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The Challenge and Motivation of Students through Live Animal Projects

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carried out where animals can eat a balanced diet, for example one diet fed in a cube state giving recognition that most of the rodents are gnawers; then another group fed on a powdered ration or a meal mixture and a third group fed on a ration which is moistened by water. The animals should be in a growing stage; they are weighed each day and measurements such as body weight gains recorded. In this the student learns to handle the animal and to make accurate measurements. In such studies fecal and urinary output are possible adaptations.

F. Environmental Studies—Again in this area light, darkness, temperature may be measured against weight gains in young animals or food intake or urinary output. The animals can be maintained in the darkness, handled or not handled and then brought into the light; handled regularly and increasing or decreasing weight gains observed under these different regimens. With respect to temperature only a normal temperature for the animal should be studied or one where the temperatures are increased five to ten degrees above the recommended normal maintenance temperature for the animal. For example, if the normal temperature for rats is considered as 72° Fahrenheit then raising the temperature to 78 or 80 degrees could be studied. It is not recommended that anyone should study effects of temperatures above 80° F or below 65° F.

G. Anatomical Preparations—The bodies of dead animals may be obtained from humane societies or research laboratories where animals have been killed humanely. The preparation of skeletons from these animals, cleaning the bones and restructuring the body is a giant task. Comparison of the various bones in animals is another interesting detail, particularly if function is also brought into the study.

H. Genetics—Under this heading, various colours of mice or rats, hamsters or rabbits may be bred and the colour adaptations recorded. Similarly, in this one can study the effects of random breeding, brother and sister matings, and line breeding with respect to number of young-born, colours, sex, etc.

I. Field Studies—Data collecting of information concerning numbers of wild animals within a given area i.e. woodpecker population in an area close to an industrialized or a built up area and one far removed. There are all kinds of combinations of studies that can be made studying the influence of various changes in the environment inflicted on the animal by man. Into this study as well one could build feeding stations and study bird population or animal populations as they arise. One such field study that would be worthwhile would be observation of animals in a dump.

Study of the senses—studies on sight, smell, taste, the type of exposure should be on only those things which we may contact daily. Various studies can be done here where behaviour of animals can be observed when exposed to various colours in their environment, or by the exposure of the environment say of a heavy peppermint smell or an onion odour. Ordinary food stuffs fed laboratory animals can be coloured with vegetable dyes or can be altered with respect to taste by adding spices etc. Nothing should be added which would be regarded as unacceptable to human senses.

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Abstract

The subject of use of live animals by secondary schools either in classroom work or science fairs is a very controversial and often emotional issue. The author emphasizes the dedication to humane treatment of animals while at the same time explaining the process by which rules have been formulated to provide for the appropriate use of live animals. The difference between permission and mandate is clarified for the purpose of explaining the need to provide for the more effective challenge and motivation of the high achiever while still allowing for more modest undertakings by the average student. The perils of overregulation are stated. Recommendations for the further improvement of the program are offered.

Introduction

The biomedical scientific community has a serious responsibility to participate in the development of its own replacements from subsequent generations. We have learned the problems of affirmative action for admission to professional and graduate schools must be addressed to preparation at the elementary levels of education in terms of basic learning of reading, writing, and mathematical skills. Likewise, it is important to introduce students to the biological sciences early in the educational process if motivation for career in the biological, life, and health sciences is to be achieved (NABT, 1966).

Educators generally agree that participation of students is one of the crucial ingredients in learning. Individual research projects are one means of insuring student participation. The proper use of live animals in science fair competitions has been recognized as one that generates enthusiastic participation (Bellipanni, 1977).

An article by W. B. Cannon, M.D., Professor of Physiology at Harvard, in 1912 clearly identified the significant difference between observation and the experimental method. He placed this transition at about 1850. Prior to then "to account for sickness, all sorts of theories were advanced such as bad air, the influence of stars and mysterious humours and myasisms; but these theories were subjected to almost no experimental tests." (Cannon, 1912) Thus the scientific method was established.

Many secondary school students will not continue into higher education. This represents a greater challenge to the teacher to stimulate and motivate the student to pursue these lines of study. For these, the occasion to participate in a well-planned in-

dividual research project, with or without animals, may be their only introduction and opportunity to understand the scientific method. This valuable lesson is essential preparation for adult responsibilities.

John Dewey (1931), the famous philosopher, stated in his publication, "Ethics of Animal Experimentation":

> *Different moralists give different reasons as to why cruelty to animals is wrong. . . . There is, however, no ethical justification for the assumption that experimentation upon animals, even when it involves some pain or entails, as is more common, death without pain—since the animals are still under the influence of anesthetics—is a species of cruelty. Nor is there moral justification for the statement that the relations of scientific men to animals should be under any laws or restrictions save those general ones which regulate the behavior of all men so as to protect animals from cruelty.*

Dewey (1931) made a significant contribution when he reworded his truths to state them positively as follows:

> *1. Scientific men are under definite obligation to experiment upon animals so far as that is the alternative to random and possibly harmful experimentation upon human beings, and so far as such experimentation is a means of saving human life and of increasing human vigor and efficiency.*
>
> *2. The community at large is under definite obligations to see to it that physicians and scientific men are not needlessly hampered in carrying on the inquiries necessary for an adequate performance of their important social office of sustaining human life and vigor.*

These comments are quite interesting in light of the current series of seminars on ethics which have been occuring this year. The point is that we do not have to deal in terms of absolutes. If we want humane treatment of animals, we impose rules or guidelines that will provide for that. If the concern is that the students are not adequately prepared to carry out such efforts one of two things should happen on a one-on-one basis:

A. The individual project may be discouraged, or alternatively,
B. The necessary preparation will be provided.

Human behavior, and more specifically the behavior of students, in any population follows the same statistical distribution characterized by the Bell curve. All youngsters are not bad. In this application, for every extreme case of a young person that might have a tendency toward cruelty to animals, there is another on the other end of the distribution that would risk life and limb to return a baby sparrow to its nest. Most of the population fall in between and would be categorized as good and kind.

The position of both the National Society for Medical Research (NSMR) and the International Science and Engineering Fair (ISEF) is that secondary school students with proper supervision can conduct animal experimentation in a manner that will challenge and motivate their interest in the biological sciences and still assure humane treatment of the animals (Grafton, 1977).

Development and Content of ISEF Rules

The Rules for the ISEF (Science Service, 1979a) are promulgated by what was formerly the Committee on Animal Experimentation and is now the Scientific Review Committee. The committee consists of high school science teachers who are active in the classroom, administration, and in local or regional science fairs and veterinarians who are specially qualified for this responsibility. In the three years I have been associated with the program, there have been three charter members of the American Association of Animal Welfare Veterinarians on the committee. The current rules had input from three Diplomates of the American College of Laboratory Animal Medicine. After drafting by this committee, they are reviewed and approved by the Director of Science Service, Inc. the sponsor of the ISEF.

The first section of the rules that relates to animal research is not only dedicated to, but emphasizes the humane considerations vital to any use of animals. This was not just an accident of format. It was deliberate to direct attention to the importance of the subject as the first and foremost thing that must be considered.

The mandated preparation of a protocol **BEFORE** undertaking any animal work is mainly for two purposes: (1) to cause the students to think through what it is they are looking for, how they propose to find out, and what methods will be involved and (2) to enable the teacher or supervisor to determine the appropriateness of the project and the degree of supervision it will require.

The most important decisions to be made at this early stage involve the selection of a subject and the animal species to be used. Students are encouraged to utilize lower forms of life including protista.

The most critical rules that make a more liberal approach to animal use possible are the detailed requirements for documentary certification of the student research by appropriate adult supervisors. These include where indicated:

A. *Teacher-Supervisor:* The teacher or supervisor agrees to assume responsibility for compliance with the ISEF rules.

B. *Animal Care Supervisor:* This certification covers primary responsibility for the quality of animal care, including both continuing supervision, and euthanasia of the animals, if required at the termination of the project.

C. *Biomedical Scientist:* A biomedical scientist is described as qualified to the doctoral level with a working knowledge of the techniques to be used by the student. The scientist certifies to ensure training, give advice and supervision, and have read the ISEF rules.

D. *Designated Adult Supervisor:* This is a fully qualified individual designated by the Biomedical Scientist to provide the direct supervision to the student after training by the Scientist.

The rules also contain specific references to federal laws, regulations, and guidelines that might impact on student research. This is most important where there may be involvement with lasers, controlled substances, human subjects, recombinant DNA, etc.

Some of the critics of the program have characterized it as "elitist" because of

the emphasis on competition and complex projects. This is an area of endeavor in which I feel elitism is a good thing. For many years there has been a movement in our society in the name of egalitarian equal opportunity for all which has resulted in reducing the opportunities for the outstanding while doing little to increase the lot of those most in need of help. Policies in this direction have had a very undesirable effect as evidenced by the lowered scores on college entrance exams. This in turn brought about the imposition of legally mandated tests for competency before high school graduation already enacted by some levels of government.

The rules for the actual exhibits permitted are very explicit to avoid misunderstanding. These were developed over the years to cope with problems affecting safety and public health. It was these concerns that years ago decreed that no live animals be exhibited. This also avoids what would otherwise be a stressful situation for animals. Health hazards are the reason we prohibit cultures of microorganisms.

The other major factor about exhibits is the matter of whether all or part of an exhibit is appropriate. Following judging, the science fairs are not only open to the public, but they are promoted as family affairs. Parents are encouraged to bring all the children to see what marvels of science their siblings and peers have accomplished. Just as the porno magazines are covered on the newsstands, the rules provide that pictures of animals in other than normal conditions which might be visually offensive to some, may not be displayed. Students are encouraged to have whatever pictures they feel necessary to describe their work mounted in their notebook for review by the judges.

Importance of Adult Supervision

As indicated above, we feel that the success of the entire science fair program is dependent upon the quality of adult supervision that is provided. It is the adult supervisors that motivate, inspire, educate, evaluate and generally keep the student out of trouble. Some of the specific functions in the area of animal research of paramount importance are:

A. *Define reasonable parameters:* One of the basic elements of an ordered society is to clearly define the rules of the game. If you read our rules carefully, you will see that this is emphasized, wherever appropriate as before the fact, not after the fact. In this instance, it includes an evaluation of the capabilities of the student, resources and supervision available.

B. *Advise on preparation of the protocol:* This is where the suggestions of subject, species, and methodology are employed.

C. *Refer to qualified biomedical specialist:* There is absolutely no stigma associated with high school biology teachers recognizing their own limitations and referring students to a specialist in a particular area of research. This is the same principle as a physician in general practice referring a patient to a specialist when the nature of the problem exceeds the capabilities of the generalist.

D. *Continuing supervision:* The importance of adult supervision at all stages of the student/animal research cannot be overemphasized. It must be continuous **BEFORE,** during, and following the animal phase. The before and during have been referred to

previously. The responsibilities following include: evaluation of the results promoting sensitive understanding of death, and advice on writing scientific reports.

E. *Evaluation of results:* This aspect of the scientific method is critical. It is here that the supervisor helps the student to perceive and interpret the cause and effect relationship of the research. The concept of significant variation versus random chance is introduced in a subtle, but understandable way. The rejustification of the methodology and animal use in light of study results is an important learning outcome.

Dangers of Overregulation

There is a serious danger in the tendency toward overregulation which as citizens of this country we all recognize. You have all heard how the cost of compliance with federal regulations increases the cost of an automobile by $800. At a symposium on the ethics of animal research, Theodore Meth, the lawyer on the program, suggested that most of the meeting's participants were legal laymen of the era of 1929 when the answer to all societal ills was "There ought to be a law!" He stated the history of law has involved progression from definition to prohibition to management. Today it is moving away from direct government controls to less intrusive legal devices such as planning, goal setting, discretionary funding and fact-finding (Meth, 1979).

The rules that have been published and distributed for the 31st ISEF have already been the subject of criticism from the very persons they were designed to help the most—the high school science teachers. The complaint is that they are so very complex one needs to be a lawyer to interpret them.

The fact is that this set of rules has been expanded to recognize a demonstrated interest in student research involving not only the use of live animals, but human subjects, and recombinant DNA technology. The easy course for the committee would have been very simple, prohibit them all. The committee and the directors of the program took a more responsible, although more difficult, line of providing rules within which these new, popular challenges could be met and controlled.

A most important factor in legislation or regulation by the government or rule preparation in a science fair must be recognized and appreciated. That is the difference between permission and a mandate. Oversimplified this is the difference between "you may" and "you shall."

In preparing the rules, we have attempted to make provision for the very outstanding student who is capable of handling highly sophisticated work, and who would probably be invited to summer science programs at a university or other research facility to work with leading scientists. There is nowhere the suggestion that every student should undertake the same level of complication in their research. But, the door must not be closed to those who are high achievers.

To make the rules any more complicated, or to superimpose added laws and regulations at the federal or state level would be to place an additional paperwork load on the already overburdened teachers and administrators (Grafton, 1979a).

Targeting the use of animals specifically for tighter regulation would tend to divert student interest to other subjects. This is why we see finalists in the Westinghouse Science Talent Search, whose career goals are in medicine, with exhibits of projects in physics and theoretical mathematics (Science Service, 1979b).

Students diverted in their interests in this way may be permanently lost to the biomedical and life sciences. As our population stabilizes in numbers, the number of

young people to enter any given career pattern is less in absolute numbers. Still, with better health programs prolonging life, the needs for input of students into the biomedical sciences to provide for the needs of an aging majority of the population is greater than ever.

Suggested Areas of Improvement

It is essential that even though we embrace new technologies, we must keep rules simple enough for all to understand. It is regrettable, but true, that the reading comprehension level of secondary school students has fallen off to the point that previous guidelines must be rewritten in simpler language.

Local and regional science fairs must adopt ISEF rules. One clearly recognized advantage of the program in Canada is the fact that there is one set of rules governing science fairs that is applicable at all levels. In this country there is a strong sentiment in some areas for "State's Rights" particularly in terms of laws or regulations. The problem in the science fair program arises when local or regional fairs pick and choose those elements of the ISEF rules they want to apply and ignore the rest. Sometimes this is in a sincere effort to simplify what has become complex, but the fact remains that the ISEF rules were promulgated by experts to do it right. Anything less is courting problems.

As modern technology has been reflected in college curricula, we find that the preparation of science teachers, even if they majored in science (Biology majors are not even offered at most colleges today) do not get the kind of "hands on" experience in laboratories working with live animals that is needed. Therefore, the solution to one of the most pressing needs that would do the most good in helping to improve the quality of adult supervision of student animal research would be continuing education courses on live animal work for secondary school science teachers. This could be in the form of in-service training, or in summer programs at universities (Grafton, 1979b).

Help must be provided to the science teachers to identify scientists willing to work with students. This kind of help is available not only at the nearby medical school, but in other research and development laboratories, hospitals, and veterinary practices.

Conclusion

The rules governing the 31st International Science and Engineering Fair were carefully prepared to allow for challenging motivation to students to explore the excitement of research in the biological sciences. They have been written to emphasize the responsibility of the student to employ humane methods under appropriate supervision. Further restrictions are not in the best interest of the public in terms of educational motivation, career development, and ultimate public service.

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