

Photomicrographs as a Laboratory Teaching Aid in the Biological Sciences

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Within the last few decades many supplementary teaching aids have been developed to make the laboratory teaching of the biological sciences more effective. It is felt, however, that the possibilities of using photomicrographs as a laboratory teaching aid are being overlooked. The work of Northern is being done on the college level, but it is felt that the same general applications could very easily be carried over to the high school.

Equipment for Photomicrography

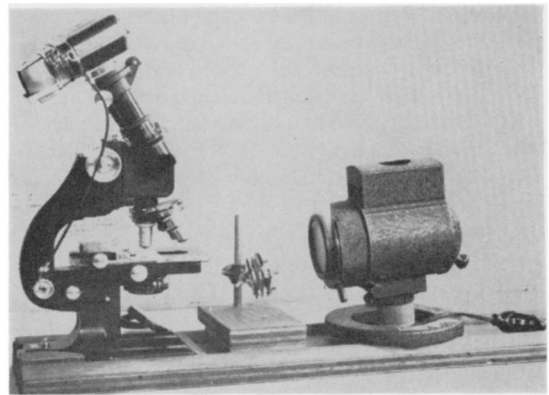
The authors do not intend to go into the fine points of the mechanics of photomicrography, but rather, to present the type of equipment that has been used satisfactorily. A brief discussion will follow of the equipment found to be needed for photomicrography.

Microscope. The microscope used for magnifications between 100 \times and 970 \times was a Spencer Model 13, inclined binocular, compound research microscope. It was equipped with a mechanical stage, adjustable Abbe 2-substage condenser, and iris diaphragm; an adjustable flat surface mirror, a 1.8-mm. oil immersion, 4-mm. dry and 16-mm. dry achromatic objectives, and a Huygenian 10 \times eyepiece. It was used in its ordinary vertical position. A monocular microscope of the same caliber would have worked, no doubt, just as well. For magnifications of 6.6 \times to 30 \times , a Bausch and Lomb Model BKW-5, senior stereoscopic microscope was used.

In general, it can be said that one should be satisfied only with the best microscope that is available, as the quality of the microscope will be reflected in the final photomicrographs.

Illumination. The source of illumination presented the greatest problem in adapting available equipment to photomicrography. A Spencer Model 370 adjustable laboratory lamp using an ordinary 140-watt, 115-volt projection bulb was found most satisfactory. The Kohler method of illumination, which is a standard method, was used in conjunction

with this lamp. Most microscope manufacturers supply information as to the use of the Kohler method with their equipment. It is suggested that before one undertakes the process of producing photomicrographs he study and experiment with illumination.



The equipment used for photomicrography.

Time spent in this manner will be reflected in the quality of the final product. This suggestion cannot be emphasized too strongly.

Filters. The use of filters may not be a necessity when using color film, but they should be utilized if maximum details are to be expected in photomicrographs of stained slides with black and white film. A simple filter holder was made which accommodates three filters so that various color combinations might be utilized.

Camera. Choosing a camera may or may not present a problem to the beginning photomicrographer. If he already has a camera he may want to prevent any additional expense by trying to adapt what he has to photomicrography. For one who is about to purchase a camera to be used for such work, several designs and features must be taken into consideration. This is especially true if the camera is to be one of such nature that it can also be used for general photographic work. The authors used a 35-mm. Kine Exakta, which is well adapted to both general photographic work and photomicrography. This

reflex camera has a single lens and a reasonably priced attachment which adapts it to photomicrography.

Listed below are some important features to be considered in choosing a camera for this type of work. These could apply whether the camera is to be used solely for photomicrography or general photography as well.

1. The camera should be economical to operate; that is, it should take standard size and make of film.
2. It should incorporate some sort of a single lens reflex system of focusing, or else have an attachment which will enable focusing to be done on a ground glass.
3. It should be easily attached to a microscope or else supported above the microscope.
4. It should preferably have a removable lens, as the eyepiece and objective of the microscope will function in this capacity.
5. It should have a focal plane shutter, particularly if the lens is to be removed.
6. It should, of course, be in good working order and be light tight.

Film. The choice of film for photomicrography is dependent on the type of camera that is to be used. If one has settled on a 35-mm. he will be limited to three or four types of film. The 35-mm camera is prob-

ably the cheapest to operate, especially if the film is bought in bulk. This size film is easy to handle and process and is readily made into 2×2 inch transparencies or filmstrips, both of which are widely used. The greatest disadvantage of 35-mm. film is its ultimate size of enlargement. However, satisfactory enlargements were obtained using Kodak Micro-file film which has a high resolving power. With some of the larger size films the initial cost of the film and the processing increases, but one has a negative which will stand greater enlargement or it can be used without enlargement to make contact prints.

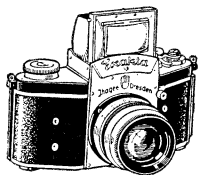
Preparing Photomicrographs

Since a brief synopsis of the equipment needed for photomicrography has been given, a few possibilities and suggestions for preparing these photomicrographs for use in laboratory teaching will next be considered.

Prints. It has been found that making standard photographic prints of the photomicrographs is a very satisfactory way of using them. The junior author used photomicrographs as an instructor's set that could be used individually with the students. The photomicrographs were printed as 3×5 inch photos and then glued on 4×6 inch file cards. An identifying caption was typed on each card. This size was chosen because it produced a photograph approximating the size of the drawings that the students were making. Such cards were not of unwieldy size.

Method for Labeling Prints

There are several possibilities for preparing photomicrographs for use as photographic



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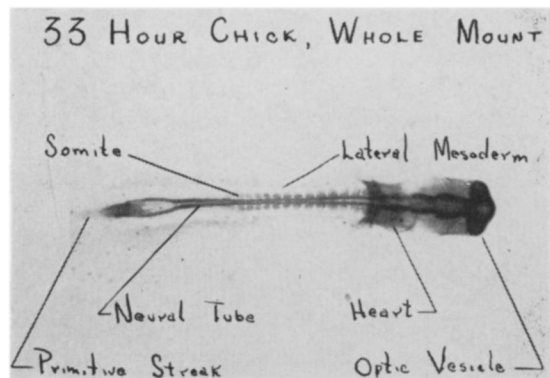
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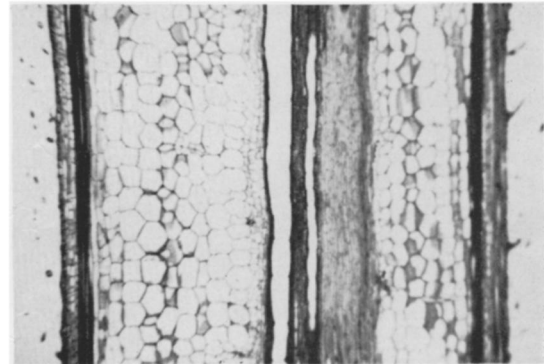
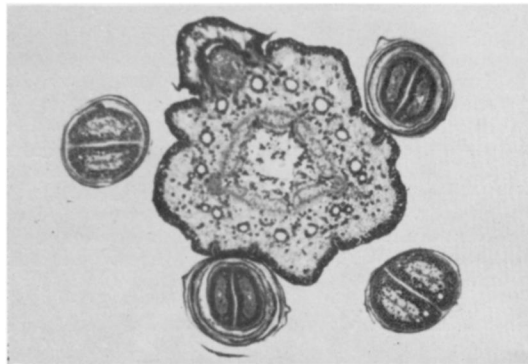
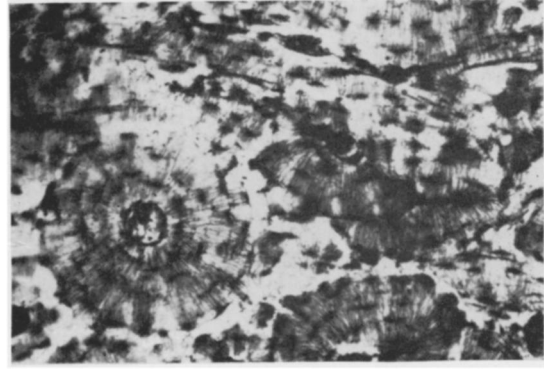
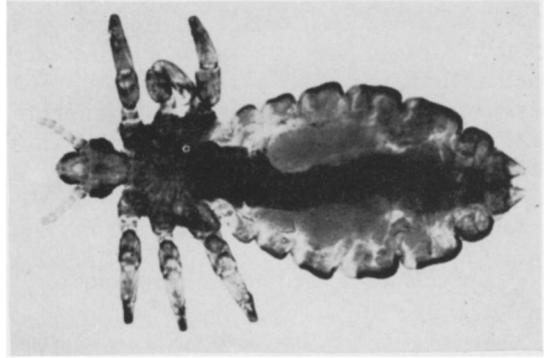
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Method for labeling prints.

prints. Among these are a set for each student, several sets for the entire class, a large set to be placed in some central location as a



Upper left, Oviductal fluke of turkey; *Upper right*, Human body louse; *Middle left*, Pancreatic diverticulum of 72-hour chick; *Middle right*, Bone; *Lower left*, Pine meristem and needles; *Lower right*, Cucurbit stem.

reference, and also a set for the instructor. The ingenuity of the individual instructor would lead to the best means of preparation of the photos for his specific requirements.

Slides or Transparencies. This is probably one of the most popular forms of preparing photos for viewing by a group. Not only do slides usually give good detail, but also they last many years if properly cared for. They can be stored in a relatively small space. They are not difficult to make and can be made in either of two sizes; 2×2 inches or $3\frac{1}{4} \times 4$ inches. Almost every educational institution will have a projector that will take one if not both of these sizes.

Referring back to the sections on cameras and films, it will be remembered that one of the advantages of using 35-mm. equipment was the fact that 35-mm. negatives can be made easily into 2×2 inch slides, either black and white or color.

The process of making $3\frac{1}{4} \times 4$ inch slides is similar to that for the 2×2 slides and the finished product is just as satisfactory. However, the larger slide increases the storage problem.

Filmstrips. One way to incorporate several photomicrographs into a specific unit is to make them into a filmstrip. These filmstrips serve the same purpose as transparencies, but

have an added advantage of requiring a smaller storage space. Also the exact sequence of photos is always maintained. The process for making filmstrips is similar to that for making slides, except that more care must be taken in masking out undesirable photos and assuring correct exposure for the entire strip.

Specific Uses for Photomicrographs

There are several ways of using photomicrographs in laboratory teaching of which three are discussed below.

Where the Supply of Microscope Slides is Limited. In many teaching situations, especially in the high school, the supply of microscope slides is limited. In this case a photomicrograph can serve the students for preliminary study. In this way students will become familiar with the specimen before looking at the actual slide. It will also give them a reference to use after viewing the slide.

To Decrease Instruction Time. In the case of a large laboratory class, it is often impossible for the instructor to give individual attention to each student. Through the use of photomicrographs all the students can be given an equal opportunity. These aids can be used by the instructor to point out to the class the various structures that should be observed. Another means of accomplishing this would be to provide each student with a small print on which the important structures were labeled.

Good results were obtained using a set of small prints in an embryology class as a means of aiding the students to find specific structures. Although each student had his own set of slides, all were not working on the same sections at the same time. The instructor, by using these prints, could quickly refer to a specific view under observation by a student.

Testing. Photomicrographs serve a very useful purpose in the testing program of a laboratory class. These photomicrographs can be used in any one of a number of ways, of which two are listed.

1. Prints which have had numbers substituted for the names of structures for identification. An enlarged print which could be viewed by the entire class could be used for this purpose. One advantage of using enlarged prints is that they can be used in a lighted room.

2. Transparencies or filmstrips can be projected and various structures pointed out for identification.

Summary

Although the teaching of laboratory classes in the biological sciences has been greatly aided by the use of charts, models, outline drawings and microscope slides, it is felt that photomicrographs are being overlooked.

The basic equipment needed for photomicrography is (1) a microscope, (2) a source of illumination, (3) filters, (4) a camera and (5) film.

Photomicrographs may be prepared for use as (1) photographic prints, (2) transparencies and (3) filmstrips. They may be used in any of the above forms for the purpose of testing, decreasing instruction time and stretching the supply of slides.

Some of the areas of zoology where photomicrographs could be used are: embryology, parasitology, histology and anatomy. Likewise they could be used in the areas of botany in plant anatomy, genetics and cytology.

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Earlybird Best Wishes for a Very Merry Christmas and a Happy New Year to all of you and yours from The Editorial Staff! May there be just enough clouds in your teaching, research, and private life to make a beautiful sunset.

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