

proceeded to surround their eggs with a shell. Within the shell was included not only enough food-yolk, but sufficient water, and as the young developed within the egg shells they grew membranes of different sorts which enveloped the yolk to absorb it, covered their bodies to protect them, all surrounded and cushioned by water, and still another membrane to lie closely applied to the inner surface of the somewhat porous shell and absorb the life-giving oxygen. By the time these babies had used up all the food in the egg they were sufficiently developed to shift for themselves, and bursting the shell, hatched out to face their world. Such creatures were the first reptiles. So successful were they that they spread over all the world, invading its every life zone, even the air, for there were flying reptiles.

The next great discovery which vertebrates made was that of the four-chambered heart, and the warm-blooded type of circulation. Just when this came about we do not know, for the skeletons of some of these denizens of the age of reptiles were so much like those of warm-blooded animals that we can not be sure that they did not have the four-chambered heart. Contrary to opinion, hearts do not fossilize! The warm-blooded type of animal advanced in two great directions. One remained very reptile-like in all characteristics save the circulation, changed its scales to feathers, and founded the great bird family. The other, made up of small, very retiring and modest, but withal persistent animals, learned still another way of caring for its young by carrying them through their early stages of development within the body of the mother, nourishing them during infancy by a peculiar secretion, milk, from glands of the skin, and substituted hair for scales as covering for their bodies. These were the mammals, and they too were destined to become great upon the face of the earth, and their most successful member,

who rejoices in the sometimes unsuitable name, *Homo sapiens*, modern man, now rules them all.

Such, very briefly told, has been the story of the progress of animal life through geologic time down to the present, which is after all so like the past, that the general features of our landscapes have not changed for millions of years. What future progress shall be, we do not know, but we may feel sure that this marvelous progression will not stop. Problems will arise, but they will be solved, as they have been in the past until the end of the present phase of the solar system with its tiny earth shall have been reached. RUTH PHILLIPS

CREATING INTEREST IN BIOLOGY

BIOLOGY is the science of life—a study of living things—and only when it is presented as such will it become interesting and important in the sight of the child. And every successful teacher knows that his first problem is that of leading his pupil to become interested in the subject and to realize its worth. In order to do this the teacher must first convince himself of the fact that the subject is worth while, that it has direct values which can be linked up with the life of the child. Less than fifty years ago this would have been almost impossible because the acceptance of any biological subject as entrance credit to college dates back less than fifty years,¹ and the subject as first taught concerned itself with anatomy and classifications. Those taking the subject in its infancy concerned themselves chiefly with learning numerous structural and descriptive terms. Botany of the early period, especially, could almost be called a vocabulary subject. "When biology was introduced into the secondary schools, the sub-

¹Finley—*Biology in Secondary Schools and the Training of Biology Teachers*, 1926.

ject was taught by men and women trained almost wholly in college courses in morphology and classification; and in consequence a diluted type of college course was almost inevitable in the high school. Much of the laboratory material consisted of preserved specimens of plants and animals. Microscopical work of too difficult a type was insisted upon. Herbaria of dried specimens cluttered home and school. In recent years increasing emphasis has been placed upon the study of living organisms. Physiological experiments and ecological studies have been introduced. But still the type of topic selected for study is more or less that which appeals to the adult mind rather than to the mind of the adolescent. The material used was often remote from the everyday experience of the students, and biological studies still failed to function as largely as had been hoped. When teachers began to present biology in its relation to human welfare, a new and vital interest in the subject was awakened, and in many schools biology has become deservedly popular. It is evident that further progress in the pedagogy of the subject should be made along the line of organization of courses in biology which relate to various aspects of human welfare."² To reduce the whole thing and put it in a nutshell, biology failed some years ago to command the respect of pupils because it failed as material which would best equip the pupil to take his place as a prosperous, self-respecting citizen of the world. The aim in biology teaching in our secondary schools has changed from "biology for the sake of biology" to "biology in relation to human welfare."³ With this aim in view the teacher can easily convince himself and then his pupil of the fact that biology contributes to the educational objectives—health, worthy home member-

ship, the worthy use of leisure, ethical character, vocation, and citizenship.

Health has for a long time been a basic end of education and much of biology deals directly with problems of health. Biology touches the home life both within and without at many angles in that it creates a purposeful interest in the life of the environment by giving first-hand information about and acquaintance with plants and animals, and especially man as the center of attraction. A desire to spend leisure time in the enjoyment of nature's store of wonders is easily acquired through after-school trips to museums, industrial plants, field trips, and the like. The aesthetic appeal of plants and animals should enrich the life of the pupil to such an extent that he will naturally appreciate and enjoy nature. Ethical character is developed chiefly through biology in that it insists upon sound methods of thinking and clear reasoning out of problems. Truth is emphasized above all things, and only logical conclusions are accepted. The underlying knowledge of the science of biology if directed in the right manner can be a great aid to a pupil in choosing a vocation. The observant teacher will detect certain indication of pupils toward some vocation. Probably it will be that of medicine, bacteriology, museum work, nursing, farming, forestry, gardening, research, or what not. Can this grow out of a study of biology? A father of one of my pupils told me that his present position as a member of a research group for the Smithsonian Institution was an outgrowth of work done in a high school biology class. A good citizen appreciates an expert and the work he does for a community. Vocations of a scientific nature render invaluable service to society. The student of biology becomes more familiar with this work and its value to the community. The pupil should early realize the great aim of biology to be "a better understanding of man's place in nature" and

²Caldwell, O. W. and Committee—*Reorganization of Science in Secondary Schools*. U. S. Bureau of Education, 1920, Bulletin No. 26.

³Finley—*Biology in Secondary Schools and the Training of Biology Teachers*.

"the interdependence of plants and animals in relation to human welfare."

We have considered briefly the value and importance of biology. Now let us show some means by which it may be made practical and interesting to the pupil. Biology should deal primarily with living, growing things, because adolescent boys and girls are interested in activity and in things that concern themselves. Therefore, functions rather than structures of living things should be emphasized. In the beginning, at least, the materials should be the living things of the pupils' environment. Pupils come for the first time into a biology class with many and varied ideas as to what it is all about, and most of them are eager to find out. Invariably he wants to study "bugs" or "frogs." He has stood on the outside of your laboratory door many a time before he was far enough advanced to take the course, and watched you dissect a frog. Now he rejoices that he can "come in." Dare we kill the interest of such a pupil by stressing memory of long dictated paragraphs or repetitions of General Science when there is so much of life and interest already in the biological course? Why do we not begin with the topic of vital interest to the pupil and work in skillfully those details which are essential? Many readers will contend that this is very easy to say but not so easy to do. I agree with you that this is true if you are confining yourself to the textbook and the old question-answer method of teaching, exclusively. But if you are willing to undertake a project in the Group-Study Plan or the Contract Plan you will find it quite different. I wish to outline below a unit of work which was done by a 9B Biology Class under my direction in the Washington Lee High School in Arlington County. I shall not only give the unit, but include the results also.

BIRDS IN RELATION TO HUMAN WELFARE

Time: One week.

Text: Peabody and Hunt—*Biology and Human Welfare.*"

D—Assignment

1. Read carefully Chapter XX, "How Birds Are Related to Human Welfare." (text)
2. Make a list of ten outstanding questions that you intend to answer during this study. Read these questions to the class and receive a criticism of them.
3. Sketch the bird found on page 420, Fig. 268, of the text. Label and learn each region indicated there.
4. Write out brief answers to these questions:
 - a. How does a bird fly?
 - b. How are the legs and feet fitted for their function?
 - c. Explain how birds reproduce.
 - d. Of what does a hen's egg consist?
 - e. How is a hen's egg formed?
 - f. Why does a hen's egg develop into a chick?
(One pupil from the group will be asked to lead a discussion involving these questions. The one who finishes first will be designated to do this.)
5. The instructor will use ten minutes of each class period to lecture and discuss with the entire class the following topics. Pupils will take notes:
 - a. Vital functions and organs of a bird.
 - (1) Circulation—Monday
 - (2) Respiration—Tuesday
 - (3) Digestion and Excretion—Wednesday
 - (4) *Reproduction—Thursday
 - (5) Sensation—Friday
*Experiment (demonstration)
Dissection of a hen's egg and study of parts. (Each pupil will write up the experiment.)
6. Make a list of all the books and maga-

zines (with authors and publishers) that you use in this work.

C—Assignment

1. Write a composition on one of the following topics and read it to the class as soon as it is finished:
 - a. The Value of Birds to Man
 - b. The Dangers That Threaten Birds
 - c. Some Ways in Which Birds May Be Injurious to Man
2. Make a study of the living bird in its natural abode and write up the experiment answering these questions:
 - a. What is the name of the bird?
 - b. How many toes has it? Are these toes grouped two in front and two behind, or three in front and one behind? Are the toe nails long or short? Why? Are they used for taking food? For holding food? For perching? For scratching? For wading? or for what?
 - c. How are the feathers distributed? Where are the long feathers? the short feathers? Are they evenly colored? Does the bird have any special markings?
 - d. Does the bird walk or hop?
 - e. Examine the beak. Is it adapted for crushing seed? tearing flesh? catching insects? drilling? or what?
 - f. Examine the eyes. Does the bird wink? Does it have eyelashes?
 - g. Describe the sound made by the bird.
 - h. How does the bird eat? bathe? "dust"?
 - i. State any additional observation that you make regarding the bird.
3. Make a list of five distinctively useful birds and five harmful birds, giving one outstanding characteristic of each.
4. Explain how protection of the law has been extended to birds and also tell what the United States and Great Britain together have done to protect

migratory birds. Is this a good thing? Why? (Written paragraph.)

B—Assignment (answer any four)

1. Give an oral report on the topic: "My Favorite Bird." Include in your report—
 - a. The outstanding characteristics.
 - b. Its habits of life (nest-building, food-getting, care of young, etc.)
 - c. Use or harm to man.
 - d. Habitat (where it lives).
 2. Write a composition on the life and works of one of the following men:
 - a. John James Audubon
 - b. John Burroughs (be prepared to read this to the class).
 3. Keep a bird chart for one week:
 - a. Name of bird.
 - b. Where seen.
 - c. When seen.
 - d. What doing.
 - e. Description.
 4. Make a list of the ways in which an individual can protect birds and encourage them to breed.
 5. Make a poster bird chart or a bird calendar, give the name of each bird, and its native home if possible.
- A—Assignment (answer any two)
1. Make a list of fifty common birds and give a characteristic of each.
 2. Visit the birds at the Zoölogical Gardens in Washington, and make a list of as many birds that you see there as you can, giving one characteristic of each. (Our school is two miles from Washington, D. C.) Report to the class on this trip.
 3. Visit the National Museum and study the birds found there. Write an account of your visit and report your finding to the class.
 4. Write a composition of at least 500 words on the subject: "The Work of the Government in Protecting Birds." (1) National, (2) State, (3) Private.

Include in this as many of the bird laws as you can.

5. Make two of the following and tell the class how you did it:
 - a. Bird box.
 - b. Bird bath.
 - c. Feeding station.

References:

1. Peabody and Hunt—*Biology and Human Welfare*.
2. Smith—*Everyday Science Projects*.
3. Smallwood, Reveley, and Bailey—*New Biology*.
4. Davenport—*Elements of Zoölogy*.
5. Clement—*Living Things*.
6. Blanchian—*Birds*.
7. Moon—*Biology for Beginners*.
8. *Useful Birds of America*, Series A, one, two, three, four—30 in a set. Sent on request by Church and Dwight Co., Inc., 27 Cedar St., New York, N. Y. (10 cents to cover mailing.)
9. Audubon bird leaflets 5½ by 8½ with four pages of descriptive material. 5 cents each (five cards). National Association of Audubon Societies, 1974 Broadway, New York City.
10. Booklet of sixteen common birds (sent upon request). Dwinell-Wright Co., 311 Summer St., Boston, Mass.
11. Reed—*Bird Guide*.

This assignment was given to an average class of thirty pupils. My first step, after providing each pupil with a copy, was to explain every part of it in detail and to give instructions as to the procedure. This was done on Friday before the Monday on which the work was to be started. Each copy was then collected and held by me until the day of beginning. The pupils were asked to use the week-end for obtaining books and material for work. Books and pamphlets were to be brought in and left on a shelf designated for this purpose. The class as a whole appeared very much interested. On Monday—the day of beginning—quite a good supply of books and some bird charts were brought in. I had outline charts and pictures on the walls of the room also. The room had begun to take on the appearance of a work shop. The papers were given out and work started (of course, certain directions as to mechanical details

were given). Results at the end of the week were as follows:

- 3 pupils completed the A-Assignment
- 6 pupils completed the B-Assignment
- 14 pupils completed the C-Assignment
- 7 pupils completed the D-Assignment
- 0 pupils below the D-Assignment
- 1 pupil started the A-Assignment, but did not finish it.
- 4 pupils started the B-Assignment, but did not finish it.
- 5 pupils started the C-Assignment, but did not finish it.
- 5 pupils visited the zoo in the interest of this work.
- 6 pupils visited the museum.
- A large percentage of the class sent for one or more of the pamphlets on birds.
- All pupils liked the work and several asked for another unit.
- This unit of work was chiefly centered around the plan outlined by Miller and Hargreaves in *The Self-Directed School*. At present I am working on a unit based on "The Group-Study Plan" by Edward R. Maguire.

SADIE S. WILLIAMS.

BIRD STUDY

TO THE close observer, it is evident that in recent years there has been a great increase of interest by people of all ages and all walks of life in the identification and life habits of birds. This is shown by the increased number of adults who have taken up bird study as a hobby and by the large amount of legislation designed to protect birds. Children, too, are changing their attitude from the destructive to the constructive. We do not have to search far nor long to find the reasons for this interest.

Perhaps the basic reason is an economic one. Agriculture has become intensified and new forms of plants have been introduced into our country. With them have come new weeds and insects which, added to those we already had, have complicated