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Plant Study in General Science

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of the body and its environment should be emphasized in some such course as hygiene and sanitation. Nutrition and clothing, first aid, home care of the sick, and communicable disease prevention are essential topics in health education.

A good text book can help materially in making health topics interesting. A number of such books have lately been published and pamphlets on health teaching are also available. A list of these books and pamphlets will be sent free to Iowa teachers in service from the Extension Division of the Iowa State Teachers College, if the request is accompanied by a stamped, self-addressed envelope.

The general aims, content and methods of health teaching have been briefly sketched. Methods of presentation and selection of subject matter must be adapted to the local conditions. Yet in every case the work must be so handled as to offer interest and make a personal appeal to the pupils. It should be presented in so vital and attractive a way that its benefits are obvious. The health course should be so planned and conducted that boys and girls when exposed to it will be thoroughly inoculated, and that positive reactions for better health attitudes and habits will result.

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PLANT STUDY IN GENERAL SCIENCE

General Science

The general science course in most high schools is conspicuous by its lack of plant study. Usually there is a brief study of micro-organisms, but the higher plant is often completely ignored. Why is this? Is it because the subject matter of plant study is of a special nature and is not of general importance? Is it because plant study is not of interest and cannot be adapted to beginners in high school? Perchance it is because most of our general science textbooks have been written by physicists and chemists. Some may say that plant study is omitted because the pupils will take biology later in their high school course. This is not a valid reason in Iowa. I have had the opportunity to observe several hundred college students from Iowa high schools in general botany. Nearly all of them have studied physics in high school, but relatively few of them have had biology. In Iowa high schools, there is a special need for a unit on the study of the higher plant in a course in general science. Let me suggest some material for such a study.

Certainly, there is nothing of greater importance in our lives than food supply and a study of the source of this supply must be of general scientific interest. The most unique and important fact about green plants is their ability to take inorganic food materials and make food. This process is photosynthesis. All living things, both plant and animal, are dependent upon green plants for food. The green plant manufactures the food for the world, and most of the work done in this world is accomplished by the energy that plants store in this process. This subject deserves a place in general science. Try these simple demonstrations on photosynthesis.

Problem 1. Is chlorophyll necessary for the manufacture of starch by a plant?

Either the geranium with the white edged leaf known as "Mme. Salleroi" or a coleus, commonly called a foliage plant, is suitable for this demonstration. A leaf is taken from one of these plants which has been in the sunlight for about six hours. Note the location of the chlorophyll in the leaf. Remove the chlorophyll by boiling in alcohol. Ordinary denatured alcohol is suitable. After the chlorophyll is removed, place the leaf in a dish and cover with iodine solution. The presence of the starch will be shown by a dark blue color. (The pupils should first be shown the iodine test for starch.) Starch will be found only in that part of the leaf that contained chlorophyll.

Problem 2. Is light necessary for the manufacture of starch by a green plant?

Take two ordinary potted geranium plants, (A) and (B). Set (A) in sunlight and (B) in the dark. After (A) has been in sunlight for about six hours and (B) in the dark for about twenty-four hours, remove a leaf from each. Extract the chlorophyll

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get for criticism. With some teachers, the enthusiasm for individual experiment has resulted in much wasted time; with others, the lack of laboratory work has made the course degenerate into a mere reading of the textbook. We need to strike a happy medium between these two extremes. The laboratory enthusiasts must remember that it is not necessary to rediscover all the chief facts of science in the laboratory, and that such a method is the slowest possible way of learning. They must also appreciate that pupils retain definite ideas of work demonstrated and explained by the teacher for quite as long a time as they do those ideas which they themselves have worked out individually. Investigation has shown that in many instances the child's ideas are clearer when the demonstration method is used than when he works individually. When he works alone he is so absorbed by the mechanical difficulties he encounters in his experiment that he cannot see the bearing it has on other phases of his science work. On the other hand, the teachers who depend on the textbook almost entirely need to be reminded that no science course can be effective unless the child comes in contact with and sees in operation the objects under discussion. If we believe that the functions of the laboratory are: (1) to teach our pupils to think, (2) to teach them to observe, and (3) to clarify facts that are not easily understood without concrete demonstration, then we cannot go far astray in our work.

Researches have indicated that in General Science and Physics courses, the most satisfactory results in laboratory work come from demonstrations performed by the teacher rather than by the individual student. These investigations have also indicated that pupils retain definite ideas of work demonstrated and explained, for a longer period of time than they do those which are merely read from the textbook. In Biology, the study of living things out of doors or in the laboratory offers a great incentive to the pupils, and is an excellent means of training in observation. (Note: excellent discussions of this question have appeared in earlier issues of the Bulletin.)

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with alcohol and test the leaves for starch as described above. The leaf from plant (A) will show an abundance of starch while the one from (B) will show no starch.

These two demonstrations, if properly presented, should call forth discussion. Many questions should be asked. How do green plants differ from animals in the way they secure their food? What is the peculiar place of the green plant in relation to the food suply of the world? Why are we so dependent upon agriculture? How do plants, such as molds, secure their food? Are the green algae, such as pond scums, of any significance to aquatic animals? The necessity of sunlight and the storage of energy in manufactured food should be discussed in connection with the second demonstration. The conservation and transformation of energy in nature is illustrated here. Trace the origin of the energy by which our homes are heated in a discussion of coal and its origin. Photosynthesis might be considered in relation to the energy that a locomotive uses in pulling a train of cars.

We are now led to a study of the method by which plants and animals secure their energy from food in the process of respiration. A few simple experiments can now be used to demonstrate plant respiration.

Problem 3. Do germinating seeds release energy in their growth?

Use two thermos bottles. In one place dry seeds and in the other germinating seeds. Oats or barley are quite satisfactory. Germination should be started on blotting paper before the seeds are placed in the bottle. Place a thermometer in each bottle and plug with cotton. After a few hours, note the temperatures. A decided rise in temperature will be caused by the germinating seeds. If the seeds are not sterilized, bacteria and molds will cause part of this rise, but even this action is a type of respiration by which these micro-organisms secure energy.

Problem 4. Do growing seeds use oxygen?

Obtain two bottles, (A) and (B). Place germinating seeds, oats or barley, in (A) and dry seeds in (B).

Close bottles air-tight with rubber stoppers. After a few hours test the gas in the bottles with a burning splint. There will not be enough oxygen in (A) to support combustion while the splint will burn in (B).

Problem 5. What gas do germinating seeds release?

Prepare two bottles with dry and germinating seeds, respectively, as described above. Place an open vial containing clear lime water in each bottle. After a few hours, note the lime water in the vials. The lime water in the bottle of germinating seeds will have turned milky showing carbon dioxide while there will be no carbon dioxide shown in the other bottle.

These demonstrations offer an opportunity to develop the principle that plants and animals secure their energy from food manufactured by plants in photosynthesis. The analogy between the oxidation processes of respiration and combustion can be pointed out. The confusion concerning respiration in plants and animals should be cleared up.

Experiments of the type here described bring out fundamental principles concerning plants which can be taught to freshmen in high school. It is the general science course which offers the only place where this material can be taught in many of our Iowa high schools.

C. W. LANTZ

LABORATORY WORK IN POULTRY

Agriculture

It is probable that the winter feeding, housing and management problems of poultry have been taken up in class before this time. If not, the alert agricultural instructor can develop some very practical laboratory work by conducting a survey in the community of the conditions under which poultry is kept, and then comparing the results obtained from flocks cared for under varying conditions. This survey can be conducted while the subject of care, feeding and housing is being studied in the class room. In case two flocks are found which are being cared for under fairly equal conditions but are producing unequally, it will be well to do some culling and make a thorough study of type as related to egg production.

If some of the class are taking work in manual training, it might be well to have the class repair an old poultry house and modernize it. Very often this will require only the closing of cracks, putting in a straw loft, opening a couple of spaces in the ends of the loft, and opening the front of the house to provide for sunlight and ventilation. A few changes of this kind will often improve the conditions in the house so much that a marked improvement in the flock will result.

The feeding problem at this time of year should present some interesting comparisons. A preliminary survey should be made to learn what methods of feeding are being used and what results are being obtained in order to make the work in poultry feeding practical. I have found a growing tendency toward the method of using all scratch feed, and some excellent results have been secured, especially where milk was available. A first-hand comparison of feeding methods is more likely to set the class to thinking and produce a lasting impression than is the theoretical study of any system.

The big problem in poultry teaching for this time of year, however, is that of next year's crop. Again a survey of the community will be valuable. First, determine what percentage of the poultry raisers use the eggs from their own flock for hatching purposes. Even though the prevailing practice is to purchase baby chicks, the study of methods of flock improvement is desirable and essential. You should also determine how many poultry raisers use a special breeding flock, when this is selected, what age of hens are used, and on what basis selection is made. With a knowledge of these facts, the class will be more interested in the breeding problem.

In attacking the problem of the breeding flock, it is desirable to take up the study of the pullets and show the value of early maturity, strength and health. (See monthly bulletin of the Ohio Agricultural Experiment Station for November and December, 1921). The ideal method would involve the culling of several flocks of pullets in the fall, throwing out the weak, late maturing birds and banding those showing outstanding breeding prospects. Next, study the sum-