Living Damsel Fly Larvae as Supplementary Material for the Study of Insects

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Although a study of insects is admittedly of outstanding importance as a unit of the high school course in biology, the laboratory approach to this subject is often confined to an evaluation of the external features of a single example such as the grasshopper. Moreover, even this limited illustrative material usually involves preserved specimens only.

A proper appreciation of the amazing adaptations of insects, and the consequent success which insects enjoy as competitors of mankind, cannot be attained through the use of such limited material. Field studies of living insects could add much to the student's understanding and appreciation of the fitness of insects to survive and compete with man. But such field studies are impractical for many high school biology classes for a number of reasons.

In lieu of other materials to supplement the student's experience with the insect type, the author recommends the use of living damsel fly nymphs. There follows a brief outline descriptive of the method of collection and the study of these nymphs and of important features of structure and physiology which they clearly illustrate.

Source and Method of Collection

Many fresh-water ponds are used by adult female damsel flies as breeding grounds for their larvae. After hatching, the nymphs may be found clinging to aquatic plants, fallen tree leaves, decaying woody stems, and stones. Because some species of damsel flies require a two-year span for metamorphosis to adulthood, the nymphs may be found in ponds during every month of the year. They can be easily obtained by the collection of a mass of the vegetation to which they cling. In the laboratory, the nymphs should be separated from the vegetation and transferred to shallow dishes of pond water for storage. For a reasonable length of time in storage, the nymphs require no food, especially at lower temperatures; but they do have an unfortunate tendency to bite away each other's caudal gills. This tendency may be frustrated in large measure by allowing them to cling to aquatic plants such as Elodea which should be added to the culture dish.

Methods of Handling and Study

A. *Mounting for Study:* Add a large drop of pond water to a clean microscope slide. Slip either a section lifter or a scalpel blade under the larva and lift it gently from the culture dish onto the slide, using a dissecting needle to nudge the animal from lifter to slide. Add a cover glass gently and add enough additional water to level the cover glass. In this position, the larva may be studied for an hour or more without injury to the animal and undamaged nymphs may be recovered for use in other class sections. Depending on the viewpoint desired, the larvae may be mounted either dorsal side up or ventral side up.

B. *Methods of Study:* The nymphs to be studied should be selected from culture for light pigmentation and cleanliness of their exoskeletons.

1. *Orientation:* A majority of the high lights of structure of the nymphs are best observed from dorsal aspect. The ventral aspect, however, shows clearly several features mentioned later in this outline.

2. *Magnification:* While the gross structure and behavior of the animal may be observed under a hand lens, a 30-mm. objective, or under a wide-field binocular microscope, microscopic details of structure and physiology show more clearly under a 16-mm. objective used with a $\times$ 10 ocular.

3. *Light and Focus:* Sufficient illumination and careful focus are essential for observation of details of circulation and muscle structure.

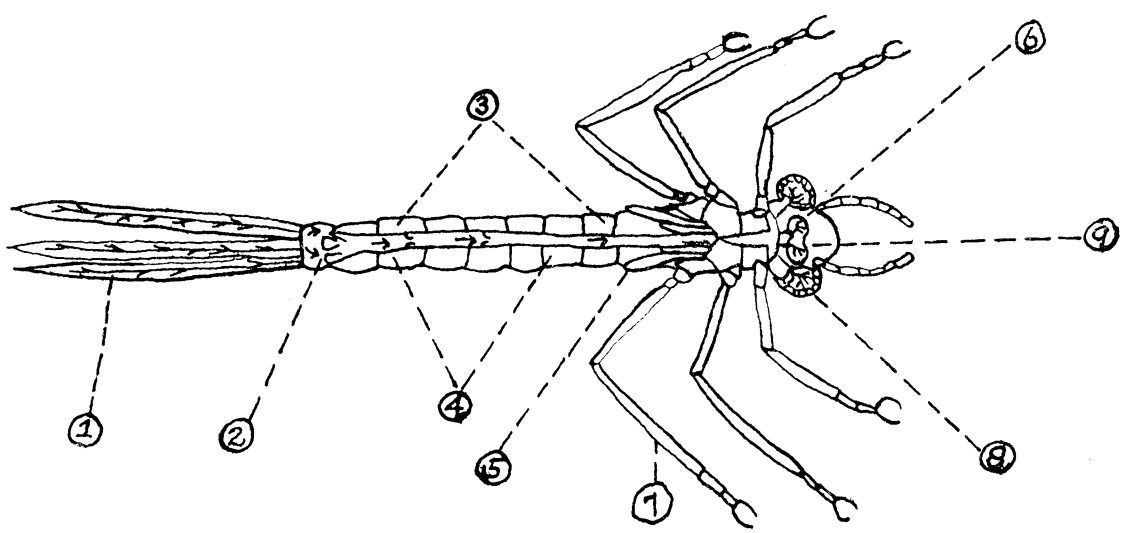
C. *Fundamentals of Morphology and Physiology:*

1. *Capture and Ingestion of Food:* If

small crustaceans, e.g., Daphnia, are introduced into a finger bowl containing hungry damsel fly larvae, the method of capture and ingestion of the food may be observed in some detail. The larva bends its flexible neck joint to focus a compound eye on the crustacean, slowly stalks its prey, and then suddenly lashes out with its folding type of labium, characteristic of these larvae, to effect the capture. Then the victim is held and manipulated by a pair of mouth parts (presumably maxillipeds or labial palps) so that the shorter, dark-tipped mandibles are given opportunity to tear the softer viscera loose from the crustacean's exoskeleton and push this soft food material on into the alimentary canal. The mandibles do not ordinarily protrude beyond the anterior border of the head but they are clearly visible through the translucent head itself. Peristaltic action may be seen to move the ingested food back through the intestine of the larva.

2. *Open Type of Circulatory System:* The elongated, dorsally located heart which extends almost the entire length of the body axis is clearly visible only in the abdominal region. The posterior end of the heart, located at the posterior border of the next to the last abdominal segment, is marked by a pair of ostia (2) through which blood enters the heart. One-way valves guarding these ostia open to admit blood, the flow of which is indicated by the movement of its colorless corpuscles. As the heart walls contract to pump blood anteriorly, these valves close to prevent escape of blood through the ostia. Several other one-way valves can be located within the heart itself. In the head region (9), the blood is seen escaping from the anterior end of the heart into free circulation posteriorly among the viscera. Blood flow can be traced posteriorly by movement of corpuscles seen along the sides of the body (3).

3. *The Respiratory System:* This system lies clearly outlined in black as though drawn with India ink. The tracheal respiratory system typical of insects shows major longitudinal vessels, segmental branches, and major branches to important organs. The finer tracheae branch in proportion to the rate of metabolism as is clearly shown by the abundance of finer branches surrounding the cerebral ganglia (6) (dorsal view) and surrounding also the segmental ganglia (ventral view). The tracheae are prominent also in



Sketch of damsel fly larva, indicating some of the easily observed structures.

1. Tracheal gills.
2. Posterior end of the heart (heart ostia and valves).
3. Region showing open blood circulation.
4. Position of fat bodies.
5. Wing bud.
6. Cerebral ganglion.
7. Leg segment (showing striated muscle).
8. Compound eye.
9. Anterior end of the heart.

the three tracheal gills at the posterior end of the body (1).

4. *The Fat Bodies:* These organs, so well developed and characteristic of insects, are prominent and unmistakable in paired position along the two sides of the longitudinal body axis lateral to the heart (4).

5. *The Compound Eyes:* The many-faceted compound eyes (8) are typical of specialized insects.

6. *The Wing Buds:* Two pairs of wing buds (5) typical of the larval stages in direct metamorphosis.

7. *Striated Muscles:* With proper light and focus, cross striations of leg musculature are clearly visible (7).

Wherever used in high school and college classes, the living damsel fly nymph has met with an enthusiastic reception by students and instructors alike. The added appreciation of the insect type implemented by the use of this material pays a rich dividend for the time and effort involved in the collection and handling of the material.

Books

MAVOR, JAMES WATT. *General Biology.* 4th ed. The Macmillan Company, New York. xii + 875 pp. illus. 1952. $5.75.

The new edition follows the same general plan of organization as that of previous editions. There has been some rearrangement of certain chapters, and others have been rewritten to bring them up to date. The chapter dealing with *chemical principles* has been moved from Part I to the Appendix. The chapter pertaining to the *cell* has been rewritten. The treatment of photosynthesis has been improved. The discussions on *viruses* and *antibiotics* are timely.

In Part III, the significance of *parasitism* is emphasized. The treatment of the "human side" of insects has been extended. To the Anthropod *mind* has been added a discussion on the *language* of the bees—an account of the work of Von Frisch on the behavior of bees.

In Part IV, there is presented considerable tabular material on vitamins, enzymes, and hormones. The metabolism of carbohydrates, fat, and proteins is adequately treated. Here, as in other sections of the book, the practical side of biology is emphasized. In Part V, Professor Mavor presents a more adequate treatment of the physical basis of heredity, Mendelian principles, linkage, crossing over, mutations, and chromosomal aberrations than most elementary textbooks in biology. The writer would have appreciated a discussion by Professor Mavor on the action of genes.

The appendix consists of three parts: 1. A synoptic table of the plant and animal kingdoms. Etymology and pronunciation of the scientific names together with brief characteristics and examples are given. 2. References and background material in chemistry as a basis for understanding biology, and 3. A glossary of biological terms. There are fifteen pages of definitions, etymology and pronunciations of biological terms. An extensive list of commonly used prefixes, suffixes, and combining word forms are included.

There are several new illustrations in the fourth edition, and the book is of a more attractive format than previous editions. The book continues to be a compendium of biological facts, and is an extensive source book of practical information for students of biology.

The manual has been revised to conform to the new fourth edition of *General Biology*. It consists of thirty units. To the thirty-six diagrammatic figures have been added several full-page halftone plates which improve the appearance and usefulness of the manual. Materials required for the various laboratory units and a list of sources of biology equipment and materials are given. The manual consists of 333 pages. It is priced at $3.50.

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ROYLE, HOWARD A. *Laboratory Exercises in Genetics.* Burgess Publishing Company, Minneapolis. iv + 53 pp. Paper, spiral binding. 1950. $1.50.

This is a concisely written guide for the laboratory part of an introductory course in genetics. It is adapted for use with any modern textbook of genetics. The exercises listed are more than ample for the usual semester's course, thus permitting some choice. There are three parts:

I. Mitosis, meiosis, life cycles of spermatophytes, and early development of animals.

II. Drosophila: its description, culturing, and experimental breeding (7 exercises on the last).

III. Human heredity: taste test, blood groups, and blood types.

Among several appendices there is one on the application of the Chi Square test, with a reproduction of Fisher's table.

The book is attractively lithographed on paper