1. Seeds of the following trees: oak, walnut, hickory, hazel, apple, pear, peach, cherry, plum, etc.

2. Cereals: corn, wheat, oats, rye, barley, rice, etc.

3. Grasses and clovers: red clover, alsike, white clover, alfalfa, timothy, millet, orchard grass, blue grass, Johnson grass, Bermuda grass, cowpeas, redtop, etc.

4. Common weeds: purslane, morning glory, Jamestown weed, cocklebur, cheat, ragweed, horseweed, etc.

B. Apparatus for Soil Studies.

(Equipment for 20 students.)

1 pair of balances weighing to grams or quarter ounces. (A four-pound postal scale may be used.)
5 glass tumblers.
10 wide mouthed 8-ounce bottles.
10 pint glass fruit jars.
5 thermometers.
10 student lamp chimneys.
10 shallow pans.
½ lb. glass tubing (small sizes).
¼ lb. glass rods (small sizes).
Filter paper.
Litmus paper.
5 glass or tin funnels.
5 small sieves of various meshes.
10 six-inch flower pots.

C. Material for Plant Studies.

(Equipment for 20 students.)

10 heavy dinner plates for seed germination.
10 panes of glass (8x11 inches).
10 small microscopes.
Quantity of heavy cotton cloth for use in seed germination.
10 shallow wooden boxes (12x18x3 inches) for growing cuttings, etc.
Apparatus for Babcock milk test (cost $5.00).

If possible, not less than one-half acre of good land for a school garden and experiment field. (If the school has no such plot, land from a nearby farm may be rented.)

Apparatus now in the physical, chemical, or biological laboratory need not be duplicated for agriculture. Much of the material can be made by the students or brought from their homes. The entire list should be purchased through a local dealer for about $18.00.

D. Text-Books.

If one copy of each of the following four books is purchased for each four pupils in the class, it will not be necessary for the students to purchase any book. This plan is strongly recommended. If any particular text is used, it should be one of these:

Elements of Agriculture, *Warren,* Macmillan Co.....$1.10
Agriculture, *Jackson & Daugherty,* Orange Judd Co..... 1.50
Agriculture, *Ferguson & Lewis,* Ferguson Publishing Co., Sherman, Texas..... 1.00
First Book of Farming, *Goodrich,* Doubleday, Page & Co..... 1.00

E. Books for Special Reference.

Types and Breeds of Farm Animals, *Plumb,* Ginn & Co..... 2.00
Physics of Agriculture, *King,* published by the author, Madison, Wis..... 1.75
Nursery Book, *Bailey,* Macmillan Co..... 1.50
Experiments with Plants, *Osterhaut,* Macmillan Co..... 1.25
Soils, *Lyon and Fippin,* Macmillan Co..... 1.75
The Soil, *King,* Macmillan Co..... 1.50
Progressive Poultry Culture, *Brigham,* Torch Press, Cedar Rapids, Iowa..... 1.30

From the Secretary of Agriculture, Washington:

1 complete set Farmers' Bulletins, and extra copies, one for each member of the class, of Nos. 44, 123, 143, 154, 157, 187, 203, 218, 229, 255 and 260.
1 copy of list of bulletins for free distribution.
1 copy of list of publications for sale. (Some of these may be obtained through the congressman of the district.)
Year Books, U. S. Dept. of Agriculture.
U. S. Bureau of Entomology, Circular No. 59.
U. S. Office of Experiment Station, Circular No. 34.
U. S. Bureau of Soil Study, Circulars Nos. 13, 195.
U. S. Bureau of Plant Industry, Circular No. 30.
1 set of your State Agricultural College Reports.

U. S. Bureau of Animal Industry, Bulletins Nos. 37, 113.
Bureau of Education Bulletin No. 2 (1907).
Note.—Where no price is given the books are free.

F. Books Very Desirable, but Not Absolutely Essential.

Cyclopedia of American Agriculture, (four volumes), *Bailey,* Macmillan Co.....$20.00
(This is the very best work of the kind, and will be of much value to patrons as well as to students.)
Principles of Fruit Growing, *Bailey,* Macmillan Co..... 1.50
Plant Breeding, *Bailey,* Macmillan Co..... 1.25
Vegetable Gardening, *Bailey,* Macmillan Co..... 1.50
The Horse, *Roberts,* Macmillan Co..... 1.25
Fertilizers, *Voorhees,* Macmillan Co..... 1.25
Farm Science, International Harvester Co. (free).
Corn, *Bowman & Crossley,* published by the authors, Ames, Iowa 2.50
Farm Buildings, Sanders Publishing Co., Chicago..... 2.00
First Principles of Soil Fertility, *Vivian,* Orange Judd Co.... 1.00
Soils, *Burkett,* Orange Judd Co..... 1.00

G. Each School Should Subscribe for a Few Agricultural Papers.

II. GENERAL SUGGESTIONS TO TEACHERS.

1. The teacher should have a definite aim and plan for each lesson, a clear notion of what he is going to do, the sources of information and the material to be used.

2. As a general rule, the laboratory and field work should precede the study of the text. The following order is strongly recommended:

a. The experiment, field or laboratory. Written or printed directions for the work should be given. See Part II. Pupils should be required to manipulate carefully, observe closely, think connectedly, and record in writing.

b. The assigned readings.

c. The recitation. Here the whole topic should be reviewed, put in correct form and reduced to use. An opportunity to show the bearing and use of the lesson on the home life of the child and the community should never be lost.

4. Each student should keep a note book in which each laboratory and field exercise and each demonstration is carefully recorded in good English. This note book should contain the date and subject of each exercise, a statement of the materials used, description of the work done, and such illustrative drawings as may be necessary. In preparing an index to his note book, the student should specify whether the work is a laboratory exercise, a field exercise, or a demonstration made by the teacher or by another student. The index should bear the teacher's endorsement certifying that it is a true abstract of the student's work.

5. The course is planned for one year. At least two double periods per week should be given to individual laboratory or field work. It is expected that some schools will do more work than is outlined and that each will place some emphasis upon such topics

as are of special interest to the community in which the school is located.

6. While certain substitutions may be made in both library and equipment, the lists given are considered minimum lists and should be provided.

7. The course as planned presupposes no previous scientific training on the part of the pupil, and may be placed in any year of the high school. Students having had one or more sciences will do more work than those who have had no such training. If physical geography is taught, it is strongly recommended that this subject be given in the first year and agriculture in the second year.

8. *A beginning should be made.* If the teacher cannot get everything he needs, he should use what he has and can get. Much good work can be done with only such equipment as teacher and students can provide.

9. Remember that *agriculture cannot be taught successfully from a book alone.* To attempt to do so when there is such an abundance and variety of illustrative material is an unjustifiable waste of time. The pupil should not study about soil; he should study soils.

10. The required readings are given in Part I rather than in Part II for the reason that the teacher should carefully guide in the work. The teacher knows best what reading is necessary and when it is necessary. Each of the text-books gives some information concerning most of the lessons. For this reason, the texts are not given in the lists of readings. The teacher should select the best reference from each text.

11. The teacher will find it necessary to exercise careful supervision over the library. If possible, a separate case for the agricultural library should be provided.

12. The lesson should be studied by the teacher in advance of the assignment of class work. The required readings should be selected and placed on the blackboard as necessary from time to time.

13. The teacher should not be satisfied with the literature given. He will doubtless be able to find much additional that is as good or better.

14. If possible a school garden in which each student has his own plot of ground should be provided. For suggestions concerning the equipment and management of the school garden, see *Farmers' Bulletins,* Nos. 94 and 218, U. S. Department of Agriculture, and *Agricultural Education,* James A. Jewell, Bulletin No. 2 (1907), Bureau of Education, Washington, D. C. The school garden may be made the most interesting and profitable part of the work.

15. The books for special and general reference should be kept by the teacher or librarian and should be taken from the library only by permission of the teacher. Many of these books will interest patrons. With these books as a basis, an agricultural library should be built up for the use of all the people in the community. The high school should be made a social and agricultural center for the community.

16. While the topics may be studied in other than the order named, it is probable that the order given is best. In any event, soil study should precede plant study, and farm management should come last.

17. It is believed that the average class can complete the course as planned and do all the work well in one year of nine months.

18. If at any time suggestions are needed all the assistance possible may be secured by addressing your State Agricultural College.

19. Problems and review questions may be selected from the excellent lists in Warren's text.

20. This course is largely a compilation of what seems to be the best features of several courses. It is at best only tentative and will doubtless need revision. To this end, the author will appreciate the criticisms and suggestions of teachers it.

III. OUTLINE COURSE.

A. FARM CROPS.

I. Corn.

1. Study of a grain of corn. Ex. 1.
2. Study of an ear of corn. Ex. 2.
3. Study of complete plant. Ex. 3.
4. Study of the three principal types of corn:
   - (a) Pop corn.
   - (b) Dent corn.
   - (c) Sweet corn.
5. A more careful study of the six important varieties:
   - (a) Boone County White.
   - (b) Reid's Yellow Dent.
   - (c) St. Charles White.
   - (d) Leaming.
   - (e) St. Charles Yellow.
   - (f) Commercial White.
6. Corn judging, use of score card. Exs. 4 and 5.
7. How to select and store seed corn.
8. Testing seed corn for germination. Ex. 6.
9. Methods of cultivation.
   - (a) Relation of climate to corn production.
   - (b) Preparation of soil for corn; fall plowing, spring plowing, depth of plowing.
   - (c) Fitting the land after plowing.
   - (d) Planting: time, manner, depth, distance apart, number of grains in a hill, etc.
   - (e) Tillage: tools, frequency, depth of tillage, etc.
   - (f) Harvesting.
10. Simple methods of corn improvement.
    - (a) Ear to row plot in field.
11. Enemies of corn and how to control or destroy them.

12. Corn and corn products: importance, use and value.

Literature.

The Nebraska Corn Book.
Farm Science, pp. 21-39.
Farmers' Bulletins, Nos. 199, 229, 253, 298, 303, 313.
Bureau of Entomology, Circular No. 59.
Office of Experiment Station, Circular No. 34 (rev.).
Year Book, Reprints 446 (1907), 488 (1908).
Bowman and Crossley, Corn.

II. Wheat.

1. Study of a grain of wheat. Ex. 7.
2. Study of a head of wheat. Ex. 8.
3. Study of a complete plant. Ex. 9.
4. Principal varieties.
5. Improving of wheat.
   (a) Crossing.
   (b) Selection of seed.
   (c) Selection of individual plants.
6. Methods of cultivation.
   (a) Relation of climate to wheat production.
   (b) Plowing for wheat: time, depth.
   (c) Preparation of ground after breaking.
   (d) Sowing: broadcast, drill; amount of seed per acre.
7. Harvesting and marketing wheat.
8. Wheat and wheat products: importance and value.
9. Enemies of wheat and how to fight them:
   (a) Rust.
   (b) Hessian fly.
   (c) Chinch bug.
   (d) Smut.

Literature.

Farmers' Bulletins, Nos. 132, 250.

Bureau of Soil, Circular No. 195.
Bureau of Entomology, Circular No. 70.

III. Oats.

1. Study of a head of oats. Ex. 10.
2. Principal varieties.
3. Methods of cultivation.
   (a) Preparation of seed bed: plowing vs. disking.
   (b) Seeding: drilling vs. broadcasting; amount of seed per acre.
4. Treating oats for smut.

Literature.

Farmers' Bulletin, No. 250.
Bureau of Plant Industry, Circular No. 30.

IV. Shipping, Storing, Testing, Grading, and Marketing Corn, Wheat, and Oats.

V. The Legumes.

1. Identification and description of alfalfa, red clover, alsike, white clover, cow peas, soy beans, and vetch. Ex. 11.

2. Methods of cultivation, character of soil, preparation of seed bed, inoculation of soil, amount of seed per acre, time of season to sow, methods and time of cutting and curing.

3. Use and value of each.

Literature.

Farmers' Bulletins, Nos. 58, 89, 121, 194, 278, 289, 315, 318, 339, 372.

VI. The Grasses.

1. Identification and description of blue grass, orchard grass, timothy, Bermuda grass, redtop and Johnson grass.

Literature.

Farmers' Bulletins, Nos. 66, 312.

VII. Potatoes.

1. A study of the Irish potato. Ex. 12.

2. Effect of large and small potatoes on yield.
3. Selection of seed potatoes.
4. Principal varieties.
5. Methods of cultivation.
6. Enemies of the Irish potato and how to fight them: scab, dry rot, potato beetles.
7. Sweet potatoes: principal varieties, method of culture, yield and uses as compared with Irish potatoes.
8. Improvement of potatoes.
   (a) Selection from high yielding hills.

Literature.

Farmers' Bulletins, Nos. 35, 91, 295, 324.

VIII. Cotton.

1. Study of cotton plant.
2. Principal types of cotton:
   (a) Sea Island type.
   (b) Upland type.
3. Conditions of soil and climate favorable to the production of cotton.
4. Planting and cultivation of cotton.
   (a) Preparation of soil.
   (b) Planting.
   (c) Cultivating.
   (d) Harvesting.
5. Preparation for market.
   (a) Ginning.
   (b) Baling.
6. Cotton seed and cotton-seed products, importance and use.
7. Insect enemies of cotton and how to fight them.

Literature.

Farmers' Bulletins, Nos. 36, 48, 209, 211, 285, 286, 302, 314, 344.

IX. Tobacco.

1. Study of complete plant.

2. Conditions of soil and climate favorable to the production of tobacco.
3. Principal varieties.
4. Planting and cultivating tobacco:
   (a) Preparation of seed bed.
   (b) Time and manner of sowing the seed.
   (c) Preparation of the soil for crop.
   (d) Transplanting.
   (e) Cultivating.
5. Harvesting tobacco.
6. Curing and preparation for market.
7. Insect enemies of tobacco and how to fight them.

Literature.

Farmers' Bulletins, Nos. 60, 82, 83, 126, 343.

B. THE SOIL.

1. Origin and formation of soil. Ex. 17.
2. Composition of soil. Exs. 13, 14, 15, and 16.
3. Soil water. Exs. 17, 19, 20.
4. Experiments to show how plants absorb water from the soil. Exs. 21, 22, 23.
5. Soil air. Ex. 25.
6. Soil temperature. Ex. 18, 26.
7. Soil drainage. Ex. 27.
8. Meaning and method of tilling the soil.

Literature.

King, The Soil, chapters 2, 5, and 6.
King, Physics of Agriculture.
Any good Physical Geography, chapter on weathering.
Farmers' Bulletins, Nos. 187, 245, 257, 266.
Bureau of Soils, Circular No. 13.
Year Book, Reprint, No. 169 (1899).

C. PLANT PROPAGATION.

I. Propagation by Seeds

1. Process of germination.
   (a) Absorption of moisture.
   (b) Chemical changes of compounds in the seed from insoluble to soluble substances.
   (c) The production of heat.
2. Conditions of germination.
   (a) Vitality of seed.
   (b) Moisture.
   (c) Heat.
   (d) Air.
3. Vitality of seeds conditioned by:
   (a) Maturity.
   (b) Age.
   (c) Size.
   (d) Kind.
   (e) Extremes of temperature.
   (f) Repeated germination.
   Exs. 28, 29, 30.
4. Methods of production and preservation of most important seeds.
5. Selecting seeds of different crops.
6. Seed testing.
   (a) For germination (see Ex. 6).
   (b) For impurities. Ex. 31.
7. Treatment of refractory seeds.
   (a) By freezing (hickory, oak, walnut, hazel, pear, apple, peach, plum, etc.).
   (b) By scalding (black locust, honey locust, Kentucky coffee bean).
   (c) By stratifying (berries, blackberry, strawberry, raspberry, rose).

II. Propagation Other Than by Seeds. Ex. 32.

1. Spores—mushrooms, ferns.
2. Root stocks—iris, calamus, June grass.
3. Stolons or runners—strawberry.
4. Suckers or root stalks—blackberry.
5. Bulbs or corms—onion, crocus.
6. Tubers—Irish potato, artichoke.
7. Cuttings—grape, currant.
8. Grafts—apple, pear.
9. Layers—grape, ornamental vines.
   Exs. 33, 34, 35, 36, 37.

Literature.

Plant Propagation, Pub. School Bulletin, No. 1, pub. by University of Missouri.
Farmers' Bulletin, No. 157.
Bailey, Nursery Book.

D. PLANT GROWTH.

1. Conditions of plant growth.
   (a) Plant food.
   (b) Moisture.
   (c) Heat.
   (d) Air.
   (e) Light.
   Exs. 38, 39, 40.
2. Principal elements of plant food: oxygen, hydrogen, nitrogen, carbon, sulphur, phosphorous, potassium, calcium, magnesium, iron.
3. Air-derived elements: oxygen, hydrogen, nitrogen, carbon. Exs. 41, 42, 43, 44. (See any elementary chemistry for O., N., H., CO_2.)
4. Soil-derived elements: nitrogen, phosphorus, potassium, magnesium, iron, sulphur. Ex. 45.

5. Relative amount of soil-derived and air-derived plant food.
6. Most important soil-derived elements: nitrogen, phosphorus and potassium. Ex. 46.

E. ENEMIES OF PLANTS.

1. Insects.
   (a) Biting insects, as potato beetle, cabbage worm, etc.
   (b) Sucking insects, as chinch bug, plant lice, squash bug, San Jose scale, etc.
2. Diseases caused by certain bacteria, as fire blight in pear and apple tree.
3. Fungus diseases, as brown rot on peaches, potato scab, rust on wheat and oats, etc. Ex. 47.
4. Spraying to control insects and diseases.
   (a) Fungicides—Bordeaux mixture, lime-sulphur, etc.
   (b) Poisons for biting insects—Paris green, arsenate of lead, hellebore, etc. Ex. 48.
   (c) Contact remedies for sucking insects—lime-sulphur, tobacco, carbon bisulphide, etc.
5. Identification of injurious insects and preparation of collection. Exs. 49, 50, 51, 52, 53.

Note.—This collection should be as complete as possible, well mounted and increased from year to year. It should include all the more common insect enemies of corn, wheat, potatoes, orchard fruits, and garden plants.

Literature.

Bailey, Nursery Book.

Farmers' Bulletins, Nos. 91, 99, 126, 132, 155, 227, 231, 264, 275, 281, 283, 316, 320, 329.

Cyclopedia of American Agriculture.

E. ANIMAL HUSBANDRY.

I. The Horse.

1. Origin and brief history.
2. The two principal types.

(a) The speed type. (b) The draft type.

3. Breeds of horses.
   (a) Draft breeds—Percheron, Clydesdale, English Shire.
   (b) Roadsters—American trotter, American saddle horse, English thoroughbred, Hackney French coach.
4. Care of horses.

Literature.

Plumb, Types and Breeds of Farm Animals, pp. 1-166.
Bureau of Animal Industry Bulletins, Nos. 37, 113.
Farmers' Bulletin, No. 170.

II. Cattle.

1. Origin and brief history.
2. The two principal types.
   (a) Dairy cattle.
   (b) Beef cattle. Ex. 54.
3. Breeds of cattle.
   (a) Beef breeds—Shorthorn, Hereford, Polled Hereford, Aberdeen-Angus, Polled Durham, Galloway.
   (b) Dairy breeds—Holstein-Friesian, Jersey, Guernsey, Ayrshire, Dutch Belted, Brown Swiss.
   (c) Dual purpose breeds—Shorthorn (milking strains), Devon, Red Polled.
4. Cattle products—meat, milk, leather, glue, etc.

Literature.

Plumb, Types and Breeds of Farm Animals, pp. 175-322.
Farmers' Bulletins, Nos. 29, 42, 55, 63, 71, 106, 166, 183, 233, 241, 350.

III. Sheep.

1. The two types.
   (a) Wool producing type.
   (b) Mutton producing type.
2. Principal breeds.
   (a) Wool producing—American Merino, Delaine and Rambouillet.

(b) Mutton producing—Shropshire, Southdown, and Cotswold.

3. Care of sheep.

Literature.

Plumb, Types and Breeds of Farm Animals, pp. 333-454.
Farmers' Bulletins, Nos. 96, 119, 159.

IV. Swine.

1. A study of the following principal breeds: Poland-China, Berkshire, Duroc-Jersey, Chester White, Hampshire, Tamworth, Large Yorkshire.
2. Care of swine.
3. Diseases of swine and how to control or prevent them.
   (a) Hog cholera.
   (b) Tuberculosis.

Literature.

Farmers' Bulletins, Nos. 100, 133, 222, 272, 296, 315, 329.
Plumb, Types and Breeds of Farm Animals, pp. 467-554.

V. Poultry. Chickens.

1. The four principal types.
   (a) Meat type.
   (b) Egg type.
   (c) General purpose type.
   (d) Ornamental type.
2. Breeds.
   (a) Meat type or Asiatic class—Brahma, Cochin, Langshan.
   (b) Egg type or Mediterranean class—Leghorns, Minorca, Black Spanish. Ex. 55.
   (c) General purpose or American class—Plymouth Rock, Wyandotte, Rhode Island Red.
3. Care of poultry.
   (a) Feeding chickens.
   (b) The incubator.
   (c) The chicken house. Ex. 56.

4. Poultry and poultry products, their growing importance, value and use.

Literature.

Farmers' Bulletins, Nos. 51, 128, 182, 236, 281, 287.

VI. Live Stock Judging.

1. Horse.
   (a) Heavy horse. Ex. 57.
   (b) Light horse. Ex. 58.
2. Cattle.
   (a) Beef cattle. Ex. 59.
   (b) Dairy cattle. Ex. 60.
3. Sheep.
   (a) Mutton. Ex. 61.
4. Swine. Ex. 62.

VII. Feeding.

1. Composition of food plants: (a) water, (b) ash, (c) protein, (d) fats and carbohydrates.
2. Percentage of each in different plants.
3. Function of each constituent.
4. Composition of animal tissue. (Compare with animal food plants.)
5. Digestion and palatability of foods.
6. The balanced ration.

C. PROBLEMS OF FARM MANAGEMENT.

I. Choice of Farm Determined By:

(1) purpose, (2) capital, (3) character of soil, (4) climate, (5) nearness to market, (6) improvements, (7) environment—roads, schools, factories, etc.

II. The Farm Home or Dwelling:

(1) location, (2) character and material, (3) number and arrangement of rooms, (4) drainage, (5) water supply, (6)

lighting, (7) heating and ventilation, (8) furniture, (9) environment—shade, lawn, other buildings, etc. Exs. 63, 64.

Literature.

Farmers' Bulletins, Nos. 126, 155, 270, 317, 342.

III. Other Farm Buildings:

(1) number, (2) purpose, (3) location, (4) material, (5) adaptability, (6) sanitation. Ex. 65.

Literature.

Farmers' Bulletins, Nos. 32, 126, 136, 225, 227.

IV. Maintenance of Soil Fertility.

1. Fundamental importance of this problem. (Review work on soils and plant growth.)
2. The problem involves:
   (a) The topography of the land.
   (b) The physical properties of the soil.
   (c) The chemical constituents of the soil.
3. Means of maintaining soil fertility.
   (a) Crop rotation.
   (b) Use of fertilizers. Ex. 66, 67.

Literature.

Missouri Experiment Station, Circular No. 38 (1910). [Best.]

Farmers' Bulletins, Nos. 44, 77, 192, 222, 225, 245, 257, 266, 278, 327, 342.

Vivian, First Principles of Soil Fertility.

V. Improvement of Farm Animals.

1. Determining what animals shall be grown on the farm.
2. Importance of selecting only the best breeds.
3. Economy in feeding—the balanced ration.
4. Study of comparative value of common foods at current prices

Literature.

Plumb, Types and Breeds of Farm Animals.

Farmers' Bulletins, Nos. 22, 49, 71, 96, 100, 137, 170, 205, 364, 378.

VI. Farm Machinery.

A study of the best types of farm machinery in use in the community.

Literature.

Farmers' Bulletins, Nos. 303, 321, 347.

VII. Additional Topics for Special Study.

(Select at will according to the dominant interests of the community.)

1. The home garden. Ex. 68.

Literature.

Farmers' Bulletins, Nos. 94, 154, 218, 255.

2. Farm forestry. Ex. 69.

Literature.

Farmers' Bulletin, No. 173.

Year Book, 1903, pp. 279-88.

3. Agricultural manufacturing. Ex. 70.
4. Special study of the dairy.
   (a) Butter making—the Babcock milk test. Ex. 71.
   (b) Cheese making.

Literature.

Farmers' Bulletins, Nos. 29, 55, 166, 201, 227, 241.

PART II.

STUDENTS' LABORATORY MANUAL.

FARM CROPS.

Ex. 1. A Grain of Corn.

Soak a few grains of corn in hot water for twenty minutes. With a small sharp knife, remove the *tip cap*. This tip cap is a small cap covering the end of the kernel. Beginning at the end where the hull has been broken by the removal of the tip cap, pull off the *hull* in strips. The part immediately under the hull and covering almost or quite all of the kernel is called the *horny gluten*. Carefully remove it by shaving it off with a sharp knife. Now carefully remove the germ. Notice carefully the size, position and parts of the germ. After the tip cap, hull, horny gluten, and germ have been removed, there remains only starch, of which there are two kinds—the *horny starch* and the *white starch*. The horny starch lies next to the horny gluten on the back and sides of the kernel. The white starch occupies the crown end of the kernel above the germ, and it also nearly surrounds the germ toward the tip of the kernel. Separate, as far as possible, the horny starch and the white starch. How many and what distinct parts have we found? Make an enlarged drawing of grain of corn, front view, showing and naming the parts.

Ex. 2. An Ear of Corn.

Material: three or four different varieties of corn grown in the neighborhood. Table the varieties by name. Observe carefully and note the following: (1) color of grain, color of cob, and whether surface of ear is smooth, rough or very rough; (2) number of rows, number of grains in a row; (3) total number of grains on the ear; (4) whether the rows are straight or twisted, and, if twisted, which way; (5) whether the grains are closely packed or loose, firmly attached to the cob or loosely attached; (6) whether shape of ear is cylindrical, conical, or irregular. Do you think the ear is well proportioned?

Note the butt of the ear and describe as even, slightly rounded, well rounded, enlarged, etc. Describe and draw the tip of the ear. Notice carefully the shape of the grains and their position on the cob. Measure length of ear, circumference of ear. Find weight of corn and weight of cob. Give percentage of grain. (The percentage should be from 86 to 90.)

Ex. 3. The Corn Plant.

Go to any corn field near the school.

Observe closely and note:

1. Name of variety.
2. Size of field.
3. Height of plant (average of ten plants).
4. Number of leaves on plant (average of ten plants).
5. Number of leaves below ear (average of ten plants).
6. Average leaf surface (take the product of the length and breadth of the average leaf times the number of leaves).
7. Husks: whether abundant, medium or scarce.
8. Husks: whether close, medium or loose.
9. Height of ear above ground (average of ten plants).
10. Position of ear on the stalk: whether pendant, horizontal or pointed upward.
11. Shank: whether long or short, strong or weak.

Measure ten hills square; give number of ears in one hundred hills. Count the missing hills in the plot. Determine the percentage of stand. Give number of stalks having two ears and number having no ear. Find distance apart of hills each way. Give number of hills per acre. Measure off one acre which represents a good average of the field; husk one-twentieth of this, and, after weighing same carefully, estimate the average yield of field. If hills of corn are 3 feet 6 inches each way, how many hills to the acre?

If, in a field of corn planted 3 feet 6 inches each way, there is on the average 1½ lbs. of corn to each hill, allowing 10 lbs. to the bushel for shrinkage, what is the yield per acre?

If corn is planted 3 feet 6 inches each way, and when mature is cut and put in shocks, each shock containing corn from an area 14 hills square, how many shocks to the acre? How many, if shocks are 16 hills square?

The following tables will assist in making accurate estimate of the amount of land in different fields or plots:

10	rods	x 16	rods	= 1 acre.
8	rods	x 20	rods	= 1 acre.
5	rods	x 32	rods	= 1 acre.
4	rods	x 40	rods	= 1 acre.
5	yds.	x 968	yds.	= 1 acre.
10	yds.	x 484	yds.	= 1 acre.
20	yds.	x 242	yds.	= 1 acre.
40	yds.	x 121	yds.	= 1 acre.
80	yds.	x 60½	yds.	= 1 acre.

220	ft.	x 198	ft.	= 1 acre.
440	ft.	x 99	ft.	= 1 acre.
110	ft.	x 396	ft.	= 1 acre.
60	ft.	x 726	ft.	= 1 acre.
120	ft.	x 363	ft.	= 1 acre.
240	ft.	x 181.5	ft.	= 1 acre.
200	ft.	x 108.9	ft.	= ½ acre.
100	ft.	x 145.2	ft.	= ½ acre.

10	square chains	= 1 acre.
160	square rods	= 1 acre.
4,840	square yards	= 1 acre.
43,560	square feet	= 1 acre.
640	square acres	= 1 square mile.
36	square miles	(6 miles sq.) = 1 township.

Ex. 4. Corn Judging—Single Ear.

A good ear of corn may be described as follows:—The ear should be from 9 to 10½ inches long and from 7 to 7½ inches around, measured at a point 1-3 the distance from the butt to the tip. It should

be practically the same diameter from end to end; that is, it should not be distinctly tapering. The rows of kernels should be straight and the kernels should be of such a shape that they will fit tightly together with no furrows left between the rows. The butts should be well rounded out with kernels evenly arranged around a cup shaped cavity about one inch across. The tips should be well filled out to the end with deep, even kernels. The kernels of the ear should all be very nearly the same size and shape. They should be wedge shaped, but not pointed; they should have large, smooth hearts or germs, not blistered or discolored. The length of the kernel should be about 1½ times as great as its width at the widest part, and it should be of the same thickness from one end to the other. The kernels should show no mixture with corn of the opposite color. The cob should be of medium size, neither very large nor very small.

Secure a number of ears of corn and notice the faults of each. Pick out the ones that are most nearly perfect. Take an ear and write a description of it, telling in what points it is good and in what points it is imperfect.

Lay five ears of corn on the table and try to pick out the one having the least number of faults. Go over the various points of the ear as given in Lesson 4, in the description of a good ear, and place that ear which is most nearly perfect on the left. Put the next best one second, the third best third, and so on. In what ways is No. 1 better than No. 2? Give the good and bad points of each ear.

Ex. 5. Corn Judging—Use of Score Card.

At fairs and other places where corn is shown for premiums, it is customary to show ten ears together as a sample. Consequently, in judging such samples, ten ears must be considered instead of a single ear. To help in this judging, a card giving a scale of points arranged to represent the different characters of the ears is used. This is called a score card, and the one that is used in Missouri is as follows:

	Scale of Points
Maturity and soundness	10
Uniformity of ears	10

Length	10
Circumference	5
Purity of cobs	5
Purity of kernels	5
Uniformity of kernels	10
Shape of kernels	10
Character of germ	10
Space between rows	5
Butts	5
Tips	5
Size of cob	10
Total	100

Following is an explanation of how to use the score card:

Maturity and soundness. (10.)

An ear that is not mature will not be perfectly tight. This is the best determined by giving the ear a slight twist. The kernels should all be sound and free from decay. For every ear not perfectly mature and sound, deduct one point.

Uniformity of ears. (10.)

All ears in the sample should be as nearly alike in every way as possible. This is very important. They should be the same in size, in color and in character of kernel. For every ear strikingly different from the average, deduct one point.

Shape of ears. (10.)

Ears should be practically the same diameter from one end to the other. For each ear that is distinctly tapering, deduct one point.

Length. (10.)

Ears should be between 9 and 10½ inches in length. For every ear that is under 8½ inches or for every ear that is over 10½ inches, deduct one point.

Circumference. (5.)

Ears should be from 7 to 7½ inches around, measured at a point 1-3 the distance from butt to tip. For each ear less than 7 inches or over 7¾ inches, deduct one-half point.

Purity of cob. (5.)

Yellow corn should have red cobs, and white corn, white cobs (with the exception of St. Charles White). A single ear with a cob of the wrong color bars an exhibit from competing for prizes.

Purity of kernel. (5.)

For every mixed kernel in the exhibit, deduct one-fourth point.

Uniformity of kernels. (5.)

All ears should have kernels of approximately the same size. For every ear having kernels larger or smaller than the average, deduct one-half point.

Shape of kernels. (5.)

Take out two kernels from the middle of each ear. Deduct one-half point for each ear having poorly shaped kernels.

Character of germ. (10.)

Examine kernels of each ear as to character of germ and deduct one point for each ear having poor germs.

Space between rows. (5.)

For each ear having wide furrows between the rows of kernels, deduct one-half point.

Butts. (5.)

For each poor butt, deduct one-half point.

Tips. (5.)

For each poor tip, deduct one-half point.

Size of Cob. (10.)

For each ear having a cob either too large or too small, deduct one point.

Ex. 6. Testing Seed Corn for Germination.

Make a box 4 inches deep, 14 inches long, and 12 inches wide. Fill the box half full of moist earth, packing it down firmly so that the surface is even and smooth. Rule a piece of white cloth, the size of the box, into squares 2 inches each way. Number the squares 1, 2, 3, 4....30. Place the cloth on the soil in the box and tack it to the corners and edges of the box to keep it in place. Number thirty ears of corn. Take ten grains from each ear—from middle, tip, and butt. Place these grains on the square corresponding to the number of the ear. When all the samples are in place, cover with a piece of cheese cloth the size of the box. Now cover with a heavier cloth larger than the box and over this place about 2 inches of moist earth. Put in a warm place and let it remain ten days.

Carefully remove the cover. Now make a careful study of the ten kernels in each square and carefully note those which either failed to grow or are weak in vitality. In how many and in which squares did all the kernels germinate? In how many and in which squares did no kernels germinate? If you had planted all the seed from these thirty ears, what per cent of a stand of corn would you have?

Ex. 7. Study of a Grain of Wheat.

Soak a few grains of wheat in warm water. Using a lens and a small sharp knife, try to remove the coverings of the grain. There are four of these, three epidermic layers and one testa or true seed coat. These coats constitute the bran and make up about 11 per cent of the grain.

Immediately under the testa, find the endosperm. This makes up the large part of the seed and is the flour of commerce. Notice the position, form and size of the embryo.

Ask your teacher to cut a thin slice across the grain, place in a drop of water on a glass slide, cover with a cover glass and place under the low power of the compound microscope.

Observe carefully and draw, naming the parts.

Ex. 8. Study of a Head of Wheat.

Observe that the grains are arranged in groups on either side of the stem. A single group is called a mesh. How many meshes on this head? How are they arranged? How many grains in a mesh? Is the number uniform? Are the meshes all filled? Find a mesh with three grains, with four, with five. Carefully remove the covering from a single grain. How many coverings are there? How is the grain attached?

Ex. 9. The Wheat Plant.

Pull up an entire wheat plant. How many stalks in the bunch? Does the number vary with different bunches? How many joints in each stalk? How many leaves on each stalk? Observe the form and arrangement of the roots. From the data in Ex. 8 and 9, estimate the number of grains that is produced by one grain.

Ex. 10. Study of a Head of Oats.

How does the oat head differ from the head of wheat? In what are they alike? Make drawing. Carefully remove a single grain. Notice the hard outer cover. Remove the hard cover and make an enlarged drawing of the kernel, naming parts.

Ex. 11. Study of the Legumes.

Material: red clover, alsike, white clover, alfalfa, soy beans, cow peas. The specimens should be fresh, but dried ones may be used. Study each plant separately.

1. Observe the number, arrangement, size and shape of leaves, and make drawing of a leaf.

2. Observe the number and height of the stems, and the diameter of stem an inch above the ground. Are the stems erect, spreading, decumbent, or training?

3. Are there many, few or no branches?

4. If in bloom, notice the place, form, color, and size of blossoms. Make drawing of a blossom.

5. If in seed, note kind, number, and shape of seed pods. Note

number of seed in pod and size and form of single seed. Draw seed pod, using magnifier. Make enlarged drawing of a single seed.

6. Observe carefully the form, size, number and length of the roots. Look closely for small nodules on the roots. These nodules are very important and we shall learn more about them later. Make drawing of root.

Ex. 12. Study of the Irish Potato.

Material: potatoes, preferably of several varieties, with some showing scab, dry rot, etc.

Note the following:

1. Variety: whether early, medium, or late.
2. Shape: whether cylindrical, oval, flat oval, compound, regular or irregular.
3. Size: whether large, medium, small, uniform or not uniform.
4. Shape of eyes: whether deep, medium or shallow; oval or narrow and elongated; large or small (small as compared with size of tuber); numerous or few; uniformly distributed or mainly at bud end; ridge prominent or ridge not prominent.
5. Color: whether yellowish white, pink or russet.
6. Texture of skin: whether corky, netted or lenticoled; glossy smooth or dull smooth.
7. Color of skin: whether yellowish white, russet, red, pink or blue; uniform or not uniform.
8. General characteristics: whether clean or dirty; cracked or not cracked; if diseased, whether scab, dry rot or blight.
9. Color of flesh: whether white, yellowish, pink or blue.

Make a drawing of the tuber, showing eyes, and indicate which is the stem end of the tuber.

SOILS.

Ex. 13. Study of Soil.

Material: a handful of soil from the school yard. What is the color of this soil? Are all the particles the same color? Wet a little

and observe whether there is a change in color. Feel the soil. Is it smooth, sticky, or gritty? Do you find small pieces of rock in it? Examine closely with the hand glass and describe fully all that you see. Try to find out what the hard particles are. If they will scratch glass, we may be quite sure that they are some form of quartz. Put some of the soil in a large test tube, cover with water, shake thoroughly and set aside for a few minutes. Which part of the soil goes to the bottom of the tube? Which next? Make a drawing of the soil in the tube. By digging a few holes in the home garden or field, try to find out whether the arrangement of the soil particles is the same as in the tube. Examine the soil along a stream to see whether you can find illustrations of sorting soil by water. Pour off the water from the soil in the tube, and evaporate to dryness. Is there anything left? What do you suppose it is? What does this prove? Examine the inside of a tea kettle for a scale of covering. How did it get there? Its presence there proves what?

Ex. 14. Study of Soil (continued).

Material: a handful of soil from the school yard. Carefully weigh a small handful of the soil. Now dry thoroughly, being careful not to burn any part of it, and weigh it again. Account for any difference in weight. The loss in weight is what per cent of the weight before drying? Now place the dry soil in a sand crucible or iron pan and heat hot. Cool, weigh, and examine carefully. Account for any loss in weight. Do you believe that you could burn all of the soil? Do you notice any difference in color after burning? Do you know what it was that burned?

Ex. 15. Study of Soil (continued).

Repeat Exercise 14, using the richest black soil you can get from the home garden. Compare the results with those obtained in Exercise 14. Compare results with those obtained by one of your classmates who used the same soil. Is there substantial agreement? Try to account for any difference.

Ex. 16. Field Lesson.

Material: a suitable field as near the schoolhouse as possible. Do you find any ledges of outcropping rock? If you do, break off a small piece and compare the freshly broken surface with the outside or weathered surface. Note carefully any difference. Do you find any boulders or pebbles? Break one open and compare the freshly broken surface with the outside surface as before. Are the boulders and pebbles of the same material as the rock in the ledge? Select a piece of each different rock you find to take to school for future study.

Look along the bed of a stream for pebbles. (If there is no stream at hand, this work may be done at another time and place by individual pupils.) How do the pebbles in the bed of the stream compare in size and shape with those back from the stream? How do you account for the difference?

Find some good rich soil and dig a hole about 18x12 inches and 18 inches to 2 feet deep. Observe closely the material and the color at different depths. Notice especially the amount of black soil.

Make a drawing of one side of the wall. Repeat this exercise by digging the hole on a steep slope. Account for any differences in the soil at the two places. What is subsoil? Which do you think will grow the better crop, the side hill or the lowland? Why? From your observation of farm crops, can you state whether this is generally true?

Ex. 17. Soil Texture.

Material: sand, clay, and loam—two small fruit jars full of each, from the farms in the neighborhood of the school, if possible. Label each jar and set one jar of each aside for use in Exercise 18. Compare the three kinds of soil as to color, texture, and amount of humus. Put some of each kind in a large test tube, cover with water, shake thoroughly and set aside. Which settles most rapidly? Most slowly? Which contains particles that float? If these soils were poured into a running stream which would be carried farthest? Put a little hydrochloric acid on each and note the result. Mix the three samples in a

large test tube or long bottle, cover with water, shake thoroughly and set aside. Which soil is at the bottom? Which at the top? Make drawing of tube. Compare with results of Exercise 13. Dry some of each kind of soil as in Exercise 14. Weigh very carefully about the same amount of each, and put in separate beakers. (Each soil should be pulverized after drying.) Pour water into each beaker from a graduate containing a measured quantity, until the water rises to the surface of the soil. Find how much water it takes in each case, recording results as follows:

	Sand	Clay	Loam
Volume of soil			
Volume of water added			
Per cent of air space			

The amount of water is the approximate measure of the air space. Which soil contains the most air? Which least?

Ex. 18. Temperature of Soils.

Material: the three jars of soil set aside in Exercise 17. Into each jar pour sufficient water to wet thoroughly. In each jar put a thermometer so placed that the bulb is just below the surface of the soil. Weigh each jar and set the jars close together in the window and where the sunlight can strike fairly. Take the temperature and weight of each jar at the same hour of the day on alternate days for one week. Record the results as follows:

	Sand	Clay	Loam
Weight first observation			
Weight second observation			
Weight third observation			
Temperature first observation			
Temperature second observation			
Temperature third observation			

Which soil shows the highest temperature? Which the lowest? From which does the water evaporate most rapidly? From which does it evaporate most slowly? What is meant by a warm soil? By a

cold soil? By a dry soil? By a wet soil? Review Exercise 14 and state whether there is any relation between soil temperature and air space. What are some of the ways in which a cold soil may be made warmer?

Ex. 19. Water Capacity of Soils.

Material: different kinds of soils, five long-necked bottles with the bottoms broken off, rack for holding bottles, five tumblers. Tie a small piece of cheese cloth over the mouth of each bottle, place in the frame upside down with a tumbler under each. Fill the bottles to the same height, about two-thirds full, with different kinds of soil. Firm the soils by shaking the bottle. With watch in hand and glass of water held as near as possible to the soil, pour water into one of the bottles just fast enough to keep the surface of the soil covered. Note how long before the water begins dropping into the tumbler below. Do the same with each of the other bottles. Which takes in water most rapidly? Which most slowly? Which is the most porous? Which is the least porous? Compare results with results in Exercise 18. What happens to the less porous soils when a heavy shower of rain comes? Repeat the experiment with any two of the soils, packing the soil in the bottle tightly before pouring in the water. What is the effect of packing? Does this experiment have any bearing on farm practice? What bearing has it? Which of the soils could absorb the heaviest shower? Which soil continued to drip longest? Which would drain most readily?

Ex. 20. Capillarity of Soils.

Material: same as in Exercise 19. Fill each bottle with a different kind of dry soil. Fill each tumbler about two-thirds full of water and set the bottles, neck down, in the tumblers so that the cheese cloth is just above the bottom of the tumbler. Observe the rise of water in the different soils. Note how high it rises in each bottle and the time it takes. In which soil does the water rise most rapidly? In which to the greatest height? Which soil draws up the greatest amount of water? This can be determined by measuring or weighing

the water in the tumbler before and after the experiment. This power of soils to raise water from below is called capillarity, and the water is called capillary water. Because of this capillarity, plants are able to get moisture from the subsoil in time of drought. What effect on water capacity does the addition of organic matter have? Give one method by which the farmer may increase the amount of organic matter in the soil.

Water that percolates through the soil until it reaches the rock or hard pan is called soil water. How deep are the wells in your neighborhood? Are they deeper on the upland than on the lowland? Is the impervious layer rock or clay? Are there any springs? If so, observe the character of the strata over which the water flows.

Ex. 21. Absorption of Moisture from the Soil.

Material: a wide mouthed bottle, an egg, a glass tube 3 or 4 inches long and about ¼ inch in diameter, a candle and a piece of wire about 5 inches long.

Remove part of the shell, about the size of a dime, from the large end of the egg, without breaking the skin beneath. In the same manner remove a piece of shell, no larger than the diameter of the glass tube, from the small end of the egg. Cut from the lower end of the candle a piece about ½ inch long and bore a hole in this the size of the glass tube. Soften one end of the piece of candle and stick it on the small end of the egg so that the hole in the candle covers the hole in the egg, making a water-tight joint. Place the glass tube in the hole in the candle, cement closely as before. Now run the wire down the tube and break the skin of the egg. Now fill the bottle with water until it overflows and set the egg over the mouth of the bottle, small end up. In an hour or so, the white of the egg will be seen rising in the glass tube. The water enters the egg through the skin and forces the white to rise in the tube. The skin itself has no openings that can be seen even with a microscope. This process by which a liquid passes through a membrane is called *osmosis*. It is by this

process that water containing plant food enters the fine root hairs of plants.

Ex. 22. Absorption of Moisture from Soil (continued).

Material: thistle tube, piece of waste bladder, jar, water and molasses. Partly fill the thistle tube with molasses. Tie the bladder over the large end of the tube and insert into the jar of water. Put the tube into the jar so that the molasses in the stem is just on the level with the water in the jar. Fasten the tube in this position and observe what happens. Explain.

Ex. 23. Rise of Water in Plants.

Fill a tumbler one-third full of luke warm water colored with a few drops of red ink or some brilliant coloring matter. Place in the colored water the freshly cut stem of a white carnation, lily or almost any soft green plant. Observe closely and explain what happens.

Ex. 24. Rise of Water in Plants (continued).

Pull up any good sized green plant, as, for instance, a bunch of clover. Weigh it carefully and record the weight. Now dry the plant thoroughly, being careful not to burn it, and weigh again. What are the percentages of dry material and water as shown by the weights? Estimate the number of pounds of water in one ton of freshly cut clover hay.

Note.—It has been found that corn roots take up over 300 lbs. of water for each pound of dry matter produced. Oats and clover take up 500 lbs. What two important facts are shown by this experiment?

Ex. 25. Effects of Excluding Air from the Soil.

Into a fruit jar or water-tight can containing a healthy growing plant, pour water until the surface of the soil is covered to the depth of one inch. Keep the soil covered with water, observe the plant closely for several days and note results. Have you noticed the effects of standing water on young corn? If not, do so. Would you say the plant has been smothered or has it been drowned? Why? Can you suggest a method of soil ventilation?

Ex. 26. Soil Temperature.

Review Exercise 19. Which of the soils was warmest? What coldest? In the same jar of soil insert two thermometers, one to the depth of 2 inches and one 6 inches. Do you notice any difference in the temperature shown? Try this experiment out of doors and note the temperature of the air as shown by the third thermometer suspended a foot above the ground. Make three observations the same day, one at 8:00 a. m., one at 2:00 p. m. and one at 6:00 p. m. Is the surface of the soil warmer or colder than the air? Is this true of all times of the day? If not, when? Is the average temperature of the surface soil higher or lower than the average temperature of the air? Which is more nearly uniform, the temperature of the air, the surface soil or the soil at a depth of 6 inches? Do you know whether each of your conclusions above will hold for different seasons of the year? Should seeds be planted deeper or shallower in early spring or late spring? Why?

Ex. 27. Soil Drainage.

Take two flower pots the same size and label them 1 and 2 respectively. In No. 1 pour melted paraffin or wax to plug up the hole so that no air can get through. In the bottom of No. 2 put about one inch of fine pebbles or coarse sand. Nearly fill each pot with a mixture of good soil and sand, three parts soil and one part sand. Place in each pot a healthy growing plant of the same kind and size. Sprinkle each with water till the soil is saturated and place the pots in a sunny window. In each pot place a thermometer with a bulb at a depth of two inches. Every two days note the temperature of the soil and the condition of the plants in each pot. If each of these conditions of soil and moisture were found in a field, which would be more apt to be flooded in time of rain? In which could the air penetrate more readily? In which would the temperature be higher? Every two or three days apply equal quantities of water to each pot. At the end of a month remove the plant, soil and all. In which pot have the roots gone deeper? In which would they go deeper, the drained or undrained soil?

PLANT PROPAGATION.

Ex. 28. Absorption of Water by Seeds.

Soak a few beans in luke warm water. Notice closely the appearance of the bean at the end of ten minutes and at the end of forty minutes. What changes in form of surface and size of bean? With a hand lens, examine the bean closely to find the place where the water gets in. Try the same experiment, using three or more of the following seeds: squash, apple, gourd, pea, corn, pumpkin.

Ex. 29. Effects of Temperature Upon Seed Germination.

Prepare two pieces of canton flannel a little larger than a dinner plate. Wet one piece and place it on the bottom of the plate. On this place a few seeds—squash, corn, or butter beans. Moisten the second piece of cloth, lay it over the seeds and cover with a pane of window glass. Prepare a second germinating apparatus in precisely the same way. Place one of the plates in a warm place, 80 to 120 degrees if possible; place the other in a cold place at or near the freezing point if possible. (The refrigerator may be used in summer.) At intervals of two days examine each and note results.

Ex. 30. Effects of Air Upon Seed Germination in Water.

Fill two small wide mouthed bottles with water. Shake one thoroughly and put a few seeds of different kinds in it. Remove the water from the other bottle and boil it. Pour it back into the bottle and put in it the same number and kind of seeds. Cover the surface of the water in the last bottle with oil, set both in the window and note results. In which bottle do the seeds germinate best? Why? Exercises 6, 28, 29 and 30 indicate quite clearly the *conditions* of seed germination. What are these conditions? Give an illustration from your own experience on the home farm or garden to show that *all* these conditions must *always* be present when seeds germinate well.

Ex. 31. Purity of Seeds.

Material: clover seed from several sources, alfalfa, timothy, wheat and millet. The price of each sample should be ascertained. Weigh out three grams of seed and spread on a sheet of paper. Using a

lens, separate the seeds into three piles: (1) chaff, dirt, broken seed, etc.; (2) weed seed; (3) clover seed. Weigh each lot, record the results and save the clean seed. Considering price, quality and weeds, which sample should be purchased.

Ex. 32. Propagating Bed.

Prepare a box five or six inches deep, three feet wide and any convenient length (to be determined by the size of the window). Place the box on a firm support and fill with clean sand thoroughly wet. If the class is large and the windows small, two or more such beds will be needed.

Ex. 33. Cuttings.

Make cuttings from any or all of the following plants: geranium, coleus, wandering Jew, rose, heliotrope, chrysanthemum, begonia, California privet. Make a small hole with a stick or pencil, insert the cutting and then pack the sand firmly with the fingers. If the bed is properly made and placed, most of the cuttings should grow. When the cuttings are well rooted, they may be transplanted in pots or in the garden.

Ex. 34. Grafting. (Demonstration by Teacher.)

The teacher will prepare the roots, scions, knife and wax, and will do the work before the class, explaining each step. Each student make drawings of each kind of graft.

Ex. 35. Grafting.*

Each student provide material and make not less than six grafts.

Ex. 36. Budding. (Demonstration.)

The teacher will do the work, making all necessary explanations.

Ex. 37. Budding.*

Each student bud a definite number of plants in the school garden or home orchard.

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* If possible, students should do considerable grafting and budding at home, or elsewhere, while the method is clear in their minds.

Ex. 38. Effects of Air Upon Seed Germination in Soil.

Into each of two fruit jars containing rich sandy loam, put a few seeds of wheat, corn and beans. Moisten the soil in both jars, screw the top on one tight, being sure to keep the rubber band in place. Leave the other open. Set both in a warm lighted place and note results at the end of one week, two weeks, three weeks. What does this experiment teach?

Ex. 39. Relation of Light to Growth.

Prepare two fruit jars as in Exercise 38. Put one jar in a closet or dark basement to exclude the light, and note results. Substitute for the fruit jars and seeds flower pots containing growing plants. Are plants attracted by the light? Plan an experiment to prove. Why do trees grow taller when planted near together than when planted far apart?

Ex. 40. Relation of Temperature to Growth.

Note.—The work will vary with the facilities for maintaining fixed temperatures. Try to germinate seeds and grow plants at different temperatures. Work out fairly accurate answers to such questions as the following: What is the lowest temperature at which corn will germinate? At what temperature does it germinate most quickly? etc.

Ex. 41. Preparation and Properties of Oxygen.*

Ex. 42. Preparation and Properties of Hydrogen.*

Ex. 43. Preparation and Properties of Nitrogen.*

Ex. 44. Preparation and Properties of CO_2.*

Ex. 45. Plant Food.

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* To be performed by teacher before the class. Pupils should observe closely and record in full.

Fill seven four-inch flower pots with clean sand. Number the pots and place plant food in each as follows:

No. 1. Nothing.

No. 2. Ten grams lime.

No. 3. Ten grams lime and one gram potassium chloride.

No. 4. Ten grams lime and one gram acid phosphate.

No. 5. Ten grams lime and one gram sodium nitrate.

No. 6. Ten grams lime and one gram each of the compounds used in Nos. 3, 4, 5.

No. 7. About one-half pint of manure.

Mix the materials in each pot, then plant five kernels of wheat in each. Record the growth of the plants from day to day, noting differences in color and amount of growth. Let the plants grow until the differences are clearly apparent.

Ex. 46. Air-Derived and Soil-Derived Elements.

Select a dry plant or a piece of dry wood. Weigh it carefully. Now burn it and weigh the ashes. What per cent of the plant burned? This method gives a fair approximation of the amount of materials derived from the air and amount of materials derived from the soil. Review the following questions:

Will any seed germinate in a perfectly dry soil? Will any plant grow without some moisture? Why is there so little vegetation in the desert? What is a desert? What is meant by a drouth? What would be the effects on this country of a total cessation of rainfall?

Ex. 47. Bacteria and Molds.

Material: three test tubes, cotton, boiled potato, fruit or apple sauce, three apples, one partly decayed.

Fill each tube about one-third full of apple sauce. Plug each with cotton. Set one aside. Put the other two into a pail of water and boil for half an hour. After boiling, set one tube aside with the cotton undisturbed. Take the cotton from the third tube, leave it out half an hour or more, and then put it in again. Leave these for a few days, note what happens and account for different results. Is

it desirable to leave canned fruit open a few minutes before covering after cooking? Why?

Prick one of the sound apples in several places with a pin. Put the pin into the rotten apple and then into the other sound apple. Repeat this in several places. Set the two sound apples aside for about a week. Note what happens and account for the different results.

What is pasteurization, and how may it be performed at home? Why discard the first few streams of "foremilk?" Why not feed just before milking? Explain sour bread and formation of vinegar from cider. What principle is employed in preserving silage?

Ex. 48. Preparation of Bordeaux Mixture.

Material: copper sulphate, lime, potassium ferrocyanid, balances, two Mason fruit jars (quart size).

Bordeaux mixture is prepared by using 2 to 6 pounds of copper sulphate to 50 gallons of water and adding enough lime to neutralize it. Four pounds to 50 gallons of water is a good formula for use on many plants.

(a) Put five cents' worth of potassium ferrocyanid into a 4-ounce bottle of water and label it "poison." (b) Dissolve 2 ounces of copper sulphate in a pint of water. (c) Slake about 4 ounces of lime. Put 3 fluid ounces of (b) into each of the two jars. Fill the second jar nearly full of water. Add some of (c) to each jar and test with (a). If there is enough lime to neutralize the copper sulphate, (a) will retain its yellow color when a drop of it is added. If there is not enough lime, it will assume a decided brown red color. Add (c) until the test is satisfied. Then add as much more. Now fill each jar with water. In which case does the mixture settle more quickly and what is its color? These proportions give a mixture at the rate of 4 pounds of copper sulphate to 50 gallons of water. It is usually best to use double the lime called for by the test, because there is then less danger of injuring the plants sprayed. Note that the mixture containing the copper sulphate solution diluted before adding lime

did not settle as quickly as the other. The copper sulphate should always be diluted with nearly all the water before the lime is added. Some bulletins state that both should be diluted and then put together, but this way is quite as good and is easier.

Ex. 49. Insect Net.

Material: a handle about three feet long (an old broom stick will do), a piece of No. 3 galvanized wire three feet six inches long, and three-fourths of a yard of cheese cloth.

Bend the wire into a ring about a foot in diameter and bend back about three inches of each end to insert into a hole made in the end of the handle. Fasten securely. Make the cheese cloth into a bag with rounded bottom and just wide enough to fit the wire loop; fasten securely.

Ex. 50. Killing Bottle.

Take any small, wide-mouthed bottle—a quinine bottle or pickle bottle will do. Secure a cork that will fit the bottle closely, and that is long enough to handle easily. Get two cents' worth of cyanide of potassium, and one cent's worth of plaster of Paris. Put the cyanide in the bottle, cover with water and add the plaster of Paris until all the water is soaked up. Leave the bottle open in a shady place for an hour, when the plaster should be hard. Cork the bottle and label it poison. Now it is ready for use.

Caution.—Do not breathe the fumes of the bottle.

Ex. 51. Insect Box.

Secure an empty cigar box. Cover the bottom with some soft material as cork, cork linoleum or pith of dried corn stalks. Fasten this material to the bottom of the box with glue and cover with white paper.

If your collection is to be a permanent one, make a glass cover for the box and fit it air tight.

Ex. 52. Spreading Board.

The spreading board may be any length. Material: two strips of soft wood, 1½ inches wide and ½ inch thick; one piece 3¼ inches

wide, ½ inch thick; two cleats 3½ inches wide by ¾ inch by ½ inch; one strip of cork linoleum a little less than 1 inch wide and as long as the longest strips.

Place the two narrow cleats ½ inch apart and fasten on the under side to the longer cleats. On the same side as the cleats, tack the cork or linoleum over the open space. Now tack the whole to the bottom board, which should fit exactly.

Ex. 53. Killing and Mounting Insects.

Immediately after having caught the insect, put it in the killing bottle and cork tightly.

For mounting all insects except the butterfly and moth use the insect box. Stick a steel pin (a sewing needle is better) through the insect so that the insect is about ½ an inch from the point. Now stick the needle about ¼ inch into the cork at the bottom of the box.

Write the name of the insect on a piece of white paper and fasten near the pin.

To use the spreading board, do as follows:

Kill the moth or butterfly as before, and mount within half an hour. Insert the pin, with the insect on it, into the cork just far enough so the body of the insect will be in the space between the boards up to the wings. Place the wings out flat on the board and fasten them with narrow strips of paper held by pins. Arrange the wings so that the rear margins of the front wings will just cover the front margins of the rear wings and shall be at right angles to the body. Now pin larger pieces of paper so as to hold all firmly until dry.

Ex. 54. Study of Cuts of Beef.

Study Farmers' Bulletin No. 71. Copy drawing of ox showing different cuts of beef.

Ex. 55. Study of the Egg.

Each student should be provided with two hen's eggs. With the ends of the egg in the hollow of the hands, press firmly. Account

for the great strength of the shell. Break a fresh uncooked egg in a saucer or plate by separating the shell in the middle. Observe:

1. The germinal disc (a light colored spot usually found on the upper surface of the yolk). What is the function of this part?
2. The transparent albumen or white of the egg.

Examine the shell and find the air space. Where is the air space? Of what use is it? Observe the two membranes best seen at the air space where they separate.

Examine a piece of the shell with the microscope, and observe the pores. What would be the effect on the chick while in the egg if the shell were covered with varnish?

Note the color of the egg. Ascertain whether the eggs from any particular hen are all of the same color.

Boil the egg and carefully cut lengthwise through the middle. Observe all closely and make drawing of either half, showing and naming all parts. Make an exact drawing, omitting nothing. Use colored crayon, if convenient.

Ex. 56. Poultry House.

Read Farmers' Bulletins, Nos. 225, 227. Make drawings according to scale of (a) floor plans: (b) cross section of poultry house for a given number of chickens.

Ex. 57. Judging of Draft Horse by Score Card.

In accordance with the score card given below, observe a draft horse and record your observations. (The score cards in this manual are those used by the students in the College of Agriculture, University of Missouri.)

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—24 Points			
Height, estimated.....hands; actual.....hands.			
Weight, over 1600 lbs. in good condition; estimated .....lbs., score according to age.....	4	.....	.....
Form, broad, massive, symmetrical, blocky.....	4	.....	.....
Quality, refined; bone clean, large strong; tendons clean, defined, prominent; skin and hair fine; "feather," if present, silky	4	.....	.....
Action, energetic, straight, true, elastic; walk, stride long, quick, regular; trot, free balanced, rapid.....	10	.....	.....
Temperament, energetic; disposition good.....	2	.....	.....
HEAD AND NECK—8 Points			
Head, proportionate size, clean cut, well carried; profile, straight	1	.....	.....
Muzzle, neat; nostrils large, flexible; lips thin, even, firm	1	.....	.....
Eyes, full, bright, clear, large, same color.....	1	.....	.....
Forehead, broad, full.....	1	.....	.....
Ears, medium size; tapering, well carried, alert.....	1	.....	.....
Lower Jaw, angles wide, space clean.....	1	.....	.....
Neck, medium length, well muscled, arched; throat-latch fine, windpipe large.....	2	.....	.....
FOREQUARTERS—25 Points			
Shoulders, moderate height, extending well back, moderately sloping, heavily and smoothly muscled, extending into back.....	3	.....	.....
Arms, short, heavily muscled, thrown back, well set....	1	.....	.....
Forearm, long, wide, clean, heavily muscled.....	2	.....	.....
Knees, straight, wide, deep, strong, clean, well supported	2	.....	.....
Cannons, short, wide, clean; tendons large, clean and well defined, set back.....	2	.....	.....
Fetlocks, wide, straight, strong, clean.....	1	.....	.....
Pasterns, moderate slope and length, strong, clean.....	3	.....	.....
Feet, large, even size, sound; horn dense, waxy; soles concave; bars strong, full; frog large, elastic; heels wide, strongly supported.....	8	.....	.....
Legs, viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof.....	3	.....	.....

Ex. 57. Judging of Draft Horses by Score Card (continued).

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
BODY—10 Points			
Withers, moderate height, smooth, extending well back.	1	.....	.....
Chest, deep, breast bone low; girth large.....	2	.....	.....
Ribs, deep, well sprung, closely ribbed to hip.....	2	.....	.....
Back, broad, short, strong, muscular.....	2	.....	.....
Loin, broad, short, heavily muscled.....	2	.....	.....
Underline, long, low, flanks well let down.....	1	.....	.....
HINDQUARTERS—33 Points			
Hips, broad, smooth, level.....	2	.....	.....
Croup, long, wide, heavily muscled, not markedly drooping	2	.....	.....
Tail, attached high, well carried.....	1	.....	.....
Thighs, deep, broad, heavily muscled.....	2	.....	.....
Quarters, deep, heavily muscled.....	2	.....	.....
Stifles, clean, strong, muscular.....	2	.....	.....
Gaskins (lower thighs), long, wide, heavily muscled....	2	.....	.....
Hocks, large, strong, wide, deep, clean.....	6	.....	.....
Cannons, short, wide, clean; tendons large, clean, defined, set back.....	2	.....	.....
Fetlocks, wide, straight, strong, clean.....	1	.....	.....
Pasterns, moderate slope and length, strong clean.....	2	.....	.....
Feet, large, even size, sound; horn dense, waxy; soles, concave, bars, strong, full; frog, large, elastic; heels, wide, strongly supported.....	6	.....	.....
Legs, view from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon and foot; from the side a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the line of the cannon.....	3	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.... .....

Student..... *Standing*.....

Ex. 58. Judging of Light Horses by Score Card.

In accordance with the score card given below, observe a light horse and record your observations.

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—28 Points			
Weight, estimated.....lbs.; actual.....lbs.			
Height, estimated.....hands; actual.....hands	2	.....	.....
Form, symmetrical, smooth, stylish.....	4	.....	.....
Quality, refined; bone clean, fine; tendons clean, defined; hair and skin fine.....	4	.....	.....
Action, energetic, straight, true, elastic; walk, stride long, quick, regular; trot, free, balanced, rapid.....	15	.....	.....
Temperament, active; disposition good, stylish carriage.	3	.....	.....
HEAD AND NECK—8 Points			
Head, proportionate size, clean cut, well carried, profile straight	1	.....	.....
Muzzle, neat; nostrils large, flexible; lips thin, even, firm	1	.....	.....
Eyes, full, bright, clear, large, same color.....	1	.....	.....
Forehead, broad, full.....	1	.....	.....
Ears, medium size, tapering, well carried, alert.....	1	.....	.....
Lower Jaw, angles medium wide, space clean.....	1	.....	.....
Neck, long, well muscled, arched; throat-latch fine, clean; windpipe large.....	2	.....	.....
FOREQUARTERS—20 Points			
Shoulder, long, sloping, smoothly muscled, extending into back	3	.....	.....
Arms, short, strongly muscled, thrown back, well set...	1	.....	.....
Forearm, long, wide, clean, strongly muscled.....	2	.....	.....
Knees, straight, wide, deep, strong, clean, strongly supported	2	.....	.....
Cannons, short, wide, clean, tendons large, clean, defined, set back.....	2	.....	.....
Fetlocks, wide, straight, strong, clean.....	1	.....	.....
Pasterns, long, sloping, strong, clean.....	3	.....	.....
Feet, medium and even size, sound, horn dense, waxy; soles concave; bars strong, full; frog large, elastic; heels wide, strongly supported.....	6	.....	.....
Legs, view in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot; from the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof.....	3	.....	.....

Ex. 58. Judging of Light Horses by Score Card (continued).

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
BODY—10 Points			
Withers, moderate height, smooth, extending well back.	1	.....	.....
Chest, deep, wide, breast bone low; girth large.....	2	.....	.....
Ribs, deep, well sprung, closely ribbed to hip.....	2	.....	.....
Back, broad, short, strong, muscular.....	2	.....	.....
Loins, broad, short, wide, strongly and smoothly muscled	2	.....	.....
Underline, long, low; flanks well let down.....	1	.....	.....
HINDQUARTERS—31 Points			
Hips, broad, smooth, level.....	2	.....	.....
Croup, long, wide, muscular, not markedly drooping....	2	.....	.....
Tail, attached high, well carried.....	1	.....	.....
Thighs, deep, broad, strongly muscled.....	2	.....	.....
Quarters, deep, heavily muscled.....	1	.....	.....
Stifles, strong, clean, muscular.....	2	.....	.....
Gaskins (lower thighs), long, wide, strongly muscled...	2	.....	.....
Hocks, large, strong, wide, deep, clean.....	2	.....	.....
Cannons, short, wide, clean; tendons large, clean and well defined, set back.....	2	.....	.....
Fetlocks, wide, straight, strong, clean.....	1	.....	.....
Pasterns, long, sloping, strong, clean.....	3	.....	.....
Feet, medium and even size, sound; horn dense, waxy; soles concave; bars strong, full; frog large, elastic; heels wide, strongly supported.....	4	.....	.....
Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon and foot; from the side, a perpendicular line from the hip joints should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel with the lines of the cannon.....	3	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.....

Student..... *Standing*.....

Ex. 59. Judging of Beef Cattle by Score Card.

In accordance with the score card given below, observe a beef steer and record your observations.

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—26 Points			
Weight, estimated..... .lbs., actual.....lbs., score according to age	6	.....	.....
Form, straight top line and underline; deep, broad, low, medium length, symmetrical, compact, standing squarely on legs	8	.....	.....
Quality, bone of firm texture, fine skin, silky hair, clearly defined features and joints; mellow touch	6	.....	.....
Condition, thick, even covering of firm flesh, especially in regions of valuable cuts; indicating finish; light in offal	6	.....	.....
HEAD AND NECK—8 Points			
Muzzle, good size, lips thin, nostrils large and well apart; jaws wide	1	.....	.....
Face, short, broad, profile straight	1	.....	.....
Forehead, broad	1	.....	.....
Eyes, large, full, clear, bright	1	.....	.....
Ears, well carried, fine, medium size	1	.....	.....
Neck, thick, short, throat clean; dewlap slight	3	.....	.....
FOREQUARTERS—12 Points			
Shoulder Vein, smooth, full	3	.....	.....
Shoulders, smoothly covered with firm flesh, compact	5	.....	.....
Brisket, broad, full, breast wide	2	.....	.....
Legs, straight, short, strong, wide apart, forearm full, shank fine, feet sound	2	.....	.....
BODY—32 Points			
Chest, deep, broad, girth large, foreflank full	4	.....	.....
Crops, full, thick, even with shoulders	5	.....	....
Back, broad, straight, medium length; thickly, evenly and firmly fleshed	7	.....	.....
Ribs, deep, well sprung, closely set, thickly, evenly and firmly fleshed	7	.....	.....
Loin, broad, straight, thickly, evenly and firmly fleshed.	7	.....	.....
Flanks, full, low	2	.....	.....

Ex. 59. Judging of Beef Cattle by Score Card (continued).

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
HINDQUARTERS—22 Points			
Hips, smoothly covered, proportionate width	3	.....	.....
Rump, long, level, width well carried back; thickly, evenly and firmly fleshed	5	.....	.....
Pin Bones, wide apart, not prominent	1	.....	.....
Tail, fine, tapering, medium length	1	.....	.....
Thighs, deep, wide, well fleshed	4	.....	.....
Twist, deep, broad, well filled	6	.....	.....
Legs, straight, short, strong, shank smooth, feet sound.	2	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.....

Student..... ..... *Standing*.....

Ex. 60. Judging of Dairy Cattle by Score Card.

In accordance with the score card given below, observe a dairy cow and record your observations.

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—23 Points			
Weight, estimated.....lbs., actual.....lbs. score according to age	3	.....	.....
Form, deep, low, wedge shape as viewed from front, side and top; standing squarely on legs	5	.....	.....
Quality, bone of firm texture; hair fine, soft; skin mellow, loose, medium thickness; secretion yellow	5	.....	.....
Condition, healthy; spare fleshed	3	.....	.....
Style, active, graceful carriage	2	.....	.....
Temperament, alert, tractable; highly developed nervous system perfectly controlled, indicated by clear placid eyes, marked refinement about head, neck and forequarters, prominent backbone and normal activity	5	.....	.....
HEAD AND NECK—10 Points			
Muzzle, good size, lips thin, nostril large and wide apart, jaws wide and strong	2	.....	.....
Face, medium length, broad, slightly dished	1	.....	.....
Eyes, large, full, clear, bright, placid	2	.....	.....
Forehead, broad, slightly dished	1	.....	.....
Ears, well carried, fine, medium size, yellow inside	1	.....	.....
Neck, medium length, fine, throat clean, dewlap slight	3	.....	.....
FOREQUARTERS—6 Points			
Shoulders, light, narrow at top	3	.....	.....
Brisket, light	1	.....	.....
Legs, straight, short, strong, shank fine, feet sound	2	.....	.....
BODY—22 Points			
Back, strong, prominent spinal processes, wide apart	3	.....	.....
Chest, deep and moderately wide, girth large	4	.....	.....
Ribs, deep, wide apart, well sprung	4	.....	.....
Loins, broad, strong, with roomy coupling	3	.....	.....
Barrel, deep, wide, very capacious	8	.....	.....

Ex. 60. Judging of Dairy Cattle by Score Card (continued).

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
HINDQUARTERS—39 Points			
Hips, wide apart, prominent; level with back	2	.....	.....
Rump, long, wide, straight or slightly rising; pelvis roomy	3	.....	.....
Pin Bones, high, wide apart	1	.....	.....
Tail, set high, long, tapering, heavy switch	1	.....	.....
Thighs, thin, long, wide apart; twist very open	3	.....	.....
Escutcheon, spreading over thighs, extending high and wide; large thigh ovals	1	.....	.....
Udder, broad, symmetrical, extending well forward, well up between the thighs, free from fleshiness, well held up, and quarters even in size	18	.....	.....
Teats, good size, evenly placed	4	.....	.....
Milk Veins, large, tortuous, branching milk wells large, numerous	4	.....	.....
Legs, straight, short, strong; shank fine, feet sound	2	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.....

Student..... *Standing*.....

Ex. 61. Judging of Mutton Sheep by Score Card.

In accordance with the score card given below, observe a mutton sheep, and record your observations.

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—26 Points			
Weight, estimated.....lbs., actual.....lbs. score according to age	6	.....	.....
Form, straight, top line and underline, deep, broad, low, medium length, symmetrical, compact, standing squarely on legs	8	.....	.....
Quality, bone of firm texture, fine skin, silky hair, clearly defined features and joints, mellow touch, fleece soft, fine, pure	6	.....	.....
Condition, thick, even, covering of firm flesh, especially in regions of valuable cuts, indicating finish; light in offal	6	.....	.....
HEAD AND NECK—8 Points			
Muzzle, good size, lips thin, nostrils large and well apart, jaws wide	1	.....	.....
Face, short, broad, profile straight	1	.....	.....
Eyes, large, full, clear, bright	1	.....	.....
Forehead, broad	1	.....	.....
Ears, well carried, fine, medium size	1	.....	.....
Neck, thick, short; throat clean	3	.....	.....
FOREQUARTERS—10 Points			
Shoulder Vein, smooth, full	2	.....	.....
Shoulders, smoothly covered with firm flesh; compact	4	.....	.....
Brisket, broad, full; breast wide	2	.....	.....
Legs, straight, short, strong, wide apart; forearm full; shank fine; feet sound	2	.....	.....
BODY—25 Points			
Chest, deep, broad; girth large; foreflank full	4	.....	.....
Back, broad, straight, medium length, thickly, evenly and firmly fleshed	7	.....	.....
Ribs, deep, well sprung, closely set, thickly, evenly and firmly fleshed	6	.....	.....
Loin, broad, straight, thickly, evenly and firmly fleshed.	6	.....	.....
Flanks, full, low	2	.....	.....
HINDQUARTERS—20 Points			
Hips, smoothly covered, proportionate width	3	.....	.....
Rump, long, level, width well carried back; thickly, evenly and firmly fleshed	5	.....	.....
Thighs, deep, wide, well fleshed	4	.....	.....
Twist, deep, broad, well filled	6	.....	.....
Legs, straight, short, strong; shank short but sound	2	.....	.....

Ex. 61. Judging of Mutton Sheep by Score Card (continued).

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
FLEECE AND SKIN—11 Points			
Quantity of Wool, long, dense, even, well distributed over body	3	.....	.....
Quality of Wool, fine, soft, pure, even, crimp close and uniform	3	.....	.....
Condition of Wool, bright, strong, clean, yolk abundant.	2	.....	.....
Skin, pink color, clear	3	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.....

Student..... *Standing*.....

Ex. 62. Judging of Swine by Score Card.

In accordance with the score card given below, observe swine of different breeds and record your observations.

SCALE OF POINTS	Possible Score	Points Deficient	
		Students Score	Corrected Score
Age, estimated.....yrs., actual.....yrs.			
GENERAL APPEARANCE—26 Points			
Weight estimated.....lbs., actual.....lbs., score according to age	6	.....	.....
Form, arched back, straight underline; deep, broad, low, medium length, symmetrical, compact, standing squarely on legs	8	.....	.....
Quality, bone of firm texture, fine skin, silky hair, clearly defined features and joints; mellow touch	6	.....	.....
Condition, thick, even, covering of firm flesh, especially in regions of valuable cuts; indicating finish; light in offal	6	.....	.....
HEAD AND NECK—8 Points			
Snout, short, not coarse	1	.....	.....
Face, short, broad, cheeks full	1	.....	.....
Eyes, large, full, clear, bright, wide apart, not obscured by wrinkles	1	.....	.....
Forehead, broad	1	.....	.....
Ears, well carried, fine, medium size	1	.....	.....
Jowl, full, firm, broad, neat	1	.....	.....
Neck, thick, medium length, somewhat arched, neatly joined to shoulders	2	.....	.....
FOREQUARTERS—10 Points			
Shoulders, broad, deep, full, compact, covered with firm flesh.	6	.....	.....
Breast, wide, deep, breast bone advanced	2	.....	.....
Legs, straight, short, strong, wide apart, shank strong and smooth, feet sound	2	.....	.....
BODY—33 Points			
Chest, deep, broad, girth large, foreflank full	4	.....	.....
Back, broad, slightly arched, medium length, thickly, evenly and firmly fleshed	8	.....	.....
Sides, deep, medium length, closely ribbed, thickly, evenly and firmly fleshed	8	.....	.....
Loins, broad, strong, medium length, thickly, evenly and firmly fleshed	8	.....	.....
Belly, straight, proportionate width, firmly fleshed	3	.....	.....
Flanks, full, low	2	.....	.....
HINDQUARTERS—23 Points			
Hips, smoothly covered, proportionate width	3	.....	.....
Rump, long, rounding slightly, from loin to root of tail; width well carried back, thickly, evenly and firmly fleshed	8	.....	.....
Hams, deep, wide, thickly, evenly and firmly fleshed	10	.....	.....
Legs, straight, short, strong; shank strong and smooth, feet sound	2	.....	.....
Total	100	.....	.....

Disqualifications .....

.....

Animal..... *Date*.....

Student..... *Standing*.....

FARM MANAGEMENT.

Ex. 63. Plan of Farm.

Take the measurements of the home farm. Make plot of farm; scale, one inch = 660 feet. Show location of cultivated fields, pastures, timber, barn lot, orchard and garden. Show location of all buildings and all wells, ponds, or springs.

Ex. 64. Plan of Home.

Measure and make to scale a floor plan and cross section of your home. If you can, make a good drawing of the home.

Ex. 65. Plan of Barn.

Having read the references assigned by the teacher and knowing the kind and number of animals to be provided for, make ground plan of barn; scale, one inch = 6 feet.

Ex. 66. Examination of Fertilizers.

Study small samples of all fertilizers available. Test each with litmus paper. Learn name, composition and price of each. Observe color, odor and form.

Ex. 67. Experimental Test of Fertilizers.

This experiment takes time and can not be completed before September. If there is no school garden, ask some farmer in the neighborhood to rent you the necessary land. Lay off one-half acre of land in plots, each plot being precisely one-tenth of the whole, or one-twentieth of an acre. Mark the division points by stakes set well in the ground and number the plots from one to ten.

On plot No. 1, sow nothing.

On plot No. 2, 8 lbs. of nitrate of soda and 16 lbs. of acid phosphate.

On plot No. 3, 8 lbs. of nitrate of soda and 4 lbs. of muriate of potash.

On plot No. 4, 8 lbs. of nitrate of soda, 16 lbs. of acid phosphate and 4 lbs. of muriate of potash.

On plot No. 5, 20 lbs. of any commercial fertilizer used in the neighborhood.

On plot No. 6, nothing.

On plot No. 7, 500 lbs. of barnyard manure.

On plot No. 8, 8 lbs. of nitrate of soda.

On plot No. 9, 16 lbs. of acid phosphate.

On plot No. 10, 4 lbs. of muriate of potash.

Do this work in early spring. Plant the entire plot in corn or potatoes and cultivate carefully. In the fall, gather and weigh the crop. Which plot made the best yield? Which made the poorest? Arrange the plots according to the yield. Considering the market price of the corn or potatoes, did it pay to fertilize? Which plot shows the highest per cent of profit?

Ex. 68. The Home Garden.

Make drawing of plan for a vegetable garden to supply the home with a succession of vegetables. Indicate the area planted to different vegetables, the approximate time of planting, distance between rows, method of planting and cultivating.

Note.—It is important that the garden be arranged for cultivation by horse power.

Ex. 69. Farm Forestry.

Visit the woods on a farm. Find out what trees the method of cutting has favored, and what are the leading kinds, with the proportion of each. Learn the names of the common trees. Note that much of the cutting in woods is done in such a way as to leave the undesirable trees—the tree weeds.

Ex. 70. Agricultural Manufacturing.

Visit a creamery, vinegar factory, evaporator, canning factory or other similar industry. Note the different operations and refer to the scientific principles involved.

Ex. 71. The Babcock Test for Butter-Fat in Milk.

This exercise should first be performed by the teacher as a demonstration exercise and then by the individual students.

Caution.—Examine the apparatus and read the directions carefully before using it. When pouring the acid into the milk, be sure that the bottle is not pointed toward yourself or any other person.

Mix the milk by pouring it back and forth between two vessels several times. Place the small end of the pipette near the center of

the milk and suck up the milk above the 17.6 c.c. mark. Quickly put the index finger over the upper end of the pipette; and, by releasing the pressure, allow the milk to run out until its upper surface is even with 17.6 c.c. mark when the pipette is held straight up and down.

Place the point of the pipette a short distance into the test-bottle neck, holding it against the glass and with both pipette and bottle at an angle. Remove the finger to allow the milk to flow into the bottle. Be sure to get every drop of the milk, taking care to drain the pipette and to blow the last drop into the bottle.

After all the samples of milk to be tested have been measured, the acid should be added. Fill the acid measure to the 17.5 c.c. mark with acid that is neither very cold nor very hot. Pour this into the bottle with the milk, holding the bottle in a slanting position. The acid will then carry down any milk left in the neck, follow the glass surface to the bottom of the bottle and form a layer under the milk.

Hold the bottle by the neck and give it a circular motion for a few minutes, mixing the milk and acid until no milk or clear acid is visible. By this time the contents will be dark colored and hot. This change is due to the acid dissolving all the solid constituents of the milk except the fat, which it does not affect.

Place the bottles in the machine so that each one will have another directly opposite, to keep the machine in balance. Whirl the bottles five minutes at the proper speed for the machine in use. Then stop it; and, with the pipette or other convenient means, add hot water to each bottle until the contents come up to the bottom of the neck. Whirl two minutes. Add hot water enough to bring the top of the fat nearly to the top of the graduations on the neck of the bottles. Whirl one minute. The fat should then form a clear column in the neck of the bottle.

Reading the Percentage. Keep the fat warm so that it will be in the fluid condition. Hold the bottle by the upper end of the neck, letting it hang in a perpendicular position on the level with the eye. Read the graduations at the extreme top and bottom of the fat column. The difference between these is the percentage of fat in the milk.