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Materials Used in Teaching Genetics

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Genetics, like other branches of biology, is taught most effectively to beginners by means of demonstrations, observations, and experiments. I have yet to see the student whose interest is not aroused by judiciously selected materials. My experience is in entire agreement with that of Dr. Blakeslee, as described in this issue, in indicating that the degree of retention varies directly with the use of concrete objects. As teachers, our greatest fault probably is too great dependence upon the printed and spoken word.

I should like to mention briefly the materials that I have found useful in teaching the principles of genetics. It is to be hoped that readers who have proved additional instruments of instruction will share their discoveries with the readers of this journal. To facilitate reference, the items are listed below under the genetic principle which they illustrate.

The mechanism of sexual reproduction in plants. The flower of the pea (either the edible pea or the sweet pea), or of some other seed plant, is issued to the students for study and dissection. Such study may well be supplemented by large scale models and charts.

Mendel's first law (Segregation). Permanent display bottles of seeds of several kinds of peas, especially those mentioned by Mendel, are passed around the class for observation. From a seed house the following kinds, among others, were obtained: round yellow, round green,

wrinkled yellow, wrinkled green, grey-brown seed-coated. The bottles were tightly stoppered, the corks cut off, and the necks of the bottles dipped in melted paraffin.

Ears of corn, produced by self-pollination of hybrid plants, showing Mendelian ratios of seed characters, on the cob, are distributed for study. A fairly accurate count can be made without shelling the corn. These ears, as well as the next item, are procurable from several dealers. By using a tight metal can and a few moth balls the ears have been kept in good condition for years.

Corn seedlings, segregating for green and albino in a ratio of 3:1, are produced by planting F_1 seeds. To obtain respectable ratios at least 100 seeds should be planted, from stock not more than one or two years old.

Drosophila crosses between easily classified and viable stocks. The *Drosophila Guide*, mentioned by Mr. Miller in this issue is indispensable; it is a 51-page booklet, filled with excellent illustrations and valuable information.

Cat skins, showing a variety of coat colors, were obtained from the comparative anatomy classes. Excellent pelts resulted from tacking out, scraping, and salting the hides.

A few cages of living guinea pigs illustrating coat colors, eye colors, and hair direction in rodents are kept for demonstration. Matings are made in order to produce a few litters during the semester.

Leaflets for testing taste differences with P.T.C., as described by Dr. Blakeslee in this issue, are passed out, and students are asked to test their families.

Mendel's second law (Independent assortment). Much of the material listed under Mendel's first law can also be used to demonstrate this principle: there are ears of corn showing independent assortment of colors and form of seed (starchy vs. sugary); guinea pigs showing assortment of coat colors and hair direction (rough vs. smooth); dihybrid matings of *Drosophila*, etc.

The chromosome mechanism. Microscope slides showing mitosis in plants and animals (root tips, *Ascaris*, and whitefish) are effective. These are supplemented with models and charts.

The factor principle and multiple alleles. Ears of corn, showing colors resulting from the interaction of several genes, in numerous modified ratios, are used. With *Drosophila*, a very successful mating has been between the mutants brown and scarlet. The F_2 's give a 9:3:3:1 ratio of red, brown, scarlet, and white; the double recessive eliminates all pigment from the eye. Guinea pigs are used to show that coat color results from the interaction of several independent genes, some of which occur as multiple alleles.

Students are tested for the A-B series of blood groups. Anti-A and anti-B sera are obtainable at reasonable cost from the supply houses, and the test is simply and rapidly applied without special training. This is an excellent example of differences due to a series of triple alleles.

Sex determination and sex linkage. Slides of sections of the testes of the classic bug *Anasa tristis* (see Wilson, *The Cell in Development and Heredity*) are used to show two classes of spermatocytes—those with 11 chromosomes and

those with 10.

Drosophila cultures showing F_2 's from a P_1 cross between eosin-miniature and Bar are excellent to demonstrate sex-linkage as well as crossing-over.

Students are tested for color blindness by means of the Ishihara plates. In accordance with expectancy, about 8% of the boys and 0.5% of the girls (Caucasoids) have proved to be more or less defective for the red-green sense. The statement is sometimes made that girls are not color blind. In one class I discovered two cases: one was so-called "red blind"; the other was "green blind." Incidentally, these two girls were very inefficient in classifying eye-colors in the *Drosophila* experiment with brown and scarlet.

Environmental effects. Corn seedlings, segregating for green and albino, are grown as a controlled experiment, in which one half of the population is denied light, with interesting results (see this journal for Dec., 1942).

An albino guinea pig kept in the laboratory develops much sooty pigment on nose, ears, and feet in the winter time, and loses it when the weather grows warm. Low skin temperatures (the laboratory sometimes goes below 50 over the week ends) are known to induce pigment formation in albino guinea pigs—a case similar to, though not so extreme as, the Himalayan rabbit and the Siamese cat.

Ears of "sun red" corn in which the husks were removed in part during development are red in the exposed regions and white in the covered areas.

Most of the foregoing items have been used successfully in a single semester in a college course in genetics. It is realized that only a few can be utilized in a course in general biology. It is hoped that the list may prove helpful to readers in selecting materials adapted to their respective classes.