

## Map Sources

1. Allen, John M., *Gray and Fox Squirrel Management in Indiana*. Pittman-Robertson Bull. No. 1, Indianapolis, Ind. 1952. 112 pp.
2. Allen, John M., *Indiana Pittman-Robertson Wildlife Restoration 1939-1955*. Pittman-Robertson Bull. No. 3, Indianapolis, Ind. 1955. 240 pp.
3. Belcher, D. J., et al., *The Formation, Distribution and Engineering Characteristics of Soils*. Eng. Ex. Sta., Research Series No. 87, Bull. No. 10, Purdue Univ. 1943. 389 pp.
4. Bishop, Sherman C., *Handbook of Salamanders*. Ithaca: Comstock Publ. Co., 1943. 555 pp.
5. Bushnell, T. M., *The Story of Indiana Soils*. Ag. Exp. Sta., Special Circular No. 1, Purdue Univ. 1944. 52 pp.
6. Deam, Charles C., *Flora of Indiana*. Indianapolis, Ind., Ind. Dept. Cons. 1940. 1236 pp.
7. Deiss, Charles F., *Geologic Formations on Which and with Which Indiana's Roads Are Built*. Ind. Dept. Cons., Geol. Survey Cir. No. 1, Indiana Univ. 1952. 17 pp.
8. Mumford, Russell E., *Waterfowl Management in Indiana*. Pittman-Robertson Bull. No. 2, Indianapolis, Ind. 1954. 99 pp.
9. Potzger, John E., Margaret E. Potzger & Jack McCormick, "The Forest Primeval of Indiana as Recorded in the Original U. S. Land Surveys and an Evaluation of Previous Interpretations of Indiana Vegetation." *Butler Univ. Bot. Stud.* XIII:95-111. 1956.
10. Switzer, J. E., *Geography of Indiana*. Boston: Ginn and Co. 1937. 52 pp.
11. Visher, Stephen S., *Climate of Indiana*. Bloomington, Ind.: Ind. Univ. Publ. Sc. Series No. 13. 1944. 511 pp.
12. Visher, Stephen S., "Indiana Regional Contrasts in Temperature and Precipitation." *Ind. Acad. Sc.* 45:183-204. 1936.

Three new forestry publications are now available for teachers and students from the American Forest Products Industries, 1816 N Street, N.W., Washington 6, D.C. They are:

1. 22" x 34" chart on *Products of the Tree Farm*. The products are listed according to their manufacturing processes. Chemical terms are used.
2. A 1955 *Teacher's Manual* for forest conservation from grades 4 to 12.
3. 1957-1958 *Bibliography of Teaching Aids* on America's forests and industries for grades 4-12.

Attention! Collectors of insects and zoological specimens should get in touch with Mr. V. A. Van Eyck, United Scientific Company, 200 N. Jefferson Street, Chicago 6, Illinois. Mr. Van Eyck is asking for collectors to get in touch with him.

## Utilizing the Frog

THOMAS G. AYLESWORTH  
Michigan State University

It would seem, from personal observation, that the typical biology teacher in our high schools uses the dissection of the frog to illustrate the structure of a typical vertebrate during that unit of classification of animals which may be titled: "A Survey of the Animal Kingdom." When this unit is completed, all reference to the frog is forgotten, because the teacher must get on with other important studies: heredity, conservation, reproduction, plant anatomy, etc. Since the biology teacher generally purchases earthworms and frogs, and, if he is in exceedingly good graces with the business office of the school system, clams or crayfish, this, more often than not, constitutes the bulk of the expendable supply budget of the biology department. Let's get more use from the frog. Earthworms can be free to the energetic biologist, but frogs in quantity are something else. The purpose of this article is to give two suggestions for the utilization of the frog that might be more meaningful to the student. At current prices, the frog uses up too much of the biology budget not to be used for longer than four or five laboratory periods during the school year.

Those parts of the typical biology course which might be termed zoological are: classification, animal physiology, behavior, reproduction, heredity, and the study of cells, tissues, organs, and systems. Some of these are studied in conjunction with the plant world but still might be more easily demonstrated through the use of animal specimens. Why not use the frog throughout the studies? As we speak about digestion, students examine the vomerine teeth, tongue, glottis, esophagus, stomach, intestines, liver, pancreas, rectum, and cloaca of the frog. These, in turn, can be directly related to their homologues and analogues in man. Since virtually the only way that we can demonstrate these parts in man is through flat pictures and slides, the students have had a three-dimensional preview of the workings of the digestive system of man. When it comes time for the various chemical demonstrations or laboratory work on the

digestive process, the students can review these processes in their frog dissections.

Respiration might better be introduced by a careful observation of the respiration of a live frog. Although this process is not quite the same as would be found in man, at least it is a more graphic presentation than the common one of the two balloons inside a gallon jar. After the process has been explained, the students return to their dissections to find the nares, the olfactory sacs, the glottis, and the lungs.

Circulation of the blood is often demonstrated with an anaesthetized live frog, but we should then return to the dissection to find the main arteries and veins and perhaps do an additional dissection of the heart. Then we can continue with the discussion of these circulatory processes in man.

The excretory system of man can be pre-viewed also. In the frog, we find kidneys, ureter, and the urinary bladder. Glandular studies can lead to the discovery of the adrenal glands, the pancreas, the testes, and the ovaries. From a study of the glands we can lead into the study of the reproductive system. Here, in addition to the sex glands, we can find the sperm ducts, oviducts, and eggs. A discussion might be started concerning the adaptations of the frog for reproduction which might well lead into the pursuit of the answers to the problem of all adaptations. Once again we return to our pictures of the various systems found in man.

Finally, the skeletal system of the frog is examined. One way to begin this study is to dissect out the bones of the frog and then to mount them on a piece of cardboard. Labels may be attached if it is so desired.

By using this technique we have studied animal physiology by using a specimen that involves the senses of sight, touch, and, unfortunately, smell in the learning process, rather than pictures, models, and preserved specimens appealing only to our eyes. The only inconvenience to the teacher is that, because of the prolonged use of the specimens, he may have to filter the formaldehyde solution from time to time. On the other hand, the student, through exploration and discovery, has learned more about physiology than that which comes from books and pictures only.

My second suggestion for effective utilization of the frog is in the semester review. The

specimen can effectively reinforce the study of cells, tissues, organs, and systems. All we need is a microscope and a dissected frog. Another area for review is in the life cycle of the frog. If the school year is long enough, or the climate is warm enough, eggs can be collected, observed in cleavage, blastulation, gastrulation, and development into the hatching stage. Perhaps some of the students could stock aquaria with the tadpoles for summer observation. Here, with luck, metamorphosis could be observed at first hand. This exercise is also an effective review of reproduction.

If living frogs are available, the behavior unit may be reviewed. S-R bonds, involuntary and voluntary behaviors, and reflex actions can all be observed through the feeding of the frog, touching its eyes and nostrils, and rubbing ammonia on its jaw. Behavior and adaptations for survival become more real to the student who is fortunate enough to study a living frog.

Finally, the whole study of physiology can be reviewed through the use of the frog, as mentioned previously in this article.

In conclusion, if you are interested in getting more mileage out of your frogs, don't relegate them to the part of your course in which you study "The Typical Vertebrate." It isn't very typical. Use your frog for a whole semester, or, at least, for a week or two for the purpose of review.

## Biology in the News

Brother H. Charles, F.S.C.

CHANGING PATTERN OF A NATION'S HEALTH, *Life*, Feb. 17, 1958, pp. 72-85.

Excellent graphic presentation of the means now being used to lengthen human life. The pictures of complex apparatus now in use gives an idea of some of the tremendous research activities now in progress. Good bulletin board material.

THRIVING ON TENSION, E. M. D. Watson, *Cosmopolitan*, February 1958, pp. 66-69.

Is it tension or is it the inability to relax which kills our executives? Must we use pills to keep us normal? How much tension is normal? A good article to stimulate discussion about how to live in the present day world.