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Objective Animal Experiments

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"Science teaching has long concerned itself chiefly with the mastery of laws, facts, and principles to the neglect of certain of the less tangible, but none the less desirable outcomes, such as attitudes of mind."[1] Not to make biology functional is a grave error on the part of any teacher, for the high school graduate today is faced with a world far more complex than that which confronted his parents or grandparents. True, we do not advertise our schools as the panacea for unemployment and award a position with each diploma, nor should we, but we *should* develop in students certain attitudes and mind-sets that will lead to better social adjustment and enrichment of life.

The fact that every once in a while some pupil asks, "Why do I have to take geometry?" or "Why must I take biology; I don't see where it is doing me any good?" indicates that the course in question has not been made functional for him. Of course it will be some years before pupils realize the value of certain high school courses, if at all, but that teacher fails indeed who fails to point out—verbally or otherwise—from day to day the things that his course can do for his students.

It seems to me that science teaching should ingrain in the mind of the student something more lasting than mere facts relative to biology, physics, or chemistry, and with this thought in mind I have cast about for a single objective around which to build an experiment that would run for several months. My primary concern was to pick an objective that, once attained, would benefit a student for the rest of his life. The Scientific Method of Problem Solving was finally chosen as the main objective, for many of the facts taught in biology courses are forgotten by the average student soon after graduation, if not before. Several educators strongly sus-

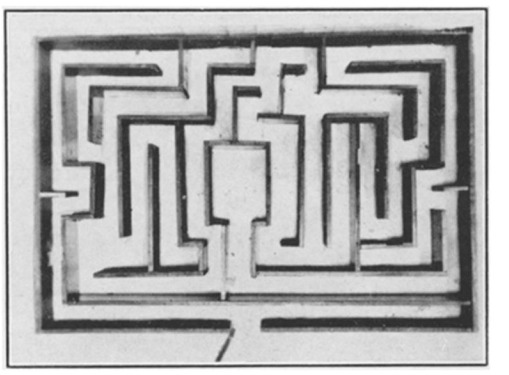
[1] Heiss, E. D., Obourn, E. S., and Hoffman, C. W., "Modern Methods and Materials for Teaching Science," Ch. 2, p. 15. The Macmillan Company, New York, 1940.

pect that under the present laboratory system the Scientific Method is not "fixed" in the student mind and does not carry over into life situations. However, if given a chance to apply the Method repeatedly and over a considerable period of time to a real live problem, not just another laboratory exercise, students may graduate with something more tangible and useful than a few hazy conceptions of scientific fact and law. They will have a lasting, reliable, keen-edged tool with which to attack their daily problems. The fact remains that the Scientific Method must be taught as an objective if our students are going to "get" it, and I feel that they must, for it will be one of the most valuable contributions a study of biology can make to their lives.

A second objective for this work is to convince students that their course in biology is a definite help to them in life *now* and not merely a passive appendage to their general education. The following account will explain an experiment devised to attain the above desired results. With the chosen objectives constantly in mind three experiments have been carefully planned and executed here for three years. They were built around animals, as children have an inherent fondness for them that can't be suppressed, even though the animal selected is the common white rat. They are also excellent aids in dispelling many myths regarding animal behavior. The experiment selected from the three referred to for discussion in this paper deals with the learning processes of white rats. It must be mentioned that careful motivation throughout the entire experiment is the keynote of success.

Having studied habit formation, touching slightly on the Laws of Learning, the class was given an opportunity to experiment with learning processes of animals. They were all in favor of the project and elected two students from each of our four classes to act as Chief Experimenters. The duties of the Chief Experimenters were to conduct the experiment and see that the animals were fed and the cages cleaned. They were authorized to delegate work to other members of the classes, and were required to report to the classes from time to time. One of the students, interested in woodworking, constructed a very good Hampton Court maze (see figure) of the type frequently used in psychology experiments. Needless to say this student was greatly pleased to see his maze in use, and has been constantly interested in the experiment. The interest and cooperation of other students was gained by encouraging them to make cages for the project.

After much discussion, carefully planned on the part of the teacher, the classes became aware of certain variable factors they would have to control; and consequently, in order to minimize hereditary differences, chose for experimentation four white rats that came from the same litter. They decided that differing ages, amount of food available,



THE HAMPTON COURT MAZE

Note the door at bottom center, for admittance of animals and the square food chamber directly above. The top is covered with removable glass.

and even sex might influence the rate of learning. As one boy put it, "Perhaps we can find out whether or not females learn faster than males," and as a result two of our animals had to be females and two males. It is through work of this nature that students are given an opportunity to weigh and evaluate factors involved in the correct solution of problems.

The experiment, begun in October, lasts until the first of May with the animals being run through the maze every other day. They are allowed no food during a day on which they are to perform, but on all other days are fed at three o'clock P.M. The recorded data consist of the following:

1. Time taken to solve maze.
2. Blind alleys investigated.
3. Blind alleys entered.
4. Blind alleys ignored entirely.
5. Time used in eating when food has been found at end of maze. (All timing is done with a stop watch.)

At first each animal took over an hour, but the Chief Experimenters would not listen to the idea of taking one out before it had solved the maze. Our discussion of variable factors was already paying dividends. At the present time all animals are going through in less than thirty seconds and the females seem to be learning faster than the males as their time is usually several seconds better. These facts are brought to the student's attention and give the instructor an excellent opportunity to point out that, with only two animals of each sex under experimentation, slight differences are of no statistical significance. General laws must be confirmed with numbers large enough to eliminate chance variations. Over a period of years such numbers will be obtained, for we plan to conduct this experiment every year, not so much for its scientific value as for its educational value in training students to use the Scientific Method.

Before the experiment is finally concluded in May the subjects are given a period of one month, during which no trials are run, for the students, familiar with the Law of Disuse, wish to discover how fast their rats forget, and which sex, if either, forgets faster. After renewing trials to obtain the above data the experiment will be brought to a close. All data will be graphed, charted, and discussed; and a thesis will be written by the entire class, which will set forth our Object, Materials, Method of Procedure, and Conclusions. Students are quick to see the practical applications of such an experiment, and never has one of these theses failed to point out the advantage to students of following the Laws of Learning in their daily studies and the difficulties met in studying by the hit or miss, trial and error method, at first used by the rats. Invariably at the end of this work we get into a discussion of habit formation, and students inquire, "How can I improve my study habits?" This gives the teacher a chance to do some much needed remedial work with individuals, and at the same time convince them of the value of applied biology.

If the only outcome of our experiment should be an improvement in student methods of study, our time and effort will have been well spent, for most of the students are sophomores with two years remaining of high school and a possibility of four years in college.

It is not enough to discuss the Scientific Method at the start of this work, it must be stressed at every opportunity, and especially at the end of experimentation, repeatedly driving home the fact that once learned this Method can be used to attack *any* problem as well as the problem of animal behavior. In the final analysis, as in all teaching, whether or

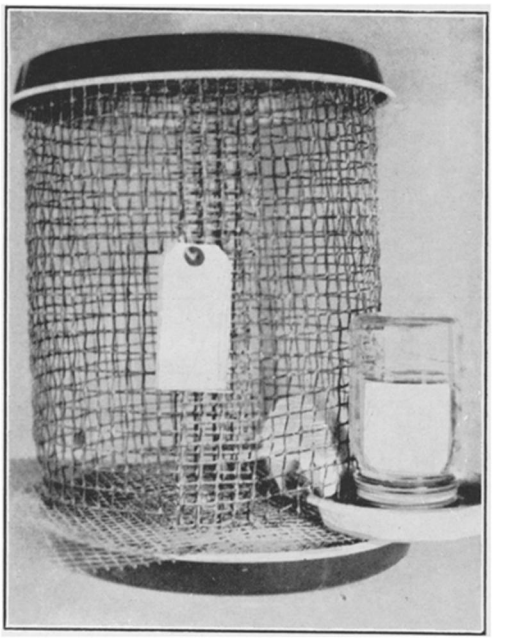
not such a project is successful and the desired objectives attained depends almost entirely upon the teacher. One of the most valuable outcomes of this experiment is the idea that conclusions based on factual data and carefully controlled experimentation are much more trustworthy and valuable than are conclusions based on any other premise.

A teacher must give much time and careful thought to put over a project of this type, but he will receive his reward throughout the entire experimental period. It is certainly gratifying to observe the keen interest taken by students in their animals and to hear them discussing a day's results after class or in the halls—and don't think they fail to compare their learning ability with that of the rats. It is also interesting to hear the questions of students not taking biology when they visit the laboratory, and the sound, accurate answers they usually receive from students in charge of the animals.

These experiments require no expensive or intricate equipment that might prohibit their use in the smallest or poorest school. For our stock rats and those under experimentation, except those used in nutrition experiments, we use the diet worked out by the Bureau of Home Economics, United States Department of Agriculture, Washington, D. C., which follows:

1. Whole wheat (ground fine)—1600 grams.
2. Whole milk (powdered)—800 grams.
3. Table salt—32 grams.

Inexpensive cages can be constructed from a piece of galvanized wire screening, three squares to the inch, $36'' \times 12''$, and two pans or round trays approximately $10''$ in diameter. Fold one narrow end of the screen forward two inches and the opposite narrow end backward an equal amount. Interlock the



The above cage cost less than fifty cents.

folded ends to form a cylinder and hammer down the ends of wire to make them firm. Fill one of the trays with sawdust and place over it a square of wire $11'' \times 11''$ to keep animals from scattering the sawdust. Now place the cylinder on top of the wire and you are ready for a tenant. The other tray, of course, is used as a top for the finished cage. Such cages are inexpensive and can be made in square or rectangular form if desired.