WHIPPLE'S ANIMAL ANALYSIS: A METHOD OF TEACHING ZOOLOGY. TO WHICH IS ADDED AN APPENDIX, CONTAINING DIRECTIONS FOR FORMING A SCHOOL CABINET; APPENDIX, PP. 119-124

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Whipple's Animal Analysis: A Method of Teaching Zoology. To which is added an appendix, containing directions for forming a school cabinet; Appendix, pp. 119-124 by Elliot Whipple

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INTRODUCTION.

A FEW teachers of Zoology, favorably situated, are able to get their pupils to study *animals* instead of *books;* the majority, although theoretically opposed to an almost exclusive use of books, practically find no other way in which to secure regular and constant work from their classes.

For the purpose of obviating this difficulty, the "Analysis of Animals" has been prepared, and it is believed that, if rightly used, it will enable teachers satisfactorily to combine the study of books and the study of nature.

With most pupils the difficulty is, that they do not know how to study or what to observe, and, if they are set at work upon specimens without a guide, they turn them over aimlessly for awhile, and then, discouraged with this profitless proceeding, beg to be allowed to return to the safe and familiar shelter of a text-book.

When the teacher can spend his time with the class during their study hours, stimulating by questions and aiding by suggestions, all this may be changed; but how few can spare time and strength for very much of such work!

The "Analysis of Animals" supplies the questions, shows the pupils what characteristics to look for, and affords convenient means of testing the amount and quality of work done.

The author offers this plan as a step in advance, but as *one* step only, and hopes that his fellow teachers, who may use it, will freely communicate to him objections and difficulties, as well as suggestions for its improvement.

HOW TO USE THE "ANALYSIS."

Beginning in the usual way, the class learns somewhat thoroughly the characteristics of one branch, *e. g.*, vertebrates, noticing the other branches briefly. Then one class, say mammals, is studied, some comparison being made with other classes of the same branch. Then two or three orders with their prominent families, and a few of their genera and species are mastered.

At this point, by means of a comparative review of the ground passed over, the following KEY may be developed in the minds of the class, but care should be taken that they receive it as a *servant*, to be *used*, and not as a *master*. It is intended as a guide to the pupil in writing out his "analyses," but it is neither infallible nor complete. It should be followed only so far as it appears to be in accordance with nature:

KEY.

Branches are characterized by plan of structure of

1. Nervous system.
2. Skeleton.
3. Blood.
4. Miscellaneous points.

Classes are characterized by execution of plan in respect to—

1. Reproduction.
2. Respiration.
3. Circulation.
4. Epidermis.
5. Details of structure.
6. Miscellaneous points.

Orders are characterized by complication of structure in—

1. Locomotive appendages.
2. Mouth parts.
3. Miscellaneous points.

Families are characterized by general resemblances of—

1. Form.
2. Miscellaneous points.

Genera are characterized by details of structure in special parts, such as—

1. Modifications of organs used in obtaining food.
2. Miscellaneous points.

Species are characterized by—

1. Size.
2. Ornamentation.
3. Proportion of parts.
4. Miscellaneous points.

The key having been written on the black-board with blank spaces to the right, provide a suitable specimen, alive or stuffed—a cat, a dog, or a rat,—and have the members of the class with the aid of the teacher, proceed to fill out the blanks with the appropriate characteristics of the specimen before them. At the next recitation, each pupil may place upon the board an "analysis" for criticism and correction. After the students become somewhat familiar with the work, it will only be necessary for them to bring in their "analyses" for criticism, as would be done with other written exercises

All "analyses" should be made with a specimen of the species to be described, at hand; otherwise the work will degenerate to a servile copying from text-books.

An entertaining and profitable exercise is to have pupils place upon the black-board, or recite orally, "analyses," leaving the names of the branch, class, order, etc., blank, the blanks to be filled by other members of the class.

If the teacher is sufficiently familiar with the subject, or has time and inclination to study, it is an excellant plan to pursue the same course with the written "analyses" that are to be handed in by the pupils; for if the descriptions are so full and accurate that the teacher can supply the *names* of the branch, class, order, family, genus and species to which the specimen belongs, it affords a very satisfactory *test* of the work, and at the same time this process stimulates both pupils and teacher to an unusual interest in the study.

An interesting occasional exercise is to bring in specimens belonging to groups already studied and call for extempore "analyses."

It is not necessary that all "analyses" should be carried out to the genus and species; the limit will depend upon the time and ability of the class. Some complete "analyses" should be made; some may include only families; and some may stop with orders or sub-orders.

No direct provision has been made for sub-classes and sub-orders, etc., but where such sub-divisions are deemed important they can be introduced, as in sample No. 3.

A good review exercise is to have pupils prepare tables containing brief statements of most important characteristics, arranged in accordance with the key.

Two samples are inserted:

TABLE OF BRANCHES.

PLAN OF STRUCTURE OF.	NERVOUS SYSTEM.	SKELETON.	BLOOD.
VERTEBRATES.	Cerebro—spinal and sympathetic.	Internal Vertebræ with neural and hæmal arches forming *two* cavities.	Red.
ARTICULATES.	Double ganglia, arranged in a line.	Rings, surrounding a single cavity.	Usually Pale.
MOLLUSKS.	Ganglia, arranged variously.	Soft bodies, with usually an external shell.	Pale.
RADIATES.	Ganglia in a circle.	Radiating from a vertical axis.	Colorless.
PROTOZOA.	None discovered.	Minute animals, having no common type.	

TABLE OF THE CLASSES OF VERTEBRATES.

Execution of Plan in Respect to :	Reproduction.	Respiration.	Circulation.	Epidermis.	Details of Structure.
Mammals.	Viviparous, and nourish young with milk.	Lungs.	Heart, with four cavities.	Usually hairy.	Plane Vertebræ.
Birds.	Oviparous.	Lungs and air sacs.	Heart, with four cavities.	Feathered.	Plane vertebræ, anchylosed to a large extent.
Reptiles.	Oviparous, or Ovoviviparous.	Lungs.	Heart with three cavities, usually.	Scaly.	Usually convexo-concave vertebræ.
Batrachians.	Oviparous.	Gills at first—usually lungs are developed in adult forms.	Heart with three cavities, usually.	Smooth.	Usually convexo-concave vertebræ or double concave.
Fishes.	Oviparous or Ovoviviparous.	Gills.	Heart with two cavities.	Scaly or Smooth.	Double concave vertebræ, or concavo-convex.

Explanatory Remarks.

Experience shows that certain difficulties are especially liable to arise in applying the Key, hence a few suggestions are added.

The fundamental idea is that there exists a parallelism of characteristics in groups of the same name through the whole animal kingdom.

Under each division, except species, is placed a general statement of the nature of the characteristics of that division; *e. g.* branches are characterized by plan of structure, classes by execution of plan, etc.

Under these general statements are placed a number of points indicating where to look for the application of the general statement; *e. g.*, under execution of plan, we find five points of application named; 1, Reproduction; 2, Respiration; 3, Circulation; 4, Epidermis; 5, Details of Structure; which are intended to show five particulars in which proper class characteristics may be found; in all cases the word miscellaneous is added, because in no case is the list of possible characteristics exhausted, and some teachers may prefer to carry out the work to a greater extent than others.

Whenever a student does not know *how* to fill a blank in regard to some particular point, he should leave it unfilled until he can obtain the requisite information; but enough points must always be filled to indicate the name of the group before the work is allowed to pass.

It would seem that the value, or at any rate the application, of the characteristics, changes somewhat in passing from higher to lower groups. In nearly all the orders of vertebrates, we must look for "complication of structure of locomotive appendages," not in the *number* of such appendages, but in some differences in structure and use. Men have hands and feet *unlike;* monkeys, *alike*. Carnivora are armed with sharp claws; ungulata, with hoofs. Cheiroptera have expanded membranes for flying; Cetacea, flippers for swimming. But in most of the lower branches the *number* of locomotive appendages appears to be *their* "complication of structure." Insects have six legs; arachnida, eight; decapods, ten; centipedes, many.

Pupils are often puzzled to know what is meant by the general statement for family characteristics. "General resemblances" are those points that would usually be noticed by untrained observers, enabling them to group together animals having a general similarity of *form;* the shape of the head, shape of body and limbs, anything in their structure modifying their manner of moving, and *not* amounting to a "complication of structure."

Generic characteristics, are those pertaining to particular details in special parts—the *finishing off*. It is suggested in the Key that these details may be found in some