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Date August 1, 1975

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IDENTIFICATION OF FACTORS CONTRIBUTING TO STUDENT PARTICIPATION OR NONPARTICIPATION IN MONTANA SCIENCE COMPETITION

by

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ABSTRACT

The problem of this study was to identify factors, as seen by Montana junior high school science teachers and identified by the researcher, which contribute to student participation or nonparticipation in Montana science competition.

This was a sample study involving 100 Montana junior high science teachers of grades 7, 8, or 9.

The general procedure for the study was to randomly select a sample from equal proportions of Class I, II, and III school districts. Teachers who were selected from these classes were also representatives of the northern, southern, eastern, and western areas of the state.

The survey forms were distributed, collected, and the data indicated that in spite of the demands placed upon the Montana junior high science teachers, over 50% of them believe that student participation in science competition is a valuable experience and intend to encourage such participation.

It was recommended by the writer that more publicity concerning competition be made by those in charge of competition, especially to teachers in Class II and III school districts. The writer, at her local level, will strive to gain support for the encouragement of students and teachers who believe in the investigative process demanded by those involved in science competition.

Chapter I

INTRODUCTION

Science competition is an activity in which students develop and carry to a conclusion a scientific experiment, a laboratory method, or some procedure for industrial development. The efforts of students are then judged and displays are exhibited for public viewing. Science competition traces its early history to cave men who drew wall pictures to describe their feats and to share their discoveries. Through the ages the value of displaying one's activities has served as a satisfaction to the exhibitor and also as an education for those who observe the display.

Types of science competition vary with the immediate environment and the purposes for which the competition is established. Competition may include simple school, city-wide, or district fairs, or may progress to the more complex state, regional, or national forms of competition.

The major thrust of science curriculum reform since the 1960's has been the effort to transfer the responsibilities for learning in the classroom from the teacher to the student. This has been done by implementing inquiry techniques and individualization. With this in mind, it is therefore evident that the goals of science education and the methodology used in science competition complement one another. The factors included in the steps of scientific method are the

framework for the completion of an individual investigation. The preparation of a science project which may then be entered in science competition, gives the student the opportunity to individually use inquiry techniques, evaluate his efforts, display them, and be evaluated by competent judges and the public itself.

Levels and categories of competition vary from kindergarten through grade twelve and encompass the pure and applied science fields. Competition is usually judged, and awards are given.

The student uses all available resources to develop his investigation guided by willing teachers, parents, librarians, and community volunteers.

The nature of science competition has drawn criticism concerning the roles that the student, teacher, or parents may play. Critics maintain that science competition itself is contrary to the aspects of scientific cooperation.

Although those teachers who encourage student participation in competition are enthusiastic about the activity and the values of it, the present state of the matter seems to indicate a preference for solving the problems of science fairs by simply not encouraging student participation. Reasons for interest and apathy on the part of teachers is not clearly understood by those who sponsor competition or by the teachers themselves; consequently, in this study, the attitudes

of teachers and the factors responsible for these attitudes will be identified and stated.

Statement of the Problem

The problem of this study will be to identify factors, as seen by Montana junior high school science teachers and identified by the researcher, which contribute to student participation or nonparticipation in Montana science competition.

Need for the Study

The state of science in the nation today is grim. According to Strassenburg (1971, p. 8) the job market for United States scientists and engineers is grimmer now then at any previous time since the depression. He predicts that by May of 1980 there will be 325,200 scientists with Ph.D.'s who are available for only 283,500 jobs and adds that in 1971 many scientists left the country to find work in other areas of expertise. (1971, p. 10)

The most obvious reason for this situation is economic. American economy is not in a peak state of health, and there has been public disenchantment with technology which only a decade ago was encouraged. As the Nixon administration tried to balance the budget and control riots and pollution, science research took on the appearance of a luxury; consequently, federal support for programs like space exploration and the aerospace industry was reduced.

The nature of reports such as these cause disillusioned youth to turn away from science, but in spite of discouraging reports, it must be remembered that the goal of science education is not to produce a multitude of scientists but rather to produce scientifically thinking people--those that have the ability to solve problems by logical methods.

Participation in science competition is an activity that develops logical thinking processes through the process of inquiry. In spite of predicted career opportunities available in the science areas, we must guard against the possibility of too few people pursuing science careers. The very future of mankind is dependent on the assessment of our environmental problems and the solutions to them. Science competition helps students make career decisions; it encourages those who have the desired qualities and therefore trains the future scientist. Even those who do not pursue science careers will be richer for the experience; America needs citizens informed and aware of developments so that intelligent decisions and solutions to problems may be approached.

Since there has been a rapid rate of change in scientific knowledge, it is essential that education stress the process by which the content of science and other disciplines is generated and changed. Science research which is a part of the preparation of an entry for science competition, gives the student the opportunity to use the

scientific method. Work on science projects helps to develop skills such as defining problems, formulating hypotheses, observing, inferfing, classifying, analyzing, interpreting data, and forming conclusions. Scientific method is a way of life; it is a habit to be developed and used forever. If teachers can engage student minds in problem solving, the activity may be applied to other areas as well. Science competition engages students in these skills by giving them practical application of them. It is important for science educators to teach not only the laws of science but also how these laws and unanswered questions are approached.

To learn independent of a formal classroom and a live teacher is another goal of education. We actually have the benefit of a formal education for a short time, and because learning should take place throughout life, we are therefore responsible for much of our own learning; consequently, we need to know how to learn. As the student competitor researches and develops his project, the goal of individualization and learning on his own is realized. The project is an individual problem and allows each student to tailor his activities to fit his own needs, interests, and abilities.

It is important that attitudes of educators encourage student participation in activities that will allow for the individual to develop his creativity. As a science teacher guides a student investigation, the ideal environment for design and creation is provided.

Even those students who are not good readers or researchers have a more equal chance of success.

Science competition activities lead students into the community where they acquire insights that help them to become aware of the adult scientific community of which they will soon become a part. Many students have pursued careers that they became aware of through a community contact.

It is the researcher's conviction that students who enter science competition develop a strong sense of achievement when the investigation is completed. Whether an entry is judged a winner or not, the completion of a project is a great sense of satisfaction. People must learn to accept failure as well as success, and the determination to try again when failure is met will produce strength of character and a positive self concept.

When high school winners in national competition have been asked who was most influential in helping them in their scientific endeavors, the students responded that their teachers and school were the stimulating influences. They also added that the time of their peak interest in science was at the age of twelve and in the seventh grade. (Moore, 1962, p. 178)

The importance of the junior high school years in stimulating interest in science activities cannot be underestimated; teacher attitudes toward science competition are therefore extremely important and

need to be identified; those teachers who do hold positive feelings and enthusiasm toward the activity have an obligation to inform, encourage, and help other educators who are perhaps hesitant. Teacher hesitancy may be due to a lack of knowledge concerning the philosophy of science competition. It may be that the teacher's own educational training was more in the products of science rather than the processes of it; therefore, there may be a lack of knowledge concerning how to guide students.

An identification of teacher attitudes toward science competition is needed and will be collected in this study. The future of mankind is dependent on thinking people, and educators have an obligation to provide the environment for engaging minds in the process of science. The emphasis of their activities will be on science, but the personal value to the student will be lasting regardless of the way he or she chooses to progress in life.

General Questions to be Answered

By the teacher:

1. Have you ever sponsored a student in any form of science competition? What type? (Local? State? National? Industry Sponsored?)

2. What do you believe are the factors that contribute to student participation or nonparticipation in Montana science competition?

3. If you have had students involved in science competition, what methods do you use to motivate them to enter?

4. Do you feel that it is important to encourage student participation in science competition?

5. What do you see as the values of science competition?

6. What are your criticisms of science competition?

7. What do you believe should be the role of the teacher in science competition? of the parents? of the community?

8. Do you feel that the judging of student entries is accurate and unbiased?

9. Did your teacher education program prepare you to guide students in the preparation of projects leading to entries in competition? If no, do you think it should have?

10. Do you feel that the awards given to winners are adequate? Express any positive or negative aspect of judging or awards that you may have.

11. What extracurricular school activities do you sponsor or assist with?

12. Do you feel that teachers whould receive additional compensation for "coaching" science projects for entry in competition? Should this be compensated for in terms of money? time? both?

13. Would you classify your school as traditional? open space? other?

General Questions to be Answered

By the researcher's investigation of science fair records:

1. What are the trends in student participation in Montana science competition? (Are there greater or fewer numbers of students taking part?)

2. In the past five years have there been more girls, more boys, or equal numbers of each sex entering science fairs?

3. Are there more entrants of one race than another?

4. Does the size of the city influence the number of contestants who enter? From what locations in Montana do the entrants come?

5. What careers have winners of science competition pursued?

General Procedure

In order to identify the factors, as seen by Montana junior high school science teachers, which contribute to student participation or nonparticipation in Montana science competition, a study of the literature relating to science competition will be pursued. This review of literature will be made from resources at the Montana State University library and the North Junior High School library in Great Falls. In addition it will include interviews from Dr. Adrien L. Hess, a professor of mathematics from Montana State University who has been actively involved in science competition for many years and from Mr. Gail Anderson who is the cashier for the Anaconda Company in Great Falls

and is in charge of arrangements for the Anaconda Company's Scientific Achievement Program.

The need for the research will be explained, and a survey instrument will be developed. This instrument will ascertain the attitudes of science teachers concerning fairs and competition and will be sent to a sample of Montana junior high science teachers. The sample will represent the various populations and geographic locations of Montana cities.

The researcher will also examine the records of the Anaconda Company's science program to collect further data important to the study.

The results of the survey and the investigator's research will be compiled, analyzed and interpreted, and the factors which contribute to student participation or nonparticipation will be stated.

Limitations of the Study

The researcher will limit the study to Montana junior high schools, or if not designated as a junior high school, to grade levels seven, eight, and nine. The review of literature will be limited to information found in the Montana State University library and the North Junior High School library in Great Falls. The review will be limited to interviews from people who have served as chairmen, committeemen, or judges during the 1974-1975 period. The survey instrument

will be limited to those Montana junior high school teachers who have been randomly selected to represent the various populations and geographic locations of cities in Montana.

The investigator's research of science competition records will be limited to those available and provided by the Anaconda Company's Scientific Achievement Program.

Definitions of Terms

applied science: any branch of science employed for a particular purpose, pursued for some end outside its own domain, whether in a distinctly utilitarian way or as an aid to some other branch. (Good, 1973, p. 517)

hypothesis, explanatory: a tentative guiding idea that seeks to account for an event by exhibiting its relationship with wider principles or considerations in terms of which the observed event becomes comprehensively understood. (Good, 1973, p. 289)

hypothesis (from a student standpoint): an intelligent logical informed prediction about a solution for a problem; a prediction based on available information.

inference: the act of obtaining a logical judgment from given data.

inquiry: a technique or strategy for bringing about learning by encouraging a student to be inquisitive and curious and to ask questions to try to find answers for himself. (Good, 1973, p. 303)

problem solving method: a method involving clear definition of the problem confronted, formation of a hypothetical solution (hunch or suggestion), and deliberate test of a hypothesis until evidence warrants its acceptance. See scientific method.

process of science: a problem solving approach in which newly encountered phenomena becomes a challenge for thinking; it begins with a set of observations, proceeds to design the measurements required, distinguishes between what is observed and what is inferred, invents interpretations which are testable under ideal circumstances, and draws reasonable conclusions. (Good, 1973, p. 303)

products of science: includes the scientific facts and principles that have been ascertained in the various areas of science.

pure science: science concerned with concrete problems of data rather than with fundamental principles, as distinguished from abstract or theoretical science. (Good, 1973, p. 617)

scientific method: a procedure used to acquire and systemize knowledge concerning things and phenomena experienced in observation and experiment or to test hypothesis or assertions about the empirical world. (Good, 1973, p. 518)

Summary

The development of a project to enter in science competition is an activity which stimulates the student to use all investigative skills and form logical conclusions. The student then uses communicative skills as he presents his information in the form of his report and exhibition and talks to judges and laymen about his project. Parents, community helpers, and especially teachers play an important role. Through participation a student prepares himself for his future educational needs and perhaps even a career. The attitudes of teachers toward science fairs and the preparation of projects influence whether a student participates or not. Criticisms may be leveled at science competition because of a misunderstanding of its philosophy or because of a lack of knowledge concerning how to guide students, or because of reasons yet unidentified. It is necessary to identify junior high school teacher attitudes because the junior high school is a time of peak interest in science. The factors that are identified by teachers and determined by the researcher, and that encourage or discourage student participation in science competition will be collected, analyzed, and stated at the conclusion of this study.

Chapter II

REVIEW OF LITERATURE

The review of related literature in this paper is concerned with science competition. A definition of science competition will be given, and early history of the science fair will be discussed. The history of Montana science competition will be related, and because Montana science competition may lead to competition in a national contest, the general nature of science competition in the United States today will be explained. The review of literature will include the purposes of competition, the structure (levels, categories, judging process, and awards) of competition, the positive values and the negative aspects of competition, plus the role of the student, teacher, parent, judges, and the community in science competition. The structure of the student's project will be discussed.

Science Competition

Science competition refers to an activity in which students develop and carry to a conclusion a science experiment, make a collection of natural objects such as sea shells, or make a model to relate a scientific law or theory. The activity may be designed to show a biological, chemical, physical, or technical principle, and may even be a process story to show the manufacture of a product. Students may work as individuals or in groups, depending on the rules of the particular competition.

Montana science competition, which is frequently called the science fair, is usually held near the end of the school year; however, the Anaconda Company's Scientific Achievement Program is held in July. In the United States the terms fair, display, exhibition, show, and exposition are used interchangeably.

History

The history of science competition may be traced to the early history of man. The early cave men drew pictures to describe their activities and the animals that they had seen and killed. The display of one's products has always held an attraction for people. Historically, fairs offered the opportunity to demonstrate skills and crafts, for the exchange of ideas, and for bartering of goods. The commerce of Western Europe during the feudal Europe was largely based on fairs, but with the coming of the Industrial Revolution, the great fairs diminished.

Later on an increasing population gave rise to greater interest in agriculture, and again fairs were held to stimulate interest in production and to educate others. By the middle of the 19th century the specialty fair was no longer useful, but today the county fair is still popular in the United States and Europe.

Art, industrial arts, and vocational teachers have long realized the value of displays to make others aware of work being done, and science teachers soon realized the value of display.

According to Hess (1966, p. 2) a science fair was held in 1931 at Roswell, New Mexico. Students prepared 51 exhibits in botany, chemistry, physics, and zoology. Within the next ten years many schools and cities began conducting fairs. Some found science fairs an excellent medium for correlation of such subjects as art, English, and science.

In 1950 Science Clubs of America conducted the first National Science Fair at Philadelphia. By 1961 the National Science Fair had become international in scope. (Hess, 1966, p. 2)

In 1963 more than four million people saw 1,104,198 science exhibits made by students and shown at fairs leading to the National Science Fair in 1963. (Science Review, 1963-64, p. 19)

In Montana, the science fair program was initiated in 1949, and in 1955 the first Montana Science Fair was held at the University of Montana. The state of Montana at this time was arbitrarily divided into districts which held competition. These district fairs were designed to proceed to the state fair which may also be called a regional fair. The regional fair affiliated with Science Clubs of America, and sent two students to enter national competition. (Hess, Personal Interview, July 2 and July 9, 1974)

In the 1974 Montana State Fair, no district fairs were held, although local competition was encourag-d by the state, and entrants

went directly to the State Fair held in Missoula at the University of Montana.

In addition to the Montana State Fair, science competition in Montana is encouraged by the Anaconda Company's Scholarship Scientific Achievement Program. This program was started in 1959. The 1959 competition was a preliminary experiment and was held as an intercity event in Great Falls alone. It was considered a success by the Anaconda Company and community, and in 1960 the scholarship program became officially established. Few changes have been made during its existence; however, the monetary awards have increased twice. The two categories of physical and biological science remain as they were initiated, but mathematics and other experiments closely related to science are never refused. (Anderson, Personal Interview, July 5, 1974)

Types of Science Competition

School Fair. The school fair is the simpliest kind of exhibition. Science projects are shown that have been done by students either in science class or in science club activities. These exhibitions may be a feature of a meeting to which the parents and the community are invited; however, the exhibits may be seen only by other students, teachers, and personnel within the school building. The displays of experiments, collections, or models may or may not be judged.

City-Wide, District or Regional Fairs. City-wide, district, or regional fairs contain more exhibits than the school fair, and the displays are seen by many more people who visit the exhibition hall which might be a gymnasium, armory, civic center, or other large community area.

Some of these fairs must accept only the number of exhibits that the space will hold, and in some cases, the fair receives only an allotted number of exhibits from earlier competitions. (Science Service, 1963-64, p. 19) The displays in city-wide, district, or regional fairs are judged, and awards are given.

National Science Fair-International. Individual winners from regional, state, or nation-wide, fairs who are sophomores, juniors, or seniors are selected for this competition. The students are sponsored by a newspaper, college, or other organization who agrees to pay the expenses of the trip. An affiliation fee is charged by Science Service (who administers Science Clubs of America) which is a non-profit institution for the popularization of science. Science Service administers this national competition; exhibits are judged, and awards are given. In Montana the state fairs have been sponsored by colleges who are obligated to support the student entrant. The sponsoring group must guarantee its sponsorship of the individuals to Science Service. The director of the Montana State Fair usually accompanies

the competing students to the National Science Fair-International. (Hess, Personal Interview, July 9, 1974)

Industry Sponsored Competition. In Montana, the Anaconda Company has encouraged competition by establishing an annual Scientific Achievement Program. Any student in any private, public, or parochial school in the State of Montana in grades seven through twelve is eligible to compete. Displays are judged and awards are given.

Purposes and Values of Science Competition

Maitland Simmons (1957, p. 229) believes that the purpose of science competition is to help the student gain insight into the habit of analytical and critical thinking. Simmons also believes that students emerge from these experiences with a prevailing attitude of faith in the school as a strong source of assistance.

According to Eyster (1969, p. 172), the goals of all science fairs are to widen the horizons, foster intellectual curiosity, and increase the knowledge of the student.

The belief that competition encourages future scientists and educates the general public has been cited as a benefit of science fairs. Eyster (1969, p. 174) maintains that the most beneficial result to the student participant in a science fair is an acute awareness of library resources and an exposure to a small part of the vast accumulated knowledge in the scientific literature.

Participation in science contests can be a tool for individualizing instruction. (Starr, 1972, p. 39)

Science fairs may have a positive public relations value in that the displays attract the attention of the parents, press, and general public, and their favorable reactions help build support for the education system and the tax demands that it makes.

The science project also has an appeal to the type of student whose extra curricular interests are not met by other school activities. These students are given the opportunity to investigate their own area of interest.

The actual presentation of the student's investigation gives the student the opportunity to organize and present material for critical evaluation. Then too, the ability to defend research is developed.

As students observe and compare the work of others, thought processes are stimulated. For those who do not win awards, there is something to be learned concerning the acceptance of failure, and the determination to try again is inherent in the scientific process. The value of meeting other contestants and discussing scientific projects outweighs any defeat encountered.

If one is successful, the recognition gained gives the entrant the feeling of accomplishment and worth. The teacher, parents, and

others instrumental in the student's success, share this feeling of accomplishment.

Levels of Competition

In the United States, school fairs may be held for students in kindergarten through grade twelve. The levels may be divided into kindergarten through grade three, grades four through grade six, grade seven through grade nine, and grade ten through grade twelve.

City-wide, district or regional fairs may be divided in this way, but are often divided into upper elementary school, junior high school, and senior high school levels.

In Montana, the state fair is divided into junior high and senior high divisions.

The National Science Fair-International has in the past been limited to grades ten through twelve.

The Anaconda Company's program is divided into two divisions. Grades seven, eight, and nine comprise the junior division, and grades ten, eleven, and twelve constitute the senior division.

Categories of Competition

School, district, state, regional, and national science competition in the past have covered a wide variety of categories. At the national level the categories may be designed to show a biological,

chemical, physical, or technical principle. A laboratory procedure or industrial development is also acceptable.

The Montana State Fair categories in the senior division have included astronomy, meteorology, light, physics-atomic energy, electricity, and magnetism, geology, conservation, wildlife, and forestry, mathematics, medicine, physics-mechanics, heat and sound, and zoology. The junior division of the State Fair has included the biological and physical sciences also.

The Anaconda Company's Scientific Achievement Program lists the categories as the physical sciences or the biological sciences, but it will also accept mathematics and other fields related to pure and applied science. (Anderson, Phone Interview, July 5, 1974)

Judging of Competition

Those sponsoring science competition are responsible for the selection of judges for the event. Committees of scientists, teachers, engineers, and other community experts are invited to judge the projects. Judges are not paid, but housing, food, and travel expenses may be provided.

Standards nationally approved are used, and in the case of the National-Science Fair-International include criteria such as creative ability (30 points), scientific thought (30 points), thoroughness (10 points), skill (10 points), clarity (10 points), and dramatic value (10 points). (Science Service, 1963-64, p. 25)

Judges should adhere to the point score value, but may give greater values to one area and subtract from others. Judges are to judge only what is exhibited and not what might have been improved. Finalists are interviewed before the judges make their final decisions.

The same basic criteria related above is in general applied to other science competition.

Awards

In the simplest of school fairs the awards are varied. When there is no judging and the purpose of exhibit is merely to display the product of stduent efforts, prizes are seldom given. Competition, however, is judged and awards are given. Certificates, ribbons, emblems, and cash prizes may be given with organizations or individuals within the community donating money and awards.

The Montana Science Fair awards have included certificates of participation which are given to each exhibiter. Superior, excellent, good, and honorable mention ribbons are given in each category. Two grand award ribbons and medals are given, and the best girl and boy exhibiters are sent on an all-expense paid trip to the National Science Fair-International. Awards for the purchase of scientific equipment or books of the winners' choices are given to the next two best exhibiters, and community agencies such as the Montana Heart Association, radio stations, encyclopedia publishers, armed forces divisions, and

the National Aeronautics and Space Administration give citations and awards to those students that they feel have the best exhibits in their specifically related areas.

In the National Science Fair-International, each finalist receives a rainbow-ribboned solid silver medal with a solid gold science emblem. Each school from which the finalist came receives a replica medal on a certificate. Other finalists receive "wish awards" of equipment and books pertaining to their particular area of scientific interest.

The Anaconda Company awards are made in the senior and junior divisions. The senior division awards consist of:

1st	$1,000 scholarship
2nd	750 scholarship
3rd	500 scholarship
4th	250 scolarship

The junior division awards consist of:

1st	$100 Savings Bond
2nd	75 Savings Bond
3rd	50 Savings Bond
4th	25 Savings Bond

(Anaconda Company Scholarship Scientific Achievement Program)

Role of the Student in Science Competition

The student should use all resources available at his level of understanding to develop his project and inform himself subject-wise. The student is responsible for actual preparation of his project, but

he should have had experiences provided by his teachers in the process of science. Today's textbooks stress the techniques of inquiry and experimentation, but it is not enough for the student only to have read about experimentation. It is important that he has had experiences in problem solving.

The first step that the student must undertake is to select his project. He may do this by reading books of suggestions, by talking to others, or by expanding on his own ideas or those suggested by the teachers, parents, or friends. Then the student must read widely on his topic and plan his progressive steps. At this time it is important that the student consult with others as they may see a flaw in this planning that was not evident to the student himself. Then the student must plan his investigation to make certain that he has effective controls and that he plans to keep all measurements and data carefully recorded. A written report including pertinent background information whould be done, a hypothesis may be written, and as data is collected, it is recorded. The data may be summarized on graphs, and finally after a reasonable amount of time, the data should be examined, interpreted, and a conclusion formed. Possible new questions and further plans should be included in the report, and a list of references and resource people which helped the student prepare his project should be included. If the student plans to enter his project in an exhibit type of competition, a display must be made in addition to the written

report. Displays must conform to the rules stated in the particular competition. It is extremely important that the project demonstrate the student's level of understanding and that it have a special interest for him. The student must also be aware of the rules of the particular contest that he plans to enter, and all application forms must be thoroughly completed and deadlines met.

Role of the Teacher in Science Competition

The role of the teacher in science competition is varied. It is important that his role include that of being a resource person. Librarians are also helpful people, but the teacher should strive to make students aware of possible interest areas.

Starr (1972, p. 39) suggests that the teacher should (a) compile and post a master list of science fairs and contests, (b) serve as judge to gain expertise in sponsoring student projects, (c) locate and bring together students and potential local sponsors of research projects, (d) encourage student participation by freeing students and permitting individualized independent study, and (e) constantly look for and tell students about researchable problems.

The teacher may find project directors such as volunteer aides within the school or community, as teachers and librarians need not be in charge of all research. Perhaps the most important role that the teacher may play is to teach the process of science as well as the

products of science. The success of students must in someway depend on the willingness of the teacher to take an individual interest and be willing and able to spend the extra time to help with the development of the project.

The teacher may find that the addition of resource people into the classroom will serve as motivation for many student projects. A teacher's role should also include that of making contest rules and information available to students. Proof-reading of reports, especially for elementary and junior high entrants, is an important function of the teacher.

Role of the Parents in Science Competition

Parents have an important role to play when their child is involved in science competition. They must be aware of the rules stating the degree of assistance that they are allowed to give. In most competition the parents may only legally advise and may not assist in the construction of exhibits.

In past national competition, adults were not allowed to assist in setting up exhibits.

Parents might serve as those who stimulate ideas for the student project and then offer assistance only in the form of guidance. They serve best as they encourage their children and guide their children by offering mature insights to problems that their children might

encounter; however, in some competition parent-child cooperation is encouraged.

Role of the Community in Science Competition

People in the community are an important part of science competition. They may serve as judges when invited to do so. Community organizations are of great importance in the sponsoring of students to national competition. Sponsors within the community are always needed to help with awards, project researchers, encouragement, and publicity. Key people in the community will be of service in helping to motivate others like themselves to keep informed of advances in scientific technology.

Criticisms of Science Competition

Because science competition is a human activity, criticisms will no doubt always be a part of it. Starr (1972, p. 39) states that science instructors with a background of courses taught by lecture and "cookbook" laboratory experiments often feel unequipped to sponsor and/or direct student projects. Yet the availability of monetary awards suggests that teachers should not willfully withhold opportunities from students.

The pressure that a teacher may face from various groups which advocate student participation in science fairs is perplexing to many teachers. Some teachers believe that science competition requires

additional time and intellectual and emotional effort and do not feel that they are compensated for this time. These teachers believe that although sports' coaches and other extracurricular acitivity sponsors are perhaps underpaid, they are nevertheless, paid.

To expect teachers to do science fair work for nothing is to support a type of one-sided slavery. (Murphy, 1973, p. 29)

Criticisms that judges are poorly qualified may also be voiced. In addition, the criticism that competition should be avoided because cooperation among scientists should be encouraged is a common complaint. Paldy (1971, p. 427) states that it may be that the competitive aspects of science fairs precludes interactions among children who are working on different projects.

Questions of whether a student's project was actually done by the student or whether a parent, friend, or teacher, was the main participant in the activity may be raised.

Students may be forced into competition, perhaps as a class assignment, and this is seen by some as incompatible with the characteristics of scientific enterprise.

The idea that it is relatively impossible to do an original work and therefore students copy work done before is a criticism. Furthermore, the disappointment of those students who do not win is cited as a poor experience for many children.

It may also be said that the structure of the fair competition may discourage parents from working cooperatively with their children in constructing an experiment and that teachers themselves become too competitive to produce winners.

In reply to most criticisms, those teachers who hold positive feelings for science competition reply that the problem of science competition should not be solved by simply not having the competition. As educators they believe that teachers have an obligation to prepare students to cope with problems, to analyze them, and to attempt to solve them.

Summary

The review of literature has included the history of science competition, defined the types, levels, categories, and awards of science competition, and has described the roles played by the student, teacher, parents, judges, and community. The review has also related the values of science competition and the criticism of it. The review will serve to help the researcher identify factors that cause students to enter or not to enter science competition in Montana.

Chapter III

PROCEDURES

This study will be designed to identify factors which contribute to student participation or nonparticipation in Montana science competition. The factors will be identified by Montana junior high school science teachers or science teachers of grades seven, eight, or nine. The factors will also be identified by the researcher's examination of the records of the Anaconda Company's Scientific Achievement Program.

The purpose of this chapter will be to develop the organizational procedures that will be undertaken to assess the problem. The initial section will describe the population and how the sample will be drawn from it. The categories which will be investigated will be stated. The methods in which the data will be collected and organized will follow, and the hypothesis for statistical questions will be stated. The next section will describe how the data will be analyzed, and the precautions taken for accuracy will be explained. A summary will conclude the chapter.

Population Description and Sampling Procedures

The population of this study will be composed of all Montana junior high science teachers or science teachers of grades seven, eight, or nine who have taught a minimum of two years and who are

teaching full time or part time science classes during the 1974-1975 school year.

A proportional stratified sample will be randomly selected from Class I, II, and III school districts in the state. Equal numbers of teachers in each class will be selected to represent the population. First Class districts are defined as those having populations of 6500 or more and shall be taken from accredited junior high schools. Second Class districts have populations between 1,000 and 6,500 and Third Class districts have less than 1,000 residents. (Montana Education Directory, 1973, p. 11)

Teachers who are selected from the Class I, II, and III schools will also equally represent geographic areas of the state which will be divided into western, eastern, northern, and southern districts according to the divisions found in the 1973 Montana High School Association Official Handbook. (1973-1974, p. 199) (see map in Appendix)

The schools will be listed according to their appropriate city-class, and geographic zone. Then each of the four groups will be serially numbered. A table of random numbers will be used to select the schools from which one hundred teachers will be randomly selected.

Categories

Teacher attitudes toward science competition will be identified in these areas:

1. The teachers' past involvement and anticipated future involvement in science competition.

2. The teachers' perception of the philosophy os science competition.

3. The teachers' views of the values and the negative aspects of science competition.

4. The teachers' attitudes towards the methods of student motivation.

5. The teachers' feelings toward the role that the community, parents, judges, and they themselves play in science competition.

6. The teachers' attitudes toward the time necessary for sponsorship of students in competition and how and if compensation for this time should be provided.

7. The teachers' perception of the role that their teacher education program played in preparing them in this activity.

The researcher will identify the following factors of science competition by examination of the Anaconda Company's records:

1. Trends of recent science competition

2. Characteristics of students and the schools and communities from which they come.

Method of Collecting Data

A survey instrument will be developed after a detailed study of the literature and texts devoted to the construction of questionnaires.

Openheim, 1966 and Shaw and Wright, 1967 are two such texts. This study will enable the researcher to construct an instrument to identify the attitudes of teachers toward science competition and factors leading to student participation or nonparticipation. When the first draft of the survey is completed, it will be submitted to a sample of teachers from Great Falls, to Dr. Worrest, the researcher's advisor, and to Dr. Hess who has offered his opinions. The parts of the survey which are ambiguous will be corrected, and constructive criticism will help improve the form of the questions on the survey.

Cities will be listed according to the previously outlined sampling procedure, and 100 cities will be selected. Questionnaires will be sent to principals who will be asked to relay the questionnaire to a teacher who has a minimum of two years of teaching experience and who has taught full or part time science during the 1974-75 school year. When the name of a teacher in the selected city is available (from information provided by the Science Teaching Assistance Center, Montana State University, Bozeman), the questionnaire will be sent directly to the teacher.

A cover letter will be developed which will explain the nature of the survey and its importance. It will express that the respondent's position as a Montana science teacher is unique and that he alone can provide indispensable information. It will be explained

that the questionnaire will take little time to complete. A follow-up letter will be sent to those who do not respond within two weeks.

The questionnaire will be mailed at an opportune time--not near vacations or close to the end of a quarter or semester. A self-addressed envelope will be included for its return.

Reliability of the instrument will be checked by administering it to the junior high school teachers in Great Falls. This sample will be considered appropriate as teacher backgrounds for this reliability check will be assumed to be representative of science teachers within the state.

The Anaconda Company's records will be examined by the researcher. These will be received from Mr. Gail Anderson who is director of the Anaconda Company's Scientific Achievement Program.

Realizing that years of teaching experience may influence attitudes, only those teachers who have taught two years or more will be surveyed.

The results will describe if the sample taken represents the actual male/female Montana science teacher ratio.

Method of Organizing Data

Data from the survey instrument will be collected and recorded. The attitudes of the respondents will be arranged, and each survey question will be followed by a tally of the responses. Data will be

compiled in the appropriate table, chart, or graphic form. The total percentage of returned questionnaires will be stated as well as those from each of the class-geographic zone groups.

Statistical Hypotheses

Statistical questions stated in Chapter I will be considered as null hypotheses to be tested. An alternative hypothesis will follow each null hypothesis.

1. H_o - There were the same number of students entering the Anaconda Company's fair in 1974 as there had been during the four previous one year periods.

H_1 - There was a significant difference in the number of students entering the Anaconda Company's fair in 1974 when compared with the previous four year periods.

2. H_o - There is no difference in the total number of boys who have entered competition in the last five years when compared with the total number of girls who entered competition during the same time period.

H_1 - There is a significant difference in the number of boys who have entered competition in the last five years when compared with the number of girls.

3. H_o - When compared with numbers of junior high school students of the caucasoid race as listed in the 1970 Census of Population for Montana, there have been equal number of minority races entering competition.

H_1 - When compared with numbers of junior high school students of the caucasoid race in Montana, there is a significant difference in the numbers of minority races entering science competition.

4. H_o - In the past five years, there have been equal proportions of students in the Class I, II, and III school districts entering science competition.

H_1 - In the past five years there has been a significant difference in the number of students from one class when compared with another.

Analysis of Data

Data will be analyzed devoid of emotional appraisal by the researcher. Limitations of data will be accounted for by the reseacher's interpretation of it. All reasonable explanations for particular facts, not just the ones endorsed by the researcher, will be discussed.

Data will be stated for the statistical hypotheses and chi square will be used to measure the discrepancy between the observed and expected frequencies. The value of χ^2 will be examined to

determine if there is evidence for retention or rejection of the null hypotheses at the .05 level of significance.

Precautions Taken for Accuracy

Percentages will be computed with the aid of an electronic calculator. A second individual will be asked to check for errors. Data will be critically examined for flaws; confusion of fact and judgement and conclusions drawn from false assumptions will be corrected.

Summary

To investigate the attitudes of Montana junior high school science teachers toward science competition, a study will be conducted by reviewing the appropriate literature, developing a survey instrument, and testing its reliability. The survey will then be sent to those randomly selected and when returned, the data will be recorded, analyzed, and interpreted. The information will be stated, and respondents who have indicated that they would like a copy of the results will be informed of them in abstract form. The information will be available for the Anaconda Company who has expressed an interest in the results of this investigation. Those who have recently been active as chairmen of the Montana Science Fair will be informed of the results as will those judges who have expressed an interest. Incidental findings will be reported, and the researcher's interpretation

of what the investigation implies for educational practices will be expressed. Previously unconsidered aspects of the problem will be stated and further investigations will be suggested; consequently, those instrumental in designing, conducting, and participating in future science competition will be alerted to the need for necessary change.

Chapter IV

FINDINGS AND INTERPRETATIONS

This chapter reports the findings of a study to identify factors, as seen by Montana junior high science teachers and identified by the researcher, which contribute to student participation or non-participation in Montana science competition. In collecting data for this study, one hundred questionnaires were sent to teachers who had been randomly selected from proportions of Class I, II, and III school districts and who represented the various geographic regions of the state.

The questionnaires were mailed April 19, 1975. By May 5, 1975 81% of the questionnaires had been returned. A follow-up letter to encourage additional response was not sent. The percentage of returned questionnaires from each class-geographic zone have been rounded to the nearest tenth. They are as follows:

	NORTH			SOUTH			EAST			WEST			TOTALS BY CLASS		
	*S	R	%	S	R	%	S	R	%	S	R	%	S	R	%
Class I	8	7	82.5	9	8	88.9	8	6	75.0	8	7	87.5	33	28	84.8
Class II	9	8	88.9	8	6	75.0	8	7	87.5	8	7	87.5	33	28	84.8
Class III	8	8	100	8	6	62.5	9	6	66.7	9	6	66.7	34	25	73.5
Total by zone	25	23	99.0	25	19	76.0	25	19	76.0	25	20	80.0			

*S - Sent
R - Returned
TOTAL QUESTIONNAIRES SENT - 100; RETURNED - 81 = 81%

The questions will be stated, the responses will be related, and any needed interpretation or comment will follow.

QUESTION 1: What grade levels of science do you teach? 7___,8___,9___

RESPONSE:

Grade 7	18.5%
Grade 8	11.1%
Grade 9	8.6%
Grades 7 & 8	33.3%
Grades 7 & 9	2.5%
Grades 8 & 9	4.9%
Grades 7, 8 & 9	17.3%
Grades 7, 8 & 9 plus other academic areas	1.2%
Grades 9 & 10	1.2%
Grades 7, 8, 9, 10, 11, & 12	1.2%

INTERPRETATION:

Sixty-one point eight percent of the teachers teach more than one grade level of science. The largest percentage of teachers (33.3%) teach both levels 7 and 8. Thirty-eight point two percent teach one grade level of science. All Class III teachers, except one, teach more than one grade level of science. One Class III teacher, the exception, teaches one grade level of science but also teaches other subject areas such as English and mathematics. Seventy-five percent of the Class I science teachers teach one grade level of science. Thirty-two point one percent of the Class II teachers teach one grade level. Four percent of the Class III teachers teach one grade level of science.