

Opportunities for Exploration and Discovery

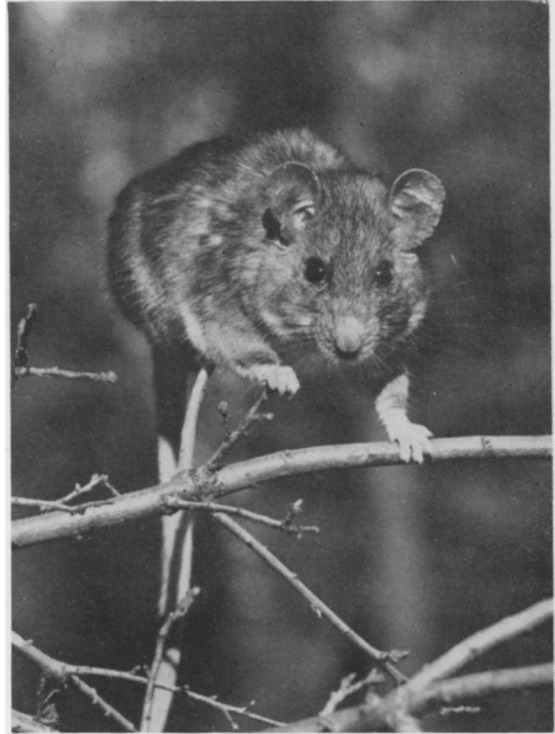
ENID A. LARSON
Carmel High School
Carmel, California

The work in biology at Carmel High School is based on the naturalist's philosophy that it is vastly important for students to study living organisms; that the indoor laboratory and the out-of-doors are available for the purposes of fostering the spirit of inquiry and arousing enthusiasms for learning.

If students are to understand the environment in which they exist as a part of the living world and as a member of a complex social organization, each student must gain his knowledge of the land and its changes from first-hand experiences. In biology there is an opportunity, as in no other field, to help the student recognize some of these problems, to observe, gather and record data carefully, set up and test his hypotheses and then arrive in some measure at a tentative conclusion that is reasonable, if we, as teachers can provide the challenge! The student's eagerness, enthusiasm and diligence know no bounds when he is given an opportunity to find out for himself. Ninety per cent of the values in study out-of-doors comes from discovery and first-hand acquaintance by the individual who goes out to observe. To the teacher who provides these opportunities comes the unmatched satisfactions in the realization that she is meeting the fundamental needs of the individual as he explores and experiences the thrills of first-hand discovery.

We have provided such opportunities at our high school. Our Board of Trustees listened to our plea and set aside for us a natural area of 2½ acres of unused land on our campus for the study of living plants and animals and their communities, under conditions that free the land from man's disturbance insofar as is possible. We were fortunate in having as an inspiration for our work the kindly guidance, counsel and leadership of one of America's most outstanding students of natural history, Dr. J. M. Linsdale.

The biology students who were instrumental in helping set aside this acreage gathered in groups and outlined a flexible yet long-range program of study. They wished to study the



Dusky-footed Woodrat (*Neotoma fuscipes*).
Courtesy of Lloyd P. Tevis, Jr.

This is the Packrat of California which builds conspicuous houses of sticks in the chaparral.

nature of soils and the effects of weather upon it; and at what rates plants grow? What kinds of plants and animals live in an acreage of this size? What interdependence of plants and animals can we discover? How can gully erosion be prevented? These were a few of the problems they suggested.

A film of our classroom and outdoor activities was taken, developed and printed by our principal, Warren W. Edwards at a cost of \$30.00. The story of the film began after initial group planning and after student-teacher conferences in which the individual problems were formulated. Each student prepared a careful outline of the problem and of his work before he went into the field.

The following paragraphs contain the commentary which accompanied the showing of

this film at the AAAS meeting at Berkley, December 28, 1954.

The story begins after this initial group planning and after student-teacher conferences in which the individual problems were formulated. Each student prepared a careful outline of the problem and his work before he went into the field.

The campus at Carmel High School is spacious. It faces the Carmel Valley where the Santa Lucia mountains of Monterey County meet the Pacific.

Senior students, enrolled for their third year of Biology, arrive and enter the classroom where laboratory work on their out-of-door problems is underway.

The setting aside of our natural area received community support and was featured in our local newspaper.

Our first task involved bounding the AREA, mapping and fencing. A directional marker was set. Geometry as a study took on new meaning and importance when its principles were put to use.

Within its boundaries on an east-facing slope are three major plant associations: open grassland, a small forest of Monterey pine trees, and between these, an irregular strip of chaparral made up of California sage, coffee-berry, coyote brush, live oak and Ceanothus.

A weather station was purchased by our Superintendent from War Surplus. It was assembled and set up by two members of our Biology Class. The station faces directly north and its floor is 4½ feet above the ground. Howard is the weatherman.

He planned his weather recording sheet and took full responsibility for keeping the readings. He entered the classroom and immediately went to the barometer on our wall for his first reading and recording. He left the classroom and walked 400 yards to the natural area where the other instruments were set up in the weather shelter. The instruments were read at the same time each day.

Reading the maximum-minimum thermometers

Setting the maximum-minimum thermometer with a magnet

Wet-dry bulb thermometers must be fanned to give an accurate reading

Filling the wet-dry bulb wind velocity gauge

Reading the rain gauge

Weather vane, designed by Howard and made in our shop

Installing the weather vane

SUMMARY

Each month a summary of the weather data was figured and recorded. These findings answered, in part, some of his questions. How much rainfall? How many cloudy days? How many sunny days? Which months in the year are most free of fog in Carmel?

This out-of-door work brought him to the point where he recognized his own need for reference reading. He had been little interested in books up to this time. Stewart's *STORM* delighted him; he asked for more. He read Miller's *WIND, RAIN AND STORM*, and Vetter's *VISIBILITY UNLIMITED*.

Bill chose to study the rate of growth in heights of Monterey Pine seedlings. We have his record of the growth of five pine seedlings over a period of 1½ years. He was interested in discovering that their growing season paralleled the rainy season which was recorded on the weather charts.

The growth of the seedlings was plotted in the laboratory from the figures he recorded in the field.

Francis made an extensive study of the wood rat. We are fortunate in having this mammal established in our area. Francis located nine of the pyramidal houses of sticks built by the rats. These are often located in impenetrable tangles of dead branches of shrubs. He measured the diameters and the heights of these houses at frequent intervals in order to determine the rates of increase in size as sticks are constantly being added to an occupied house. He studied the trails and followed their course from house to house. Wood rats are great visitors. Three individuals were live trapped and brought into the laboratory where they were accurately weighed and then returned to the site of capture and released without harm or undue fright. Subsequently, these animals were recaptured and reweighed; their gains or losses computed. *THE DUSKY-FOOTED WOOD RAT* by Linsdale and Tevis served as a source of constant reference. Francis compared what he found in our AREA with the scientific

studies recorded in this book. Although the wood rat is nocturnal, Francis was successful in live trapping during the day.

Melinda and Susan worked for part of the year on the beginnings of our collection of plants for our reference. All collections are made outside of the boundaries of our area in keeping with the principle of maintaining a natural area in an undisturbed condition. Field data: date, locality, collector, soil type, exposure, are recorded with each specimen in the field at the time of collection. The plants are pressed between standard blotters, mounted on regular sheets of herbarium paper, labelled and sorted to family and genus. Susan worked with Jepson's MANUAL and made progress in identification.

What is soil? Are there different kinds of soil? A study of soil fascinated Susan. She prepared a soil profile by making a vertical cut 15 inches deep in the ground outside of the natural area. She measured the depths of each layer and was amazed to see the narrow margin of topsoil.

She tested soils from five selected locations for acidity-alkalinity and for nitrogen content. For these tests she used LaMotte, Morgan type, equipment.

She planned an experiment under controlled conditions to test the effect of degrees of acidity of these soils on the growth of bean seedlings.

What vertebrate animals live in our AREA? Tam and Melinda observed birds throughout the year and each student kept a field notebook on special 5½ x 8½ ruled paper. The notebook record is made at the time of observations in the field. Binoculars are useful. These were purchased from War Surplus and were inexpensive. A watch is necessary for the observer to record flights, lengths of time of calls, foraging periods and feeding of young.

The object of the record is to write clearly and understandably of what one sees. This is far from easy Penmanship and written communication improved as the work progressed.

From their observations we have prepared a record of 45 species of vertebrates in our area. More important, though, are the records of what the observers saw these animals doing. Their descriptions are suffi-

ciently adequate for positive identification of birds. We have one exciting record of Bullock orioles driving a Red-tailed hawk out of the AREA.

Our reference books are original scientific studies insofar as possible, not texts. We assembled a book, Vol. I, as a permanent record of our work. Each student wrote up his own chapter and aided in the editing.

From time to time each student shared his discoveries with his classmates. Interesting discussions invariably followed.

At the close of the term we gathered to evaluate our wonderful experience.

I asked them two questions: first, what had these experiences done for them individually? and second, what had been the role of the teacher?

I wish we had the recording of their own voices on this film. The students were unanimous in their enthusiasms to explain that this experience had given them INDEPENDENCE. It had given them FREEDOM with RESPONSIBILITY. It had given them a sense of SECURITY which they had never before experienced. It had widened their range of KNOWLEDGE. It had RELEASED them from tensions of competition. It had given them ENTHUSIASM FOR STUDY.

They depended on their teacher not for answers but for more questions. When they came for help, we sat down as friends and talked out the problem from their points of view. Each student understood that this was HIS PROBLEM, not the teacher's and that the responsibility rested with him to work toward a solution. As the teacher, I could point out, only by asking further questions, possible ways of approach. The choice of procedure was his.

This type of teaching resulted in unfolding of personality growth and development. One student gained in self-esteem and self-confidence to the extent that he earned almost straight "A" throughout his entire senior year. His physical health improved. One student decided to enter the teaching profession.

Academically as to the values of this year: all I can say is, that two of the problems undertaken in this course were awarded honorable mention in The Future Scientists of America program sponsored by NSTA and The American Society of Metals in 1954.