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THE STATUS OF AND SUGGESTIONS FOR THE  
ANIMAL COLLECTIONS USED IN TEACHING  
BIOLOGY IN IDAHO'S HIGH SCHOOLS

by

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B. S. Montana State University, 1951

Presented in partial fulfillment of the  
requirements for the degree of  
Master of Education

MONTANA STATE UNIVERSITY

1955

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## CHAPTER I

### INTRODUCTION

Biology can be taught and learned with very little equipment, but it can be better learned and more effectively taught with the help of the various aids that are available. In recent years, the objectives of teaching biology have undergone considerable modification, yet the study of the animal kingdom remains as an integral part of the course in high school biology. One of the aids most important for successfully accomplishing these objectives related to the study of the animal kingdom is a collection of preserved animals representing the various phyla of the animal kingdom, and the major classes of each phylum. Despite the obvious advantages of having at hand such a collection for teaching certain aspects of biology, a great many high schools have an extremely limited collection, or no specimens at all. "It is unquestionably true that a science course that is rich in illustrative material is far more effective than one resorting only to reading the pages of the textbook."<sup>1</sup> The writer has long been interested in the extent of the variation in school collections, and in

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<sup>1</sup>Hugh E. Brown, "Materials for Laboratory and Demonstrations", The Bulletin of the National Association of Secondary School Principals, 37:119-120, January, 1953.



the reasons for these variations. This paper represents an attempt to find some of the answers.

Statement of the problem. The main purpose of this study was to develop a list of preserved animals suitable to the needs of the small high schools in Idaho, and to find the extent of the existing variation in the animal collections of these high schools, along with the reasons for the variations.

In order to accomplish this, the following set of questions were developed as a means of attacking the problem:

1. What is the present status of the preserved animal collections in Idaho's small high schools?
2. What animals are recommended for high school teaching by authorities in the field?
3. To what extent do the authorities agree?
4. How do the opinions of the biology teachers compare with those of the authorities?
5. What would be a list of specimens acceptable to both the teachers and the authorities?
6. What methods are used by the teachers to obtain the animal collections for their schools?
7. What reasons are advanced by teachers for the present status of their collections?

Setting of the problem. If an investigator were to visit the science rooms of several of the small high schools in Idaho, paying particular attention to the animal collections, he might find a few schools with an excellent repre-

sentation of the animal kingdom, preserved in attractive, labeled jars and displayed in a well-lighted, accessible case. He might also find many schools with a rather poor representation of the animal kingdom, preserved in an odd assortment of containers, and stacked in a box in a corner of the room, or in some other equally inaccessible place. In other schools, he would find no evidence whatever of a preserved animal collection.

Frequently, a biology instructor having a particular slant or philosophy of teaching will acquire a certain group of specimens which he believes essential to achieve the objectives of the course, keep them until they are dissected for study, and then discard them, feeling that the students are familiar enough with these animals that they now have an appreciation of the animal kingdom.

Delimitation. This study included only public high schools in Idaho with a student population of two hundred or less, and was restricted to the preserved animal collections used in teaching biology in these high schools. It was not the purpose of this study to discuss living laboratory animals, nor the techniques of teaching employed in using preserved animals.

Assumptions. Several assumptions had to be made in order to focus the problem for study. First was the assumption that the majority of small high schools are severely limited by meager budgets for purchasing biological equipment and, therefore, have to limit their acquisitions to

those items which are considered essential. Secondly, it must be assumed that the majority of authorities consider the ten major phyla to represent adequately the animal kingdom. The final assumption is that since most of the smaller high schools are located in a rural or semi-rural situation, the opportunities for collecting native specimens near the school are good.

Importance of the problem. Recognizing that the animal collections are important in teaching many aspects of biology, and that these collections tend to vary widely in Idaho schools, and elsewhere,<sup>2</sup> this paper will be an attempt to institute a standardization of these collections. As to the objections against standardization, Brown submits:

However, a list put out by a professional group is a very great help to a beginning teacher or one who does not have a degree in the science he is teaching and whose first years of teaching are invariable in small schools which are the ones, universally lacking in facilities of all kinds.<sup>3</sup>

The number of teachers who are poorly prepared for the courses they teach, and consequently in need of this type of help, is greater than is generally realized. Watson found:

In 29 states, a person can be licensed to teach science on the basis of study in just one science subject. Only five states require study in comprehensive fields such as the physical or biological

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<sup>2</sup>Edgar W. Martin, The Teaching of General Biology in the Public High Schools of the United States, Office of Education, Federal Security Agency, Bulletin 1952, No. 9 (Washington: Government Printing Office, 1952), pg. 29.

<sup>3</sup>Brown, op. cit., pg. 121.

sciences. ...20 per cent of all the high school teachers taught one or more science courses, but apparently only half of them [italics not in the original] were qualified in science.<sup>4</sup>

If a list that teachers will accept and use can be presented, if the great differences in school collections can be minimized, and if the advantages of maintaining these collections in good order can be accomplished, the purpose of this paper will have been achieved.

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<sup>4</sup>Fletcher G. Watson, "A Crisis in Science Teaching", Scientific American, 190:28, February, 1954.

## CHAPTER II

### REVIEW OF RELATED LITERATURE

An extensive search of the available literature was carried on by the investigator for the purpose of finding similar studies. A great number of articles have been written on such subjects as: principles of biology teaching, objectives of biology, visual aids, and biological equipment. Relatively few, however, were found which were concerned with the animals used in teaching biology, and none were found which pertained directly to the problem being considered.

Related books. Two books which dealt briefly with animal collections for biology teaching were located, one of which is familiar to anyone reasonably well acquainted with the teaching of biology.

The book by Miller and Blaydes,<sup>1</sup> an old standby of biology teachers, contains several suggestions for collecting animals and plants in Chapter XII, Collecting, Culturing, and Preserving. This chapter, as its name implies, is devoted to methods of collecting biological specimens, growing or culturing the very small plants and animals, and recommendations for correctly preserving what is grown or collect-

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<sup>1</sup>David F. Miller and Glenn W. Blaydes, Methods and Materials for Teaching Biological Science. New York: McGraw Hill Book Company, Inc., 1938.

ed. Chapter VIII, The Lack of Materials and Equipment, has many suggestions for inexpensively obtaining much of the material and equipment commonly used in high school biology courses.

Heiss, Obourn, and Hoffman,<sup>2</sup> in their book, devoted Chapter 17, Objects, Specimens, and Models, to a discussion of ways to inexpensively obtain these aids by collecting, by contacting industrial concerns, and by using students as collectors. Also included was a discussion for making home-made items useful for teaching, and several methods for preserving animal and plant specimens.

Related studies. In an unpublished Master's paper, Jones<sup>3</sup> was primarily concerned with apparatus rather than specimens. He investigated equipment needs for small Montana high schools, and mentioned specimens only as part of the overall laboratory materials needed for successfully teaching biology. He found that eight of nine state equipment lists mentioned preserved specimens,<sup>4</sup> and that these specimens were rated "high" in teaching value by Montana teachers.<sup>5</sup> In addition, he found a recommended number (forty-eight) of pre-

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<sup>2</sup>E. D. Heiss, E. S. Obourn, and C. W. Hoffman, Modern Methods and Materials for Teaching Science. New York: The Macmillan Company, Revised 1950, 462 pages.

<sup>3</sup>Layton F. Jones, Equipment Needs for a Biology Course in the Small Montana High School (Unpublished Master's paper, Montana State University, Missoula, 1952), pg.3.

<sup>4</sup>Ibid., p. 57

<sup>5</sup>Ibid., p. 49

served specimens for observation, and an average unit cost of these specimens of seventy-five cents.<sup>6</sup>

The U. S. Office of Education published a study by Martin, their specialist for Biological Science, which was

...designed to obtain general information on the courses in biological sciences which were offered in a representative sample of the public secondary schools of the United States in 1949-50, and specific information on the important quantitative and qualitative aspects of the course, in general biology as it was taught in these schools.<sup>7</sup>

There is much of interest in this pamphlet, and many valuable points were noted. But, because of the size of the sample, this study, of necessity, condensed many of its materials. Unfortunately, regional practices are not indicated, and little bears directly on the problem at hand.

Limitations of the studies. The available literature on biological studies was limited in the following ways:

1. The studies had to do with biology in general, rather than with the animals used in biology.
2. Very few studies on animal collections for use in teaching biology were available.
3. No studies were available which evaluated the animal collections used in teaching biology.
4. No studies were found which dealt with the animal collections in Idaho high schools.

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<sup>6</sup>Ibid., p. 75.

<sup>7</sup>Martin, op. cit., p. ix.

## CHAPTER III

### COLLECTION AND TREATMENT OF DATA

#### COLLECTION OF DATA

Development of the questionnaire. The questionnaire used in the study (see pages 40-44) was developed to secure five general types of information: (1) the present status of the preserved animal collections, (2) the administrative and personal factors affecting the collections, (3) the adequacy of the materials used for collecting and preserving, and the space used for displaying the specimens, (4) the interest and information exhibited by teachers for collecting their own specimens and for trading specimens, and (5) the minimum list of animals representing an approved, accepted, and used preserved animal collection in the small high schools of Idaho.

List of specimens. The animals included in the questionnaire, and shown in Table I, were selected from animals appearing three or more times in a group of four existent lists and one list made for this study. The four existent lists were selected from a group of eight biological supply house lists as being most inclusive. The selected four can be considered the recommendations of large, well-established biological supply houses, which enjoy a nationwide reputation. They are: (1) the General Biological (Turttox)



TABLE I  
 FREQUENCY TABULATION OF ANIMALS OCCURRING THREE  
 OR MORE TIMES IN THE GROUP OF FIVE LISTS\*

| Animal                 | Occurrence | Animal               | Occurrence |
|------------------------|------------|----------------------|------------|
| <b>PROTOZOA</b>        |            | Grasshopper          | 5          |
| Amoeba - model         | 5          | Beetle, large        | 4          |
| Paramecium - model     | 4          | Butterfly or moth    | 4          |
| <b>PORIFERA</b>        |            | Spider, large        | 4          |
| Marine sponge          | 5          | Centipede            | 4          |
| Fresh-water sponge     | 3          | <b>MOLLUSCA</b>      |            |
| <b>COELENTERATA</b>    |            | Slug                 | 4          |
| Hydra                  | 3          | Chiton               | 4          |
| Jellyfish              | 4          | Snail                | 5          |
| Sea anemone            | 5          | Oyster or clam       | 5          |
| <b>PLATYHELMINTHES</b> |            | Squid                | 5          |
| Tapeworm               | 5          | <b>ECHINODERMATA</b> |            |
| Liver fluke            | 5          | Starfish             | 5          |
| <b>NEMATHELMINTHES</b> |            | Sea urchin           | 5          |
| Hookworm               | 3          | Sea cucumber         | 4          |
| Roundworm              | 5          | <b>CHORDATA</b>      |            |
| <b>ANNELIDA</b>        |            | Lancelet             | 4          |
| Earthworm              | 5          | Lamprey              | 3          |
| Leech                  | 4          | Salamander           | 4          |
| Marine sandworm        | 4          | Frog                 | 5          |
| <b>ARTHROPODA</b>      |            | Turtle               | 5          |
| Barnacle               | 4          | Lizard               | 4          |
| Crayfish or lobster    | 5          | Snake                | 3          |
| Crab                   | 3          | Fish                 | 3          |
| Horseshoe crab         | 3          | Bird                 | 5          |
| Fiddler crab           | 4          | Mammal               | 5          |

\*These five lists were those of: (1) the General Biological (Turtox) Supply House, (2) the United Scientific Co., (3) the W. M. Welch Scientific Co., (4) the National Biological Supply Co., and (5) the Dean of Biological Sciences, University of Idaho, Moscow, Idaho.

Supply House, (2) The United Scientific Company, (3) the W. M. Welch Scientific Company, and (4) The National Biological Supply Company. The fifth list was the recommendation of H. Walter Steffens, Ph.D., Dean of Biological Sciences, University of Idaho, Moscow, Idaho, made in response to a request from the writer for a list of animal specimens which the "average high school in Idaho could be expected to have for display purposes".<sup>1</sup> Correspondence with the Idaho State Department of Education, Boise, Idaho, disclosed the fact that Idaho had no recommended list of animal specimens for high schools.<sup>2</sup>

Inclusive lists of the biological supply houses were chosen, as in the process of compiling the list of specimens for the questionnaire, several animals mentioned by the supply houses were eliminated. In order that teachers would likely find the animals in their collection included in the questionnaire list, it was desired to present as large a group of animals as practicable. General, or common names were used in the questionnaire, rather than scientific names for two reasons: (1) to facilitate completion of the questionnaire by teachers, and (2) to encourage teachers to name the specific animals they had in their collections for the general ones mentioned. A supplementary "write-in" column provided in the questionnaire gave teachers an opportunity to indicate any animals they had which were not mentioned in the questionnaire.

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<sup>1</sup>Personal letter from Dr. Steffens, dated April 5, 1955.

<sup>2</sup>Personal letter from the Idaho Department of Education, dated March 25, 1955.

In this way, it was hoped that the native animals used in preference to some of the exotic animals generally recommended could be determined. In addition, a "line-out" method incorporated in the questionnaire permitted teachers to note animals which they felt were specifically valuable as teaching specimens, or those animals upon which they placed the highest value, in a learning sense.

Processing the questionnaire. In the spring of 1955 (14th of May) questionnaires were sent to all high schools in Idaho with a student population of two hundred or less. This date was chosen in order that the questionnaires would arrive a short time before school ended, so that teachers would have them in hand when their school inventories were taken. Earlier mailing might have resulted in some misplaced or forgotten questionnaires. Seventy-four questionnaires were sent out, and twenty-two were returned. This constituted a return of 29.7 per cent. A word of explanation to the reader concerning this return is in order. The date chosen for mailing the questionnaires might have resulted in their arrival at a few schools after, or very near, the school's closing date. Two questionnaires were returned unopened, and were stamped at the post office, "refused, returned to writer". Investigation revealed that at least five schools did not offer biology, though this course was a state requirement for high school graduation. Like many small schools, these schools probably offered biology every other year, and it was not offered in 1955.

## TREATMENT OF DATA

The questionnaire was used to provide five general types of data which were analyzed for percentages, and are discussed below. The discussion will, in general, follow the sequence presented in the development of the questionnaire on page 9.

Present status of the collections. As shown in Table IV, page 19, 35 per cent of the schools which responded to the questionnaire did not maintain a collection of preserved animals for use in teaching biology. Sixty-five per cent of the teachers had animal collections; however, 35 per cent of these teachers indicated that their collections were inadequate, for reasons which shall shortly be discussed.

In order to determine where the shortages in the animal collections occurred, that is, which animal or group of animals was most commonly missing from the collections, an analysis of the information submitted on the questionnaire which pertained to the phyla and the specimens was prepared. A study of Table II, page 14, shows that of the ten phyla listed, all were represented in the collections of the schools which answered in percentages which varied from 30 to 65 per cent. A school which had two or more species of the Arthropods and the Chordates, and one or more species in each of the remaining phyla, was considered to have those phyla represented in their collections. The greater number required for the Chordates and the Arthropods is due to the

**TABLE II**  
**PERCENTAGE OF THE POLLED SMALL HIGH SCHOOLS**  
**POSSESSING EACH OF THE MAJOR PHYLA IN**  
**THEIR PRESERVED ANIMAL COLLECTIONS**

| Major Phylum    | Number of<br>Schools | Percentage of the<br>Schools Polled |
|-----------------|----------------------|-------------------------------------|
| Protozoa        | 8                    | 30                                  |
| Porifera        | 10                   | 50                                  |
| Coelenterata    | 11                   | 55                                  |
| Platyhelminthes | 11                   | 55                                  |
| Nemathelminthes | 10                   | 50                                  |
| Annelida        | 12                   | 60                                  |
| Arthropoda      | 12                   | 60                                  |
| Mollusca        | 12                   | 60                                  |
| Echinodermata   | 11                   | 55                                  |
| Chordata        | 13                   | 65                                  |

**Note:** Schools were considered to have each phylum represented in their collections if they had two or more species in the Arthropods and the Chordates, and one or more species in the remaining phyla.

fact that these two phyla have a greater variety in their members than the other phyla and, therefore, more animals in these two phyla were included in the group of five lists, as well as in the questionnaire. The Protozoa were the most poorly represented phylum, occurring in 30 per cent of the cases; the Chordates were the best represented, with 65 per cent of the schools possessing them in their collections. The Molluscs, Arthropods, and Annelids were each found in 60 per cent of the schools, while the Coelenterates, Platyhelminthes, and Echinoderms were indicated in 55 per cent of the collections. The Nemathelminthes were found in exactly half of the responding schools' preserved animal collections. The low percentage of the Protozoans was somewhat compensated for by the fact that 10 per cent of the respondents said that they used slides and/or live specimens. Perhaps a few teachers who did not indicate either a model or slides on the questionnaire, used live material exclusively, and did not note this on the questionnaire.

The listing of specimens in Table III, page 16, shows more specifically the condition of the collections, and illustrates just which animals were in greatest shortage, and conversely, those which occurred most commonly in the collections. "Species" was used in a general sense in this table, and in the questionnaire, in order to encourage respondents to indicate either the specific, common, or scientific name of the particular animals that they used in teaching. The animals listed in the questionnaire varied from a low of 5 to a high of 60 per cent in the school collections, with a

**TABLE III**  
**PERCENTAGE OCCURRENCE BY SPECIES\* OF THE PRESERVED**  
**ANIMALS IN THE SMALL HIGH SCHOOL COLLECTIONS**

| Species             | Percentage Occurrence | Species           | Percentage Occurrence |
|---------------------|-----------------------|-------------------|-----------------------|
| Amoeba - model      | 20                    | Butterfly or moth | 55                    |
| Paramecium - model  | 25                    | Spider, large     | 50                    |
| Marine sponge       | 45                    | Centipede         | 40                    |
| Fresh-water sponge  | 25                    | Slug              | 35                    |
| Hydra               | 45                    | Chiton            | 15                    |
| Jellyfish           | 25                    | Snail             | 45                    |
| Sea anemone         | 35                    | Oyster or clam    | 45                    |
| Tapeworm            | 55                    | Squid             | 25                    |
| Liver fluke         | 45                    | Starfish          | 50                    |
| Hookworm            | 25                    | Sea urchin        | 30                    |
| Roundworm           | 50                    | Sea cucumber      | 30                    |
| Earthworm           | 60                    | Lancelet          | 20                    |
| Leech               | 35                    | Lamprey           | 20                    |
| Marine sandworm     | 25                    | Salamander        | 35                    |
| Barnacle            | 20                    | Frog              | 60                    |
| Crayfish or lobster | 60                    | Turtle            | 40                    |
| Crab                | 25                    | Lizard            | 50                    |
| Horseshoe crab      | 15                    | Snake             | 40                    |
| Fiddler crab        | 5                     | Fish              | 55                    |
| Grasshopper         | 55                    | Bird              | 35                    |
| Beetle, large       | 50                    | Mammal            | 50                    |

\*Species is loosely used, as in many cases a very general name was used to denote an animal or group of animals.

mean occurrence of 40 per cent. Those animals which occurred in percentages below the mean were: (1) from 10 to 20 per cent; amoeba, barnacle, horseshoe crab, fiddler crab, chiton, lancelet, and lamprey, (2) from 20 to 30 per cent; paramecium, fresh-water sponge, jellyfish, hookworm, marine sandworm, crab, squid, sea urchin, and sea cucumber, (3) from 30 to 40 per cent; sea anemone, leech, centipede, slug, salamander, turtle, snake, and bird. Those animals which occurred in a percentage above the mean were: (1) from 40 to 50 per cent; marine sponge, hydra, liver fluke, roundworm, beetle, spider, snail, oyster, clam, starfish, lizard, and mammal, (2) from 50 to 60 per cent; tapeworm, earthworm, crayfish or lobster, grasshopper, butterfly or moth, and frog.

The shortages in specimens appeared to be fairly well spread through the items included in the questionnaire with no one phylum being outstandingly well represented or entirely omitted from the collections. This might indicate that teachers collect on an opportunistic basis near their schools, and purchase animals they cannot collect locally. Or, the teachers may purchase good representatives of each phylum, but not buy specimens of each class within a phylum. As would be expected in an inland situation, the lowest representation was in the marine specimens. The highest representation was in the organisms one would expect to encounter on a field trip almost anywhere in Idaho.

In summary, 35 per cent of the answering school teachers had no collection. Of the 65 per cent which had collec-



tions, 35 per cent indicated that they were inadequate for their needs. According to phylum listing, the main shortages were in the Protozoa, Porifera, and Nemathelminthes. These phylum shortages merge into individual, randomly scattered shortages of specimens of the entire animal kingdom, when viewed in the light of an overall representation. The mean percentage occurrence of the animals listed in the questionnaire on a "species", or individual, animal basis was 40 per cent.

Administrative and personal factors affecting the status of the collections. Several factors were mentioned by the respondents which directly affected the satisfactory maintenance, in fact, the very existence of the collections. These factors are attributable, mainly, to the teacher or administrative attitudes in the schools studied. Table IV, page 19, shows that 30 per cent of the respondents had no fund provided with which to acquire the materials needed for collecting and preserving specimens, or to purchase specimens not native to their areas. Sixty-five per cent of the teachers indicated that they had a fund provided, but only 25 per cent of these teachers found the fund sufficient. Significantly, 30 per cent of the respondents left this question unanswered.

Almost all the teachers indicated an interest in obtaining readily available information on specimens, sources, and trading. Ninety-five per cent said they would like a list of species and their sources in Idaho. The same percentage would like a periodical to carry some space devoted

TABLE IV

RESPONSES TO QUESTIONNAIRE ITEMS PERTAINING TO THE  
STATUS OF THE PRESERVED ANIMAL COLLECTIONS

| Questionnaire<br>Item No.*  | Per cent<br>Yes | Per cent<br>No | Per cent<br>Unanswered |
|---|-----------------|----------------|------------------------|
| 1. maintain a collection  | 65 (13)         | 35 (7)         |                        |
| 2. present collection<br>adequate   | 35 (7)          | 55 (11)        | 10 (2)                 |
| 7. have purchasing fund   | 65 (13)         | 30 (6)         | 5 (1)                  |
| 8. fund sufficient  | 25 (5)          | 45 (9)         | 30 (6)                 |
| 9. adequate display space   | 35 (7)          | 60 (12)        | 5 (1)                  |
| 10. specimens displayed   | 45 (9)          | 40 (8)         | 15 (5)                 |
| 11. displayed at times  | 40 (8)          | 10 (2)         | 10 (2)                 |
| 12. specimens displayed<br>throughout year                                  | 25 (5)          |                | 15 (5)                 |
| 13. adequate storage space  | 35 (7)          | 55 (11)        | 10 (2)                 |
| 14. sufficient collecting<br>and preserving material                        | 25 (5)          | 70 (14)        | 5 (1)                  |
| 15. room for living bio-<br>logicals  | 25 (5)          | 70 (14)        | 5 (1)                  |
| 16. interested in list of<br>species and sources                            | 95 (19)         |                | 5 (1)                  |
| 20. like periodical to list<br>sources and specimens<br>available for trade | 95 (19)         |                | 5 (1)                  |

\*See Appendix, pages 41-42, for full statement of each item.

Note: Numbers in parenthesis following the percentages are the actual number of replies to the questions.

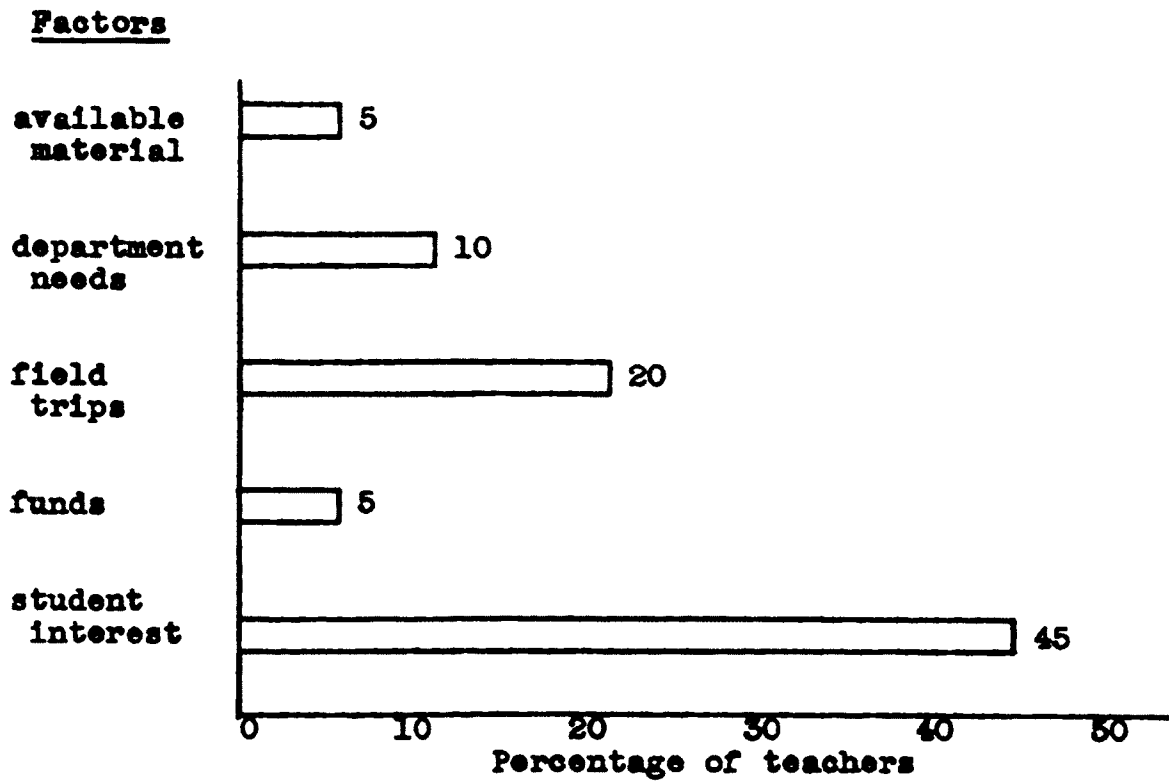
to specimens available for trading, and the sources of these animals.

The high degree of interest shown by teachers for information on adding to their collections lagged considerably when they were asked for factors which they felt favorably affected their collections. As Figure I, page 21, shows, student interest was rated the highest item in a group of five teacher-named factors. A glance at Figure II, page 22, shows that twenty-five per cent of the teachers rated their own desire (or lack of it) as a factor preventing them from having, or keeping up a collection.

Other factors which teachers named as favorably affecting their collections were: (1) field trips, 20 per cent; (2) funds for buying specimens and materials, 5 per cent; (3) departmental needs, 10 per cent; and (4) available material, 5 per cent.

"Time", as shown in Figure II, was the most frequently mentioned item which teachers felt prevented them from satisfactorily maintaining their collections. Seventy-five per cent of the respondents indicated that this factor was important to them. "Time" meant school time and after-school time. Some teachers had extra-curricular activities which prevented them from adding to their collections; others noted that from three to six daily class preparations left them little time for anything else.

Facilities and funds seemed to be related items in that all of the teachers who mentioned facilities as a limiting factor also indicated that funds restrained their actions.



**FIGURE I**

**TEACHER-NAMED FACTORS WHICH FAVORABLY  
AFFECTED THEIR COLLECTIONS  
OF PRESERVED ANIMALS**

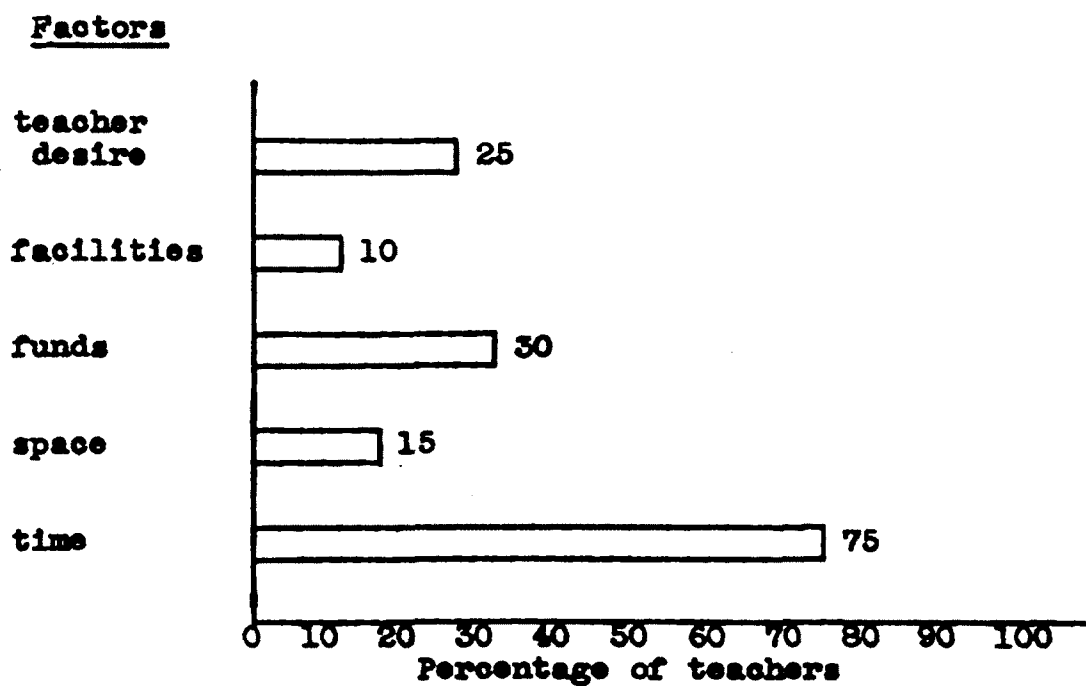


FIGURE II

**TEACHER-NAMED FACTORS WHICH FAVORABLY  
AFFECTED THEIR COLLECTIONS  
OF PRESERVED ANIMALS**

As previously discussed, 25 per cent of the teachers felt that their own lack of desire was an unfavorable factor in getting and keeping a collection!

Administratively, funds (and indirectly, facilities) were a limiting factor affecting the preserved animal collections in the responding schools.

Time, desire, student interest, and field trips were the most frequently mentioned personal items either favorably or unfavorably affecting the status of the animal collections.

Adequacy of materials and space. Space, both for displaying the specimens and for keeping the collected and preserved materials, plagued many of the teachers in Idaho's small high schools. Items 9 and 13, in Table IV, page 19, indicate that 60 per cent and 55 per cent, respectively, of the teachers considered their display and storage space inadequate effectively to show and store their preserved animal specimens. Twenty per cent of the teachers who had a fund provided found that the effectiveness of their collections was decreased by a lack of space. One teacher, in a personal note included with the returned questionnaire, said, "I have only a corner of a classroom used for several classes to store my biological equipment in". The tendency for inadequate display space was widespread, as was indicated by 40 per cent of the teachers who displayed their specimens only at times, and the 10 per cent who did not display them at all. Some connection between lack of display space and lack of storage space existed, as an identical number of tea-

chers said that adequate storage and display space were not available. Seventy per cent of the respondents did not have space in their classrooms for living laboratory animals.

In common with teachers in small schools on a nationwide scale,<sup>3</sup> 70 per cent of Idaho's small high school teachers mentioned that they had insufficient collecting and preserving materials to maintain their collections satisfactorily.

Interest and information for collecting and trading.

Most of the teachers who responded to the questionnaire (both those who did and those who did not maintain a preserved animal collection) indicated that they were interested in information on this subject. Perhaps this showed a growing interest and a desire on the part of those teachers who had no collection to set about collecting and purchasing one. At any rate, the high rate of response to these questions (95 per cent in both cases) was an encouraging note in view of the percentage responses to the other questions. The questionnaire asked if teachers would like to see "a periodical like the American Biology Teacher" carry this information. This would be particularly helpful, since none of the marine specimens listed occurs in Idaho. A local publication like the Idaho Education Association Journal would do a great service if it were to carry information on the sources and specimens available for trading among the teachers of Idaho.

Although many teachers professed a desire to obtain

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<sup>3</sup>Martin, op. cit., p. 26.

trading information, Table V, page 26, shows that few actually were interested enough to note in the questionnaire which animals they would collect for trading. Of those who did, the great majority of the animals they would like to collect for trading were those animals which are almost universally distributed in Idaho. Most of the interest in collecting for trading was concentrated on animals which are included in the Annelids, Arthropods, and Molluscs. These are animals which might be encountered on a field trip almost anywhere in Idaho and, consequently, should not be collected by the teacher, but rather by the students. In referring to such specimens, Dale says:

Despite the expertness with which the former have been prepared--by a manufacturer, a museum, or some similar agency--the exhibit that has been planned and produced by the students with the aid of the teacher is often to be preferred. Here again is an overlapping--a blend of seeing and doing, of observation and participation, with its resulting enrichment.<sup>4</sup>

Teachers are, of course, to be encouraged to collect specimens native to their localities for inter-teacher trading of animals not native to the local or field trip environment.

The animals which teachers had collected at the time of this study are interesting to note. Table VI, page 27, shows a comparison of the percentages of teachers who had collected and/or purchased specimens. Very few animals were collected more often than they were purchased, and, of those which were, the majority were Annelids, Arthropods, Molluscs,

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<sup>4</sup>Edgar Dale, Audio-Visual Methods in Teaching, The Dryden Press, New York, 1954, p. 50.



**TABLE V**  
**ANIMALS TEACHERS WOULD COLLECT FOR TRADING**

| Animals which would<br>be collected | Per cent of teachers who<br>would collect them |
|-------------------------------------|--|
| Amoeba                              | 20   |
| Paramecium                          | 20   |
| Fresh-water sponge                  | 5  |
| Hydra                               | 10   |
| Sea anemone                         | 5  |
| Tapeworm                            | 20   |
| Liver fluke                         | 20   |
| Hookworm                            | 10   |
| Roundworm                           | 15   |
| Earthworm                           | 40   |
| Leech                               | 25   |
| Crayfish                            | 20   |
| Grasshopper                         | 20   |
| Beetle                              | 40   |
| Butterfly or moth                   | 40   |
| Spider                              | 30   |
| Centipede                           | 30   |
| Slug                                | 30   |
| Snail                               | 20   |
| Clam                                | 15   |
| Starfish                            | 15   |
| Sea urchin                          | 10   |
| Sea cucumber                        | 10   |
| Lancelet                            | 10   |
| Salamander                          | 10   |
| Frog                                | 25   |
| Turtle                              | 10   |
| Lizard                              | 25   |
| Snake                               | 25   |
| Fish                                | 25   |
| Bird                                | 15   |
| Mammal                              | 20   |

TABLE VI  
ANIMALS COLLECTED OR PURCHASED BY IDAHO TEACHERS

| Animal              | Per cent<br>Collected | Per cent<br>Purchased |
|---------------------|-----------------------|-----------------------|
| Amoeba              | 20                    | 0                     |
| Paramecium          | 5                     | 25                    |
| Marine sponge       | 0                     | 45                    |
| Fresh-water sponge  | 5                     | 20                    |
| Hydra               | 10                    | 45                    |
| Jellyfish           | 0                     | 25                    |
| Sea anemone         | 0                     | 35                    |
| Tapeworm            | 0                     | 55                    |
| Liver fluke         | 5                     | 45                    |
| Hookworm            | 0                     | 25                    |
| Roundworm           | 20                    | 30                    |
| Earthworm           | 60                    | 15                    |
| Leech               | 20                    | 25                    |
| Marine sandworm     | 0                     | 20                    |
| Barnacle            | 0                     | 20                    |
| Crayfish or lobster | 25                    | 50                    |
| Crab                | 0                     | 25                    |
| Horseshoe crab      | 0                     | 15                    |
| Fiddler crab        | 0                     | 5                     |
| Grasshopper         | 45                    | 45                    |
| Beetle              | 50                    | 20                    |
| Butterfly or moth   | 50                    | 20                    |
| Spider              | 45                    | 15                    |
| Centipede           | 30                    | 15                    |
| Slug                | 25                    | 15                    |
| Chiton              | 0                     | 10                    |
| Snail               | 30                    | 15                    |
| Oyster or clam      | 10                    | 35                    |
| Squid               | 0                     | 25                    |
| Starfish            | 10                    | 50                    |
| Sea urchin          | 5                     | 30                    |
| Sea cucumber        | 0                     | 30                    |
| Lancelet            | 0                     | 20                    |
| Lamprey             | 0                     | 20                    |
| Salamander          | 15                    | 20                    |
| Frog                | 40                    | 50                    |
| Turtle              | 5                     | 35                    |
| Lizard              | 15                    | 40                    |
| Snake               | 30                    | 15                    |
| Fish                | 50                    | 30                    |
| Bird                | 30                    | 10                    |
| Mammal              | 25                    | 30                    |

or Chordates. A correlation exists between the animals teachers had collected, and those they would like to collect for trading. The animals most often collected by teachers were: (1) earthworm, (2) beetle, (3) butterfly or moth, (4) spider, (5) centipede, (6) slug, (7) snail, (8) snake, (9) fish, and (10) bird. These animals are apparently the ones most common to the Idaho scene, and little would be gained by collecting them for trading, since most teachers would have access to them in their own locality. Because so little interest was shown for collecting the rarer native animals, and those not native to Idaho, the most convenient way for teachers to obtain any animals they cannot collect locally, or on field trips, is to purchase them from one of the biological supply houses.

The minimum list of animals. The minimum list of animals representing an approved, accepted, and used preserved animal collection in the small high schools of Idaho differs little from the list of animals on the questionnaire. This list, the reader will recall, was compiled from a group of five existent lists, as shown in Table I, page 10. The specific animals found in use in Idaho schools which differed from the animals mentioned in the questionnaire are found in Table VII, page 29. A study of this table shows that the Protozoans which teachers used and which were not listed in the questionnaire were limited to two animals, Vorticella, and Euglena, used by one and two teachers respectively. None of the teachers listed animals not mentioned on the ques-

TABLE VII  
 NON-LISTED OR TEACHER-NAMED ANIMALS  
 OCCURRING IN THE COLLECTIONS

| Animal          | Frequency of<br>mention |
|-----------------|-------------------------|
| PROTOZOA        |                         |
| Vorticella      | 1                       |
| Euglena         | 2                       |
| NEMATHELMINTHES |                         |
| Vinegar eel     | 1                       |
| MOLLUSCA        |                         |
| Octopus         | 1                       |
| CHORDATA        |                         |
| Embryos of:     |                         |
| calf            | 1                       |
| cat             | 1                       |
| pig             | 1                       |
| sheep           | 1                       |
| Grass frog      | 1                       |
| Bull frog       | 1                       |
| Fence lizard    | 1                       |
| Garter snake    | 2                       |
| Rattlesnake     | 1                       |
| Bull snake      | 2                       |
| Perch           | 7                       |
| Sucker          | 1                       |
| Trout           | 1                       |
| Sparrow         | 1                       |
| Owl             | 1                       |
| Cat             | 2                       |
| Rat             | 1                       |
| Mouse           | 2                       |
| Bat             | 3                       |

tionnaire from the Porifera, Coelenterata, or Platyhelminthes. A vinegar eel, from the Nemathelminthes, was used by one teacher. No new animals were named for the Annelida or the Arthropoda. The octopus was mentioned by one teacher as a substitute for the squid in the Mollusca. The starfish, sea urchin, and sea cucumber were considered adequate for the Echinodermata, as no other animals were noted. The Chordata elicited the most discussion. Perhaps this was due to the fact that general names in this phylum suggest so many individual animals. Actually, no "non-listed" animals were mentioned. Rather, specific animals were listed for the general names used in the list. It is interesting to note that seven teachers used the perch which is, by coincidence, the fish listed in the recommendations of two of the biological supply house lists used.

Since the specific animals mentioned by Idaho teachers were so small in number as to be insignificant, and since none of the teachers contacted felt that they had an animal particularly valuable as a teaching aid, the minimum approved, accepted, and used list of preserved animals is the same as the list compiled from the recommendations of the authorities, and included in the questionnaire. For this list, see Table I, page 10, or the questionnaire in the appendix.

## CHAPTER IV

### SUMMARY AND CONCLUSIONS

#### SUMMARY

Purposes of the study. The purposes of this study on the status of the animal collections in Idaho small high schools were as follows:

1. To develop a list of preserved animals suitable to the needs of the small high schools in Idaho.
2. To find the extent of the variation in these animal collections.
3. To find the reasons for the variations in the collections of the high schools.
4. To determine the interest of the teachers in Idaho's small high schools in collecting for their own use, and in collecting specimens for inter-teacher trading of the animals.

Procedure. Five existent lists were used to compile the list of animals used in the questionnaire. In addition to this list and the questions which directly pertained to it, a set of twenty general questions relating to conditions which affected the collections was included in the questionnaire. The questionnaires were sent to all high schools in Idaho with a student population of two hundred or less, during the spring of 1955. The returned questionnaires were

analyzed for data to determine the inadequacies of the current inventories of the high schools, and to find the reasons for the inadequacies. The list of animals was analyzed to find the present status of the collections, and what constituted a list of animals suitable to the school's needs.

Findings. This study shows that, in general, the small high schools in Idaho that responded to the questionnaire do not have a satisfactory collection of preserved animal specimens for use in teaching biology. This deficiency can be attributed primarily to the biology teacher's attitude, and on a smaller scale, to an administration which does not adequately provide the funds or facilities required to satisfactorily maintain a preserved animal collection.

### CONCLUSIONS

Limitations of the study. The writer wishes to call the attention of the reader to the fact that the present study was limited in the following ways:

1. Small high schools in Idaho only were sent questionnaires.
2. The return of questionnaires was 29.7 per cent of the total number sent out.
3. Several of the returned questionnaires contained incomplete responses to several items.
4. Thirty-five per cent of the respondents did not maintain a preserved animal collection in their schools.

Conclusions. The reader is reminded that the present study included only a small sample of the small high schools of one state. No claim is made that the findings of the investigator are statewide in character. It may well be that further studies along the lines indicated might be profitable, either as substantiation for the present contentions, or as a repudiation of them.

The conclusions drawn from the study are as follows:

1. The preserved animal collections in the small high schools of Idaho that responded to the questionnaire were inadequate in the majority of cases for the biology teacher's needs.
2. The inadequacies were due primarily to the biology teacher's attitude, but also to the administrator's failure to provide adequate funds and space.
3. Lack of time, both in and out of school, was a major deterrent to biology teachers in maintaining a satisfactory animal collection.
4. Facilities, including material, money, space, and an adequate science classroom, were factors which teachers considered important in maintaining a collection.
5. Few biology teachers in Idaho's small high schools included in the study were seriously interested in trading biological animal specimens.
6. The opinions of the teachers concerning what animals constituted a satisfactory collection coin-



cided very closely with the recommendations of authorities in the field.

### RECOMMENDATIONS

One of the main purposes of this paper was to develop a list of preserved animals which teachers would accept and use in their classes. In general, the list developed in Chapter III serves as a recommended list. If this list is used as a basis with local animals substituted whenever possible, the teacher will have a very usable collection. If, in addition, other animals are added to the collection by both the teacher and the students, an excellent collection will be realized in a short period of time.

The recommendations which follow are directed to both the teacher and the administrator in the small high schools of Idaho. Each group of recommendations is directed primarily to the persons named, but is for dual consideration of both:

To the administrator. Take a critical look at your school and your scheduling, and see if you can:

1. Provide, insofar as possible, one classroom for science instruction.
2. Make available to the biology teacher sufficient storage and display space for his biological materials, both equipment and specimens.
3. Allow your teacher sufficient in-school time to maintain and add to his collection. Encourage him

to obtain a collection the school can be proud of.

4. Make available a reasonable fund for purchasing biological supplies.

To the biology teacher. Arrange a meeting with your supervisor and go over the above points with him. Then:

1. Make a determined effort to obtain a collection and maintain it in good condition.
2. Use native specimens whenever available, and purchase exotic specimens only.
3. Subscribe to a professional magazine in your field, and use some of the suggestions made for teaching with preserved animals.
4. Devote a little more of your time, short as it may be, to biological interests.
5. Develop student interest in collecting, and encourage them to bring in specimens from field trips, or outside school activities.
6. Pattern your collection along the lines of the recommended list, using local substitutes whenever you can. Don't stop when you have a minimum collection.

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## APPENDIX

DONNELLY-MCCALL H. S.  
Biology Dept.

To the Biology Instructor:

In the interest of obtaining information which will be of value in determining the status of, and in improving high school biology collections, would you please complete the inclosed questionnaire? Your sincere and objective answers will be greatly appreciated, and all information will be held confidential.

You may be interested to know that this survey will include all high schools in Idaho with a student population of 200 or less. It is a big job, and its value will be determined by your cooperation.

This project is a part of my work in obtaining the Master of Education degree at Montana State University, Missoula, Montana. Upon completion, a list of findings and recommendations will be made available to all respondents.

The inclosed self-addressed, stamped envelope is for your convenience in replying--please use it whether or not you fully complete the questionnaire, and return by the first week in June.

Thank you for participating.

Yours very truly,

WALTER J. THEM  
Biology Instructor  
D.M.H.S.

THE STATUS OF AND SUGGESTIONS FOR THE ANIMAL COLLECTIONS  
USED IN TEACHING BIOLOGY IN IDAHO'S HIGH SCHOOLS

Q\_U\_E\_S\_T\_I\_O\_N\_N\_A\_I\_R\_E

- \_\_\_\_\_ 1. Do you maintain a preserved animal collection in your school?
- \_\_\_\_\_ 2. How many different species have you?
- \_\_\_\_\_ 3. Is your collection at present adequate for your needs?
- \_\_\_\_\_ 4. Were these animals purchased or collected, or both?
- \_\_\_\_\_ 5. Approximately how many different kinds of animals (species) have you or your students collected?
- \_\_\_\_\_ 6. Of these, what number of phyla are represented?
- \_\_\_\_\_ 7. Is a fund made available to you for purchasing biological materials?
- \_\_\_\_\_ 8. Is this fund sufficient for your requirements?
- \_\_\_\_\_ 9. Do you keep your specimens on display?
- \_\_\_\_\_ 10. Do you feel that you have adequate display space for your biological materials?
- \_\_\_\_\_ 11. If yes (to No. 9), are they displayed only at times?
- \_\_\_\_\_ 12. Or, are they displayed throughout the year?
- \_\_\_\_\_ 13. Is there adequate storage space available for your collecting materials and newly collected (unclassified, etc.) specimens?
- \_\_\_\_\_ 14. Have you sufficient materials for collecting and preserving specimens?
- \_\_\_\_\_ 15. Do you have a room, or sufficient space, for living biologicals?

- \_\_\_\_\_ 16. Would you be interested in obtaining a list of specimens and where they can be obtained in Idaho?
- \_\_\_\_\_ 17. Do you prefer to use your own specimens, or those which were purchased?
- \_\_\_\_\_ 18. List the factors which aid you most in adding to your animal collection.
- \_\_\_\_\_ 19. List the most important factors which you feel prevent you from adding to your collection.
- \_\_\_\_\_ 20. Would you like to see some periodical like The Biology Teacher carry a list of animals and plants, with their sources, which are available for trade?

**DIRECTIONS:** For each specimen listed below, indicate your answer to the following questions--each of which pertains to a column for the entire list of animals--by filling in the box with the indicated response. If in doubt about a response, insert a question mark in that box.

**NOTE:** To make it easier for you to complete, this list has purposely avoided the use of scientific names. The list does not purport to be a minimum or maximum collection. From your responses, and those of others, a suggested list will be compiled.

If you do not have some of the animals named, but have a substitute, please write in the name of that animal in the last column on the right, on the line where the name of the animal you do not have appears.

In the Molluscs, Echinoderms, and Chordates particularly, very general names have been used. If you use an animal you feel is particularly good for instructional purposes, write its specific or scientific name in the right-hand column, and line out the listed animal. For example, number 49 in the Chordates is "fish". Suppose you use a brook trout. If so, line out fish, and write in "brook trout" (or, Salvelinus fontinalis--whichever you prefer), as shown below:

49. Fish    yes    col    yes    yes    late May    Brook trout



1. Is this animal now in your collection?
2. Was it collected or purchased? Use "pur" or "col".
3. Can it be collected in your locality?
4. Would you be interested in collecting this animal to trade with other teachers for animals not native to your area?
5. Give date for best collecting conditions.

|                              | 1 | 2 | 3 | 4 | 5 | Write in col. |
|------------------------------|---|---|---|---|---|---------------|
| <b>PROTOZOA</b>              |   |   |   |   |   |               |
| 1. <u>Amoeba - model</u>     |   |   |   |   |   |               |
| 2. <u>Paramecium - model</u> |   |   |   |   |   |               |
| 3. <u>Other</u>              |   |   |   |   |   |               |
| <b>FORIFERA</b>              |   |   |   |   |   |               |
| 4. <u>Marine sponge</u>      |   |   |   |   |   |               |
| 5. <u>Fresh-water sponge</u> |   |   |   |   |   |               |
| 6. <u>Other</u>              |   |   |   |   |   |               |
| <b>COELENTERATA</b>          |   |   |   |   |   |               |
| 7. <u>Hydra</u>              |   |   |   |   |   |               |
| 8. <u>Jellyfish</u>          |   |   |   |   |   |               |
| 9. <u>Sea anemone</u>        |   |   |   |   |   |               |
| 10. <u>Other</u>             |   |   |   |   |   |               |
| <b>PLATYHELMINTHES</b>       |   |   |   |   |   |               |
| 11. <u>Tapeworm</u>          |   |   |   |   |   |               |
| 12. <u>Liver fluke</u>       |   |   |   |   |   |               |
| 13. <u>Other</u>             |   |   |   |   |   |               |
| <b>NEMATHELMINTHES</b>       |   |   |   |   |   |               |
| 14. <u>Hookworm</u>          |   |   |   |   |   |               |
| 15. <u>Roundworm</u>         |   |   |   |   |   |               |
| 16. <u>Other</u>             |   |   |   |   |   |               |
| <b>ANNELIDA</b>              |   |   |   |   |   |               |
| 17. <u>Earthworm</u>         |   |   |   |   |   |               |
| 18. <u>Leech</u>             |   |   |   |   |   |               |

|                                | 1 | 2 | 3 | 4 | 5 | Write in col. |
|--------------------------------|---|---|---|---|---|---------------|
| 19. <u>Marine sandworm</u>     |   |   |   |   |   |               |
| 20. <u>Other</u>               |   |   |   |   |   |               |
| <b>ARTHROPODA</b>              |   |   |   |   |   |               |
| 21. <u>Barnacle</u>            |   |   |   |   |   |               |
| 22. <u>Crayfish or lobster</u> |   |   |   |   |   |               |
| 23. <u>Crab</u>                |   |   |   |   |   |               |
| 24. <u>Horseshoe crab</u>      |   |   |   |   |   |               |
| 25. <u>Fiddler crab</u>        |   |   |   |   |   |               |
| 26. <u>Grasshopper</u>         |   |   |   |   |   |               |
| 27. <u>Beetle, large</u>       |   |   |   |   |   |               |
| 28. <u>Butterfly or moth</u>   |   |   |   |   |   |               |
| 29. <u>Spider, large</u>       |   |   |   |   |   |               |
| 30. <u>Centipede</u>           |   |   |   |   |   |               |
| 31. <u>Other</u>               |   |   |   |   |   |               |
| <b>MOLLUSCA</b>                |   |   |   |   |   |               |
| 32. <u>Slug</u>                |   |   |   |   |   |               |
| 33. <u>Chiton</u>              |   |   |   |   |   |               |
| 34. <u>Snail</u>               |   |   |   |   |   |               |
| 35. <u>Oyster or clam</u>      |   |   |   |   |   |               |
| 36. <u>Squid</u>               |   |   |   |   |   |               |
| 37. <u>Other</u>               |   |   |   |   |   |               |
| <b>ECHINODERMATA</b>           |   |   |   |   |   |               |
| 38. <u>Starfish</u>            |   |   |   |   |   |               |
| 39. <u>Sea urchin</u>          |   |   |   |   |   |               |
| 40. <u>Sea cucumber</u>        |   |   |   |   |   |               |
| 41. <u>Other</u>               |   |   |   |   |   |               |
| <b>CHORDATA</b>                |   |   |   |   |   |               |
| 42. <u>Lancelet</u>            |   |   |   |   |   |               |

|                | 1 | 2 | 3 | 4 | 5 | Write in col. |
|----------------|---|---|---|---|---|---------------|
| 43. Lamprey    |   |   |   |   |   |               |
| 44. Salamander |   |   |   |   |   |               |
| 45. Frog       |   |   |   |   |   |               |
| 46. Turtle     |   |   |   |   |   |               |
| 47. Lizard     |   |   |   |   |   |               |
| 48. Snake      |   |   |   |   |   |               |
| 49. Fish       |   |   |   |   |   |               |
| 50. Bird       |   |   |   |   |   |               |
| 51. Mammal     |   |   |   |   |   |               |
| 52. Other      |   |   |   |   |   |               |