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ABSTRACT

This guide: (1) discusses why science is basic and considers its relationship to the development of reading and writing skills and the development of language and formal thought; (2) provides a rationale for the educational value of science research projects; (3) presents information to assist teachers in the logical sequencing of students through science projects; (4) provides planning and management guidelines for a successful science day; (5) outlines science day standards for students, judges, teachers, parents, and others planning to conduct science days; (6) reinforces the objectives of the Ohio Academy of Science; and (7) provides (in appendices) 23 outlines, checklists, forms, and sample materials used in developing science projects and science days. The guide is not intended to be read cover to cover at one time. Rather, it is written to be referred to when specific questions come up that need to be answered. (JN)

SCIENCE DAY GUIDE

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FOREWORD

PURPOSES OF THIS GUIDE

This guide is a long overdue revision and expansion of the Academy's Science Day Standards Handbook developed originally in 1966 by the late Karl A. Shumaker. Although all of the information in Shumaker's publication has been included, a significant amount of new material has been added.

This guide will meet several objectives:

1. To provide a rationale for the educational value of science research projects;

2. To assist teachers in the logical sequencing of students through science projects;

3. To provide useful outlines, forms and checklists for developing science projects and science days;

4. To provide planning and management guidelines for a successful science day;

5. To outline Science Day Standards for students, judges, teachers, parents and others planning to conduct science days; and

6. To reinforce the objectives of The Ohio Academy of Science.

WHO SHOULD USE THIS GUIDE?

Anyone who plans to involve students in scientific research projects to be presented at a Local, District or State Science Day should use this guide. While this guide is intended primarily for those wishing to develop or improve student research and Local Science Days, nearly anyone involved with these activities can learn something from this guide. All science day directors should follow the Science Day Standards if their students are going to participate in Local, District and State Science Days under the auspices of The Ohio Academy of Science.

HOW TO USE THIS GUIDE

This guide was not written to be read cover to cover at one time. Rather, it was written to be referred to when specific questions come up that need to be answered. For example, if you have never involved students in scientific research, you'll find many suggestions on how to go about this task. If you've never planned and directed a local science day you'll find out how to do this, and if you need suggestions for recruiting judges, you'll find some direction here too.

The Appendices provide useful checklists and forms. FEEL FREE TO COPY PORTIONS OF THIS GUIDE FOR YOUR LOCAL EDUCATIONAL USE. The only reason this publication is protected by copyright is to prevent commercial exploitation. WE WANT YOU TO COPY IT AS LONG AS YOU GIVE THE ACADEMY CREDIT AS THE SOURCE.

ACKNOWLEDGMENTS

Initial publication of this guide was made possible by a grant from The Standard Oil Company of Ohio. The Academy appreciates SOHIO's interest and support of science days in Ohio.

For nearly a decade various individuals have suggested that the Academy update its Standards Handbook, but nothing happened until Joanne Mann decided to take on this responsibility. During the development of this new publication many people were called upon for help and advice, but no one worked as hard as Mrs. Mann. She brings to this publication many years of success as a director of a local science day and several years of experience as school councilperson from the Central District of The Ohio Junior Academy of Science.

Science educators in Ohio owe Joanne a great deal for her willingness to outline the ways and means to develop successful science days. She is a delight to work with, and I am sure you will find this publication of great help in developing and improving science research projects and local science days.

Mr. Lynn Edward Elfner
Executive Officer
The Ohio Academy of Science
August 1984

INTRODUCTION

GOAL OF EDUCATION

One of the primary goals in science teaching is to develop a student's skill in critical thinking, inquiry and/or problem-solving. A Science Day Program offers each student the opportunity to define a problem and to design an experiment that will attempt to solve or investigate that problem, thus enabling the student to learn through discovery.

> The stumbling way in which even the ablest of the scientists in every generation have had to fight through thickets of erroneous observations, misleading generalizations, inadequate formulations, and unconscious prejudice is rarely appreciated by those who obtain their scientific knowledge from text books.
>
> James Bryant Conant
> Science & Common Sense (1951)

Preparing students for citizen participation in the development of science and technology policy, and the utilization of science in everyday life are worthwhile goals often ignored in school curricula which are achieved through a student research program.

ABOUT THE ACADEMY

The Ohio Academy of Science is a nonprofit membership organization founded in 1891 to stimulate interest in the sciences, to promote research, to improve instruction in the sciences, to disseminate scientific knowledge, and to recognize high achievements in attaining these objectives. Anyone interested in science may join. Recognized as the common meeting ground of the scientific activities of the State, the Academy publishes The Ohio Journal of Science, promotes youth science opportunities through The Ohio Junior Academy of Science, and conducts an annual meeting with presentations in nearly 20 fields of science.

THE OHIO JUNIOR ACADEMY OF SCIENCE

The Academy maintains the Junior Academy in order to discover and foster interest in science among junior and senior high school students. The Junior Academy Director serves as a member of the Academy's Executive Committee and as Chairperson of the Junior Academy Council -- the governing body for the Junior

Academy. Each of the several colleges and universities in multi-county districts have representatives who serve on the Junior Academy Council. District level councils select a school representative to the Junior Academy Council too.

The objectives of the Junior Academy are:

1. to provide an opportunity for students in public, private and parochial schools of Ohio to demonstrate their abilities and interest in science;

2. to encourage students to carry on individual research problems which are within their capabilities, and to provide these students with an opportunity to present the results of their research for evaluation;

3. to inform students about opportunities in science, and to encourage their entry into science related professions;

4. to promote excellence in high school science programs;

5. to recognize ability in the teaching of science in elementary and secondary schools; and

6. to generate public interest in science.

Science days provide the first step on the ladder to success for many students. Many youth science opportunities are available through The Ohio Junior Academy of Science, including:

1. Local, District and State science days
2. Buckeye Science and Engineering Fair
3. Ohio Westinghouse Science Talent Search
4. Junior Academy Section Annual Meeting
5. The American Junior Academy of Science
6. Ohio Student Research Grants Program
7. The Ohio Journal of Science
8. Junior Academy Section Membership

The relationship between these and other youth science opportunities is shown in the Appendix. All of these activities have one thing in common:

a carefully planned and well researched science project.

SCIENCE IS BASIC

There is a need for more students to become knowledgeable in science to meet demands of our technological society. However, many professionals and parents view science as an "extra", or a course to be taken only by the "gifted" students who will choose to specialize in a science field. It is this fallacy that needs to be discussed.

A creative science program offers much to many. It is for all students. Not only do students learn the principles and concepts of science, but they also develop skills in other curriculum areas, such as reading, language, and writing.

DEVELOPMENT OF READING SKILLS

Reading skills, foremost in importance, can be enhanced through a science program. Learning to read successfully requires a student to distinguish sounds (auditory discrimination), and objects or symbols (visual discrimination), to possess a vocabulary of spoken words (language preparedness), and to develop background experience which will add meaning to what is read. Early science activities provide the student with all these skills. Teachers include fact gathering, interpreting the story, predicting events, grouping vocabulary words, characters, etc., in their reading program, using unrelated stories as a context. Learning science process skills would accomplish goals for both disciplines by providing a meaningful context to stimulate the student's learning experience.

Science process skills such as observing - (using all the senses to describe an object, event, phenomenon); inferring - (to logically deduce beyond data given); interpreting data - (finding relationships, patterns, trends in the data collected); drawing conclusions - (reasonable judgments based on data), are directly related to the reading comprehension skills considered vital to the student's education. A glance at almost any reading workbook would provide a similar listing — getting the main idea, gathering and interpreting data, evaluating and drawing conclusions. Thus, science activities not only aid in students' literacy of science, but also in their ability to read.

LANGUAGE DEVELOPMENT

An inquiry-oriented science program is a means to language development. In this setting, when students are confronted with a problem or situation, they sort out factors and ask questions. They discuss the type of investigative procedure that would help answer their question and set up their experiment. Students may then use the data they collect to draw conclusions and make inferences or predictions. This experience can be communicated to others. Students will share their investigative procedure and results, and thus gain in developing functional language skills (following directions, communicating results).

DEVELOPMENT OF LOGICAL, FORMAL THOUGHT

Certain educational experiences are necessary to develop logical, formal thought and critical thinking (problem-solving). Science provides an ideal context. It is important throughout life to be able to identify factors influencing a situation or problem and study the effects. Making deductions from hypotheses is also important in thought development. Science activities involving investigations enable students to suggest a solution to the problem and then set up an experiment to test the validity of their suggestion. Students may find it necessary to consider other variables and design a new experiment. Predicting outcomes and estimating results are also valuable thought processes enhanced by a strong science program.

DEVELOPMENT OF WRITING SKILLS

Writing cannot be overemphasized in any of the disciplines. Students need to be taught the importance of written communication in science research, in reporting experimental data, and in writing proposals and abstracts. After discussing the why of writing, students must be taught the how. An interdisciplinary approach with the English and science teachers working together will promote the importance of writing. Students may begin the year by writing daily logs concerning their experiments followed by more in-depth writing of a research plan or proposal, experimental reports, and science abstracts. An experimental report should include:

1. Abstract

2. Statement of the problem/question being investigated.

3. Review of relevant literature

4. Statement of the hypothesis being tested.

5. Description of the design and procedures of the investigation.

6. Report of data after conducting the experiment (tables and graphs).

7. Statement of the relationship observed between the variables.

8. Comparison of the finding with the hypothesis (supports or refutes).

Science research reports should be an integral part of the science program. Skills in note taking, outlining, researching a topic, gathering and analyzing experimental data and compiling references will be necessary to complete an in-depth study of a problem.

A science abstract should be a summary of all aspects of the investigation and should not exceed 250 words. It is written after the completion of the experiment and research report.

See Appendix for samples of title page, contents page, abstract, and references.

EDUCATIONAL VALUE OF INDIVIDUAL SCIENCE PROJECTS

FOR ALL STUDENTS

Most would agree that the gifted and above average students should be involved in science. These students require the challenge, have the skills to grasp science concepts, and may consider a science career.

Students of lower academic ability are often said to need more work and practice in the "basics" and, therefore, are not always given the opportunity to become involved in the science curriculum. Research suggests, however, that this group may benefit most from an early exposure to an activity-based science program. Studies have demonstrated that such a program will help overcome other barriers, such as socioeconomic status and handicaps. These students have been found to ask a variety of thought-provoking questions, to have high curiosity levels, and to possess positive attitudes.

The obvious majority — the "average" — are given opportunities to learn science mostly from a textbook orientation and often are not expected to complete creative investigations. Research suggests that individual performance can be increased tremendously through conducting scientific investigations depending on the student's motivation and aspiration to achieve.

All students, regardless of any academic standing or handicap, should be given the opportunity to study science, thus enhancing their individual development and their place in society.

RELATES TO EVERYDAY LIFE

It is important that students have a positive attitude toward science and the facts, concepts, processes, and skills that are being taught. Students often want to know why it is necessary for them to study science and of what use it will be to them currently and in the future. Teachers should discuss the relevance of science to everyday living. Discussions, debates, and demonstrations may be used to have students generate the personal use of science in day to day living. Today's public policy issues such as population, health care, pollution, and energy, must be understood by all citizens in order for them to make the necessary decisions as individuals and as voters.

Scientists can provide the technical knowledge and make recommendations, but members of society must evaluate the consequences.

ENABLES STUDENTS TO BECOME SCIENTIFICALLY LITERATE

Because scientific knowledge is constantly changing, it is necessary to teach the development of processes, attitudes, concepts, and principles. Students possessing these skills will be able to apply them in decision-making and problem-solving.

Stressing the value of continuous questioning, verification of data, respect for logic, and consideration of consequences is imperative in educating students for their role in a democratic society.

It is important that students participate intelligently in decisions regarding critical science-related societal issues such as the environment, population, and technology. Thus, one of our goals must be to make all students scientifically literate.

INSTILLS CONFIDENCE IN STUDENTS' OWN ABILITY

One has only to visit a classroom of students working on science investigations to realize one of the most fantastic benefits of science inquiry -- that of building a student's self-confidence. Students will be able to communicate the problem, procedures, and results of their experiments. They will have constructed graphs to illustrate the data they collected and, of most importance, they will be able to state their conclusions based on their own findings. Knowing because they discovered it to be true has a greater impact and is retained longer than knowing because they were told or read it in a text.

PROMOTES CREATIVITY

Creativity has been defined as the recombining of known things to make something new. Science activities provide the content and the opportunity to promote this endeavor.

DEVELOPS LANGUAGE AND READING SKILLS

The development of both language and reading skills has been discussed previously. Science provides a unique environment for students to actively participate in project investigations. Students enjoy the "doing" of science, as well as the sharing of their findings. Language development occurs more rapidly in the context of meaningful activities. The opportunities to express their thoughts in both verbal and written form are extensive. Science assists in the teaching of reading from preschool to high school by reinforcing auditory and visual discrimination, vocabulary development, and oral and written comprehension.

PROVIDES OPPORTUNITY FOR RIGHT BRAIN TASKS

Hemispheric brain functioning emphasizes differences in processing. For most people auditory, visual and tactile information that is linguistic in nature are processed in the left hemisphere. The right hemisphere primarily processes visual-spatial, synthetical and non-linguistic materials. Complex thinking involves both hemispheres on either verbal or non-verbal tasks.

Studies of hemispheric brain functioning imply that a school program restricted to a left brain approach to reading, writing, and arithmetic will educate only one hemisphere. An activity-oriented "hands on" science program provides opportunity for right brain tasks. Science investigations require critical thinking and problem solving which offer integrated experiences for more meaningful learning as implied in the hemispheric model.

OUTLINE OF A SCIENCE DAY PROGRAM

I. OBJECTIVES

A. To enable students to work toward maximizing individual potentials

B. To enable students to improve their self-concept - feeling a sense of accomplishment - success in completion

C. To enable students to become more aware of current issues in science

D. To give students the opportunity to participate in various programs offered through The Ohio Academy of Science

1. Local, District and State Science Days
2. Ohio Westinghouse Science Talent Search
3. Junior Academy Section Annual Meeting
4. The American Junior Academy of Science
5. Ohio Student Research Grants Program
6. Ohio Journal of Science
7. Junior Academy Section Membership

E. To enhance other curriculum areas

1. Strengthen processes of reading
2. Develop research skills
3. Maximize communication skills (verbal & written)
4. Extend language and logic development
   a. Independent, critical thinking
   b. Multiple interpretation of data

II. PROJECT COMPONENTS:

A. An identified problem/question in which the student has designed an experiment to test his/her hypothesis

B. A detailed research report

1. Title page
2. Table of contents
3. Abstract - maximum of 250 words
4. Introduction - (problem and hypothesis to be investigated)
5. Methods and materials used to study problem
6. Analysis of collected data to infer results
7. Conclusions and implications for further research.
8. Graphs, tables, diagrams to illustrate

investigation
9. References

C. A physical display

1. A poster display of 3-6 posters - totally self-supporting
2. Exhibit tables, diagrams, graphs, models, etc.
3. Dimension - 36" wide x 30" deep and a maximum of 7 ft. from floor
4. Posters should be printed - neatly with correct spelling

D. An oral presentation

Students should use note cards if necessary rather than memorization to prepare an explanation of their investigations. Background information, methods used, data collected, and all visuals should be discussed. Cards are to be used for reference and are not to be read to judges.

III. IMPLEMENTATION

A. Preparing Students
1. Class Investigation
2. Time Schedule
3. Identifying a Problem
4. Stating a Hypothesis
5. Locating Information
6. Collecting and Organizing Data
7. Analyzing and Interpreting Results
8. Research Report Content
9. Display
10. Oral Presentation
11. Checklist

B. Planning and Management of Science Day

1. Set Date and Location
2. Coordinating Volunteers
3. Acquiring Support
4. Schedule
5. Recruiting and Instructing Judges
6. Entry Forms
7. Program
8. Floor Plan
9. Name Tags
10. Tally Room
11. Supplies
12. Awards
13. Awards Ceremony
14. Publicity
15. Judges' Folders

IMPLEMENTATION OF A SCIENCE DAY PROGRAM - PREPARING STUDENTS

Science teachers are usually the directors in charge of the program. They are responsible for the organizational aspects of a school Science Day and are primarily involved with advising students throughout their project work. After deciding on a Science Day Program, teachers should contact The Ohio Academy of Science and their district council persons to obtain materials and dates of the District and State Science Days. The local Science Day should be scheduled at least two weeks before District to meet entry requirements.

CLASS INVESTIGATION

Teachers advising for ~~the first time~~ may wish to follow this Class Investigation plan. (A student guide sheet is in the Appendix for students able to work independently on projects).

1. Acquaint students with project work by showing tape and slide presentations, or by simple demonstration using posters and pictures of previous science projects. Visual displays will give students an overview of project components and expectations. Students should be provided with a project component listing. (See Appendix).

2. The entire class should be involved in at least one investigation prior to the selection of their project. Some Science Days are criticized for displaying projects that are not scientific — those that are reports about a topic rather than investigations of a problem. Students who have been involved with experimentation will be knowledgeable concerning the need to define a problem and suggest a procedure to test their hypothesis. A simple investigation that may be used with the entire class is that involving cereal color and birds (See Appendix). It is recommended that the entire class complete the same experiment to enable participation of all students in the discussion of variables, controls, validity, reliability, etc.

3. A second activity may help to initiate appropriate questions for science investigations. Students should be in a lab team of two or more, be given science topics, and, as an assignment, write possible questions or problems that may be investigated. For example, using the topic of plant growth, students may suggest investigating the effect of light, temperature, soil type, water, or minerals on the growth of a plant. A class follow-up discussion of the suggested problems of each lab team and the workability of each should be implemented. One of the suggested problems should then

be selected and the scientific methodology that would be necessary to complete an investigation should be discussed (See Appendix).

Continually stress the importance of a scientific method approach in solving a problem. Present and discuss as many investigations as possible to emphasize the importance of producing investigative rather than report projects.

Students may need guidance in narrowing their project topic (See Appendix), choosing a research problem, locating information, collecting and organizing data, analyzing and interpreting results, designing their equipment or physical display, and/or the technical writing of the research paper. The teacher/director may assist students in all of these areas as necessary without actually doing any project work. Students may also be referred to experts in their chosen fields.

TIME SCHEDULE CHECKLIST

A time schedule is very important to the inexperienced project worker, (See Appendix). Teachers should announce the project completion date and suggest reasonable check points to insure individual compliance. Also necessary for the teacher having several classes involved in project work is a check sheet (See Appendix) for each student on which will be noted each time the teacher and student meet to discuss project progress. This enables a teacher not only to know at any given time what each student is working on, but also to monitor progress in outlining, note taking, location of references experimental data, etc. This listing will aid in parent conferences and in determining the degree of pupil involvement in the projects.

IDENTIFYING A PROBLEM

Identifying a problem to study is often the most difficult aspect of a science research study. After a student has been given an overview of what is expected <u>and</u> the criteria that will be used to evaluate his/her work, the student is ready to assess his/her own goals and objectives and choose an investigation that will meet these priorities. Students should consider hobbies, special interests, and current societal issues. Several sources of ideas should be available for inspection.

When formulating the question/problem, the student must consider: a) the type of information that will be necessary to collect (facts, attitudes, skills), b) how the data will be collected (experimentation, survey, collection comparison), and c) from whom the data will be collected (random choices must be used to keep prejudices from affecting the results).

STATING A HYPOTHESIS

The hypothesis should state precisely what will be tested. A hypothesis is a tentative explanation made to test ideas. It guides investigations to answer the questions. Students should consider realistic implementation of the experiment. Design of the investigation and the statistical treatment should be considered simultaneously. Questions such as how the data will be analyzed and evaluated need to be answered. A representative number of subjects are necessary to generalize to the larger group that the sample is intended to represent. The validity of the experiment should be addressed — did the experiment test the stated hypothesis? Students may also consider the reliability of their results. Possible replication of the original experiment may be used to determine the consistency of the results.

LOCATING INFORMATION

Once the students have identified the problem they wish to research, a review of the literature on that topic is necessary. Most students need direction as to the various types of reference material available. Students will have to be reminded of the importance of current writings from science periodicals. Minimum numbers of references should be designated. Proper style is essential. Locating information will be expedited if students' library skills are reviewed, and school librarians are versed as to the requirements for the research study. Direct interviews, filmstrips, visitations, and written correspondence should be encouraged as a means of gathering information (See Appendix).

COLLECTING AND ORGANIZING DATA

Students need guidelines for collecting and organizing data. An outline that may assist them follows:

A. Determine the kinds of information needed to test the hypothesis.

   1. Attitudes
   2. Facts
   3. Skills

B. Discuss methods and procedures that will be used to collect data (including but not limited to):

   1. Simple controlled experiment - an experiment in which there is only one group or subject that gets the experimental treatment. The control, another group or subject, does not get the experimental treatment but is otherwise treated the same.

2. Counter balancing or crossover design experiment - an experiment which is done twice with the same subjects. The second time, the groups are "crossed over" - thus, the control becomes the experimental, and the experimental becomes the control.

3. Blind and double-blind experiment - In a blind experiment, the subject, although being knowledgeable about the experiment, does not know if he/she is a part of the control group or experimental group. In a double-blind experiment, both the experimenter and the subjects are uninformed as to which group received the treatment.

4. Scientific observation

   a. Case study - the detailed observation or study of an individual or event

   b. Anecdotal record - one's personal experience given as a story (lesser quality scientific evidence)

   c. Naturalistic observation - observing a natural situation (people, animals, societies, etc.,) with the least amount of disturbance to the subjects

5. Survey - a sampling of opinions or collection of data from a designated group (people, plants, animals, minerals, etc.)

C. List and locate materials that are necessary to complete the experiment.

D. Keep a detailed written diary or log book of all observations, findings, procedures, etc., or dictate information into a tape recorder for later transcription. Be sure to date the records, indicating time if applicable.

Thoughts concerning the investigation should be included. Important details become vague after awhile and items not initially considered important may later be an answer for further questions.

E. Use several methods of organizing data.

1. Tables
2. Graphs
3. Diagrams
4. Charts

It is necessary that a complete, accurate description of the experiment be given for replication purposes.

ANALYZING AND INTERPRETING RESULTS

Student guidelines for analyzing and interpreting results of a study are also necessary. There are several questions to be considered.

A. Using the tables, charts, graphs, and diagrams prepared from written observation - what is the relationship between variables?

B. Consider the sampling used - is it representative of the larger group for which it is being generalized?

C. Did the results answer the original question?

D. Was the experiment a reliable test of the hypothesis?

E. Will the same results occur if the experiment is replicated?

F. Complete Statistical Analysis

Some type of statistical comparison should be completed to indicate significant findings. Simple forms might include: 1) ranking the measurements of specimen and comparing pairs or groups, 2) finding the arithmetic means (averages) of control and experimental groups and comparing the mean difference.

RESEARCH REPORT CONTENT

The research report should include:

A. Abstract

Students must summarize the investigation in a maximum of 250 words. Writing should be concise, accurate, and complete (See Appendix).

B. Literature Search

1. Background Information

2. Studies involving similar problems, methods, or instrumentation

C. Scientific Methodology (Technical Discussion)

1. The problem/question to be investigated

2. The statement to be tested - hypothesis

3. The methods, procedures and materials used during the investigation

4. The data collected
   a. Presentation and analysis of data
      1. Tables
      2. Figures
         a. Graphs
         b. Diagrams
         c. Charts
         d. Maps
         e. Photographs

5. The significance of the results - generalization and conclusions

6. Questions for further study

Tables should be on separate pages with data arranged so that the columns of like material read down. Figures include graphs, pictures, drawings, maps, etc. Tables and figures are numbered independently of each other.

A complete report will also include a Title Page, a Table of Contents, and a list of References (See Appendix for samples). It should be noted that the title should include the variable to be measured and the specific organism or condition to be investigated. For example, "Acid Rain" in an unacceptable title whereas "The Effect of Acid Rain on the Growth of Spirulina Algae" is acceptable. Scientific papers do not use a table of contents when published. However, it is suggested that the in-depth research report include a table of contents to assist with the organization and development of a logical progression. References should be listed in a standard format alphabetically by author's last name.

DISPLAY

Students should participate in several workshops given by teachers or experienced students dealing with display preparation. Instructions as to the construction of accurate graphs, tables, and diagrams are extremely important. Sessions that involve evaluating posters are valuable in giving students an opportunity to view and discuss the use of stencils, markers, color, etc. Accuracy of displayed information is most important. The display should represent the sequence of the project and be a concise representation of the experiment (see appendix).

ORAL PRESENTATION

Students are responsible for reporting all of the findings made during their investigation devoid of any prejudice or preconceived notions. The diary or log book previously mentioned is of primary importance. Keeping it in its original form (not copied) can contribute information experienced and noted that at the time seemed irrevelant, but is later viewed as significant. Students should be knowledgeable concerning the research aspects of their study as presented in their written paper, the scientific methodology of their investigation, and all data and vocabulary used on their display.

Students will find that communicating their results in an organized manner (chronological, graphing, etc.) and using all available visuals to assist them will lead to a comprehensive overview of their investigation.

CHECKLIST

Student confidence in communicating their research study results will be enhanced by following these do's:

1. Do have a complete scientific study of a question: cite problem, hypothesis, procedure, and results to demonstrate use of a scientific method approach.
2. Do have accurate written data collected to be referred to or inspected.
3. Do have data summarized in tables, charts, and graphs for easy reference in showing relationships.
4. Do have reference to the sampling and validity of the study to demonstrate knowledge of such factors and their impacts.
5. Do have some statistical analysis when referring to results or outcomes being significant.
6. Do offer some conclusions resulting from your study being careful not to overgeneralize your outcomes.
7. Do consider further questions to be investigated generated by your investigation.
8. Do have a good, basic knowledge of the theories and principles in the field of science in which you have completed your investigation.
9. Do consider revisions that may improve your study.
10. Do practice your presentation in a logical sequence.
11. Do be confident and proud of your accomplishments!

IMPLEMENTATION OF A SCIENCE DAY PROGRAM - PLANNING AND MANAGEMENT

Once the students are working independently, the director must address the second major task -- that of Local Science Day planning and management. A suggested time line for the director is available in the Appendix. The following guidelines may be followed to insure completion.

SET DATE AND LOCATION

The date and place of the event should be cleared with school administration and announced to staff and students as soon as possible. Set date at least two weeks prior to District Science Day.

COORDINATE VOLUNTEERS

Meet with fellow teachers who will be involved and discuss the program to be offered. It is important that constant communication is maintained throughout the several months leading into the actual date.

ACQUIRE SUPPORT

Initiate support from parent and community organizations. Supply background information concerning project work and specific ways that they can be involved: a) various tasks during Science Day, b) purchase of certificates and other awards, c) recommending and recruiting qualified judges, d) typing. Here again, a successful program is a cooperative effort — keep everyone informed.

SCHEDULE

The day's schedule must be posted well in advance in all science rooms, student bulletin boards, and office. Being considerate of the staffs' and students' other responsibilities will ensure positive relationships and a successful day. This schedule should be included in the letter sent to judges; therefore, it should be finalized and accepted two months prior to Science Day. (See Appendix)

RECRUIT AND INSTRUCT JUDGES

The major management task of the director is that of acquiring qualified judges. A first step is to begin a listing of possible candidates that includes their address, phone number, science area, and a column for comments. The first group to contact is the administrative office personnel (Superintendent, Assistant Superintendent, curriculum supervisors, school board members, school nurses, etc.). Next, ask teachers and principals from other schools in the area. (It is best not to involve any faculty who have direct contact with the participating students). Consider the community. Contact persons in the medical fields (veterinarians, optometrists, dental hygienists, pharmacists, lab technicians), in industry, in colleges, in universities, in vocational and technical schools, in senior citizen groups, in professional societies, and in local government (Appendix). When determining the number of judges to be invited, consider the number of projects to be available for this task. Judges should spend a minimum of ten minutes with each student and should not be expected to judge more than seven projects.

When calling potential judges, it is necessary to mention the date and time involved. First, a full explanation of the program will often be necessary unless the candidate has judged at other Science Days. Therefore, be sure to mention that the criteria and ratings being implemented are those recommended by The Ohio Academy of Science. Most apprehension can be eliminated if the phone call is followed up by a letter that includes: 1) the schedule, 2) procedures, 3) map of school location, 4) the judging criteria and, 5) a sample judging card. The director should include a phone number that judges may call for additional information.

The responsibility of acquiring qualified judges cannot be overstated. Students have worked months in preparing for this event and it is most important that they go home satisfied that they were evaluated by a professional in the field. It is recommended that careful consideration be given to parent involvement in the judging process. Certainly the individual, the number of participants, the science field, and the availability of candidates all have to be considered. However, the utmost professionalism must endure throughout the day.

To ensure that judges understand the four criteria to be evaluated, to meet with the judges before they proceed to interview students. During this session, quickly cover the program objectives and what is expected of each participant. <u>Be sure to mention that particular projects are to be evaluated by being compared to the criteria as stated in the Standards for Science Day (not one project versus another)</u>. Ask colleagues to review the project cards and exchange any cards as deemed necessary due to knowing the students, or having a project that is out of their field of study. Using the guide sheet sent to judges previously, discuss the criteria and answer any questions. <u>Always</u> give judges the flexibility to return a judging card or to request a second opinion on a project (See Appendix).

ENTRY FORM

An entry form that includes the student's name, grade, homeroom, project category, and project hypothesis will be useful throughout the Science Day preparation. Be sure to set a due date being both fair and firm in adhering to all stated rules and dates. Students must accept the responsibilities involved with being a Science Day participant. Arrange the entries in alphabetical order according to categories (See Appendix).

PROGRAM

A program of student names and project titles or categories is a nice keepsake for parents, and students find it rewarding just seeing their name in print. It also affords the director an opportunity to formally thank those who sponsored various aspects of the Science Day. Using the alphabetically arranged entry forms, an accurate listing of participating students can be easily acquired.

FLOOR PLAN

A floor plan should be designed to help organize the event. Grouping projects according to category will assist judges in locating exhibits. State standards specify a three foot (wide) space not to exceed seven feet in height from the floor per display. A card table works well if other tables are not available. Aisles should be as wide as possible to enable judges and guests to easily view projects. Space assignments (exhibit number) and table arrangements should be made well in advance.

NAME TAGS

Name tags for participants, judges, runners, and other staff are essential. The stick-on variety are easiest: the name of the participant, space number, and homeroom can be printed from the information on the entry forms. Distribute these prior to having students set up projects so they can be easily identified at all times.

TALLY ROOM

Selection and supervision of the staff working in the tallying room is also the director's responsibility. A professional atmosphere must prevail at all times. There should be no discussion of students personally or of judges or of the evaluations themselves. Only designated staff should be allowed in this room during the actual tallying of cards. As student judging cards are returned, they must be matched (if two evaluations were completed), the scores should be checked and averaged with a final rating assigned. Blue, red, green and black crayon marks corresponding to the ratings are often used to expedite the process. The certificate is then located and the proper seal is attached. The rating is stamped or handwritten. If ribbons and/or other awards are given, student names and other information can be added at this time. (See Appendix)

SUPPLIES

Judging cards, certificates, and seals may be purchased from The Ohio Academy of Science, 445 King Ave., Columbus, Ohio, phone #(614) 424-6045. It is strongly suggested that the judging criteria indicated on these cards be used at the local level with adherence to the minimum number of points necessary for earning each rating. Students are misled and may experience difficulty at district level of competition if other criteria and standards are used at the local level. Students will recognize the judging cards to be the same at the local, district, and state levels (only a color difference exists) when materials are acquired through the Academy. Order supplies six weeks in advance of your science day.

AWARDS

Ribbon and/or trophy selection should be discussed with appropriate staff and ordered well in advance of the event (2 months). Students tend to "let down", become discouraged, and tired, three to four weeks before the Science Day. It is a real incentive to create a school display of the awards to be presented along with newspaper articles and pictures of previous Science Days.

AWARD CEREMONY

The presentation of awards should be a special portion of the Science Day. All students deserve to be recognized for their project work regardless of the rating earned. It is recommended that certificates be awarded to all participants, and ribbons, medals, and/or trophies at the discretion of the director. An awards program is more effective when carefully planned and conducted in the presence of peers, as well as parents. Students earning positions at district and state levels of competition should be noted.

SPECIAL AWARDS

Many professional societies, industries, colleges, universities, and government agencies demonstrate their interest in student research by offering a variety of awards at Local, District and State Science Days. These organizations develop their own criteria and present their awards to the students they evaluate as exemplifying their objectives.

PUBLICITY

Publicity is essential for increasing community support and obtaining recognition for participating students. Be sure to call local radio, TV, and newspapers in advance to ensure their promotion of the event (See Appendix for sample news release).

JUDGES' FOLDERS

Prepare a folder for each judge. Judges' folders should include: 1) the projects assigned (according to expertise), 2) schedule of the day, 3) map of the floor design, 4) judging criteria with explanation sheet, and 5) thank you letter. The folders can be assembled in advance. On Science Day, place folders on a table in alphabetical order with the name tags on the outer cover. The judges will be given their folders as they arrive, thus giving them an opportunity to review the criteria and the projects they will evaluate. Adjustments can be made by the director for those judges not in attendance (remaining folders).

OHIO ACADEMY OF SCIENCE STANDARDS

INSTRUCTIONS TO PARTICIPANTS

Participation in a Science Day can be a rewarding experience. It offers young people an opportunity to learn and practice the principles of scientific research, an opportunity to meet others interested in science study, and a chance to earn recognition for academic excellence. Thus, those involved should not be limited to the gifted, although all should be made aware of the long and tedious work involved in science investigation. Accurate prediction of a student's potential is impossible until he/she has attempted a project a number of times. Most will not achieve perfection on the first attempt, but proficiency will come to those who are persistent.

1. Participants in Local, District, and State Science Days may be in grades 7 through 12. They must earn a superior rating (36-40 points) to submit their projects to the next-in-line Science Day. District and State Science Days operate on quota systems that may further limit participation.

2. Although projects entered in a Science Day activity must be researched and developed by the participant alone, the Academy encourages the use of advisors or mentors.

3. Projects must provide adequate sampling. This requires a great deal of time and a number of trials. Due to the nature of projects, it is not possible to state minimums. Consult your advisor or teacher for further information.

4. Each project must include a research report covering in detail all of the work, references consulted, and acknowledgment of assistance received. The experimental data, statistics, notes, and computations should be recorded in logs or record books. Only a description of the work, the results, and the conclusions need be included in the report. This report should follow an accepted form of technical reporting and be carefully checked for correct punctuation, spelling, and grammar. If possible, the report should contain illustrations in the form of photographs, sketches, graphs, or charts that contribute to the effectiveness of the material presented.

5. An abstract of fifty words or less giving a brief description of the project must be prepared and displayed with the project. The abstract bears the title of the project, the name, grade level, and school of the participant. A more extensive abstract should be included in the project report (See Appendix).

6. The participant is required to give a clear and concise oral presentation of his project, to answer questions, and to

define any terms used. This brief oral presentation should completely summarize the project. The quantity and quality of knowledge attained will be evaluated by this speech. If a question is not clear, the participant should ask the judge to rephrase it. <u>One should not attempt to memorize a formal speech.</u>

7. Physical displays are to occupy a space not more than 36" wide 30" deep. The height should not be greater than may be easily viewed above normal table height. The top of the display should not be more than seven feet above floor level. Those projects which must involve floor-standing elements must not extend beyond the three foot wide limits of the standard space allowance. Extension of a project beyond the stated limits may result in disqualification.

8. The use of "kit" models is discouraged. Such models may be used when they make a definite contribution to the research approach to the problem and are not the principle element of the display. Models made by students are preferred since they have a much greater instructional value and demonstrate that the participant has had a proportional gain in knowledge.

9. Use commercial equipment when it would be impossible to conduct the research without it. However, if such equipment is used, the participant must be prepared to describe its operation and function.

10. Displays and demonstration equipment should be neat, attractive, and stable. Refrain from using string, wire, tape, flimsy construction materials or props. Plywood, pegboard, or masonite, for example, joined together securely makes a rigid support for the display. Avoid the use of small print, indefinite colors, and crowded elements. These detract from the effectiveness of the project. A malfunctioning or non-functioning apparatus is not only of little value, but may even result in the downgrading of an otherwise good project.

11. Trick, pet, or comic names for experimental animals or specimens should not be used.

12. Project displays shall not involve materials or elements which might be dangerous to onlookers. Explosives, toxic elements, injurious chemicals or gases, open flames, or any unprotected moving parts, etc., may be necessary in the research project, but the experimenter should always exercise the greatest care and conduct these phases of his work under qualified supervision. Plastic laboratory ware should be substituted for glassware whenever possible as there is always the danger of breakage.

13. Teachers, other professionals, scientific organizations, industries, and parents can and will give much valuable aid

if the request is made in the proper way. Courtesy and consideration coupled with sincere expressions of appreciation will eliminate many of the rough spots for a young scientist. Remember, others may advise and give aid, but they must not do any work for the participant.

14. It is not recommended that students engage in group projects since such projects cannot be submitted in District or State Science Day activities.

15. Any individual project can be used for only one year; it must not be repeated nor given to another person to represent his/her work. Some projects are of a continuous nature in that they involve continued exploration of a particular area of science from year to year. However, the projects of this type submitted for evaluation must involve new material each year both in the report and the physical apparatus.

16. Students must adhere to the rules for the use of animals as adopted by the Ohio Junior Academy Council.

INSTRUCTIONS TO JUDGES

The attitudes and conduct of the judges determine the success of any Science Day activity. Therefore, it is vital that each judge understands thoroughly his/her duties and obligations. He/she should also have knowledge of all the requirements of the participants. All judges need to have a genuine interest in young people combined with a desire to offer encouragement and guidance in their efforts to pursue learning in the various fields of science.

1. It is recommended that students have an opportunity to present their project to two professionals, at least one of which should be from education. This may be achieved as a team or individually, with the scores being averaged.

2. Judges should introduce themselves upon approaching a student and attempt to establish a friendly rapport to help reduce the participant's tension.

3. The participant should first be asked to give his/her oral presentation of the project and then to answer questions about his/her work on the specific problem. It is also proper to ask questions within the discipline or subject matter involved at the student's level of learning.

4. The participant should be put at ease, especially one who appears nervous during questioning. Judges should take an active part in the evaluation; silence may be interpreted as disinterest or boredom which can have a very discouraging effect on the participant.

5. Judges should feel free to question the participant on the

materials and tools used, the methods of construction, terms used, the sources of information, and the amount and type of assistance enlisted in the preparation of the project.

6. Judges are required to check through the abstract and research paper to determine their quality, spot errors in spelling and grammar, and word-for-word copying. A check of the references will assist in making a fair determination of the scope and depth of the literature research.

7. Judges should determine the span of sustained interest in the particular field of science, as well as the approximate amount of time spent in developing the project being evaluated. Some premium should be granted for considerably extended interest and effort to encourage this quality of persistance.

8. Judges should note the number of subjects or specimen used. Is the number adequate to generalize to the larger group that the sample is intended to represent?

9. Grade level of the student should be considered.

10. Discussion and final scoring of the project should be at a considerable distance from the participant, since disclosure of scores is delayed until judging is completed. Do not hurry a judgment. If judging in pairs, make sure of agreement on each point. Comments indicating reasons for the rating may be written on the score card to be given subsequently to the student. If a team of judges or an individual judge does not feel adequate or competent to judge a project, another judge should be asked to share in the evaluation, or another team or judge should be assigned.

JUDGING CRITERIA

	SUPERIOR	EXCELLENT	GOOD	SATISFACTORY
KNOWLEDGE ACHIEVED	10-9	8-7-6	5-4-3	2-1
EFFECTIVE USE OF SCIENTIFIC METHOD	10-9	8-7-6	5-4-3	2-1
CLARITY OF EXPRESSION	10-9	8-7-6	5-4-3	2-1
ORIGINALITY AND CREATIVITY	10-9	8-7-6	5-4-3	2-1

*There is no "Satisfactory" Rating given at State Science Day.

1. <u>Minimum</u> number of points for each rating:

Superior 36, Excellent 24, Good 12, Satisfactory 4, (Not considered at State Science Day).

2. The following paragraphs are given as an interpretation of the various CRITERIA on which the project or exhibit will be judged.

A. KNOWLEDGE ACHIEVED—(CONSIDERING STUDENT'S AGE AND GRADE LEVEL)

1. Has there been a correct use of scientific terms? Does he/she understand these terms?

2. Is there evidence of an acquisition of knowledge (depth) through the research or has he/she merely acquired a manipulative technique?

3. Does he/she show evidence of knowing what the underlying principle(s) is (are)?

4. In brief, has he/she actually learned something through his/her study and research above and beyond his level of classroom work?

B. EFFECTIVE USE OF SCIENTIFIC METHOD

1. Does the student have a clear-cut idea of the purpose of his/her project, or is it something thrown together and manipulated? While the mere assembly of a "kit" is frowned upon, there can be a definite research approach wherein there may be an effective use of scientific method(s). However, it should not be the principal element of the display.

2. Is he/she aware of other approaches or theories relative to his problems or project?

3. Is there <u>evidence</u> of literary and/or experimental research? Has he/she been thorough and have there been prolonged or sustained experimentations?

4. Has he/she observed any basic phenomena?

5. Has he/she experimented sufficiently to have collected any data?

6. Has he/she analyzed his/her observations in a logical manner and drawn valid conclusions?

7. Has he/she used an adequate sample to make generalizations?

C. CLARITY OF EXPRESSION

1. Can he/she orally explain his project concisely and answer questions well? Discount a "glib tongue," but try to weigh evidence of nervousness when talking to a "pro", as you are considered. Watch out, however, for a memorized speech with little understanding of principles.

2. Has the participant expressed himself or herself well in all written material, such as the abstract and research report? Consider that this material might have been copied or written by another person.

3. Is the physical display neat and sufficiently definitive? Discount printed posters and professional placards unless you have evidence that the participant has made them and has a depth of knowledge of such material.

4. Beware of misspelled words.

5. Does the research report include a literature review, experimental data, statistics, results, and conclusions? Does it follow an accepted form of technical reporting?

D. ORIGINALITY AND CREATIVITY

1. Is the problem or the approach to the problem developed in a particularly significant or unique manner? It is true that the approach may not be new to the judge, but does he/she show an enthusiasm that one less versed in the subject of phenomena might think it was "brand new?"

2. Has he/she a new approach to an old subject?

3. Has he/she a unique presentation or organization of materials?

4. The assembly of a "kit" may not be original or creative but again, it may be a new and unique approach to a problem and may economize on time and effort.

5. Is there evidence of initiative? Place a premium on the ingenious uses of available materials and hand-made elements. Collections and manufactured

apparatus can be creative if they are assembled and used to achieve, show, or prove a stated purpose.

RULES FOR THE USE OF ANIMALS

1. Animals that are used in experiments should be kept in excellent condition. This includes proper diet, satisfactory housing, and appropriate cleanliness.

2. In dietary and other experiments, vertebrate animals should be maintained on a restricted diet only until observable symptoms are noticed, then steps should be taken to restore them to a healthy condition. They should not be allowed to die from such experimental procedures.

3. All experiments with vertebrates, which require that the animal be killed or which might otherwise cause pain or distress to the animal, should be conducted with proper anesthesia and under constant and proper supervision of an instructor and competent medical or veterinary personnel.

4. All experiments which involve vertebrates should be undertaken only in search of new knowledge and/or proof of a theory or principle. The entire plan for the experiment should be written and approved by the teacher-sponsor in advance.

5. Cages should be large enough for the particular animal. Rodents should be supplied with gnawing materials. Exercise devices are desirable.

6. Aquaria should be leakproof. Emergency equipment in the form of containers and mopping materials should be available in case of spills or leakage. An air-pump is essential if the total length of all the enclosed fish exceeds the proportion of one inch of fish per gallon of water.

7. Amphibious animals should have a landing platform available.

8. Care should be taken in moving or transporting animals to prevent rapid environmental changes.

9. Care should be taken to prevent teasing or abuse of animals by anyone.

10. Some vertebrates, particularly wild animals, require a retreat or den box.

11. Living poisonous animals cannot be displayed at Science Days.

12. A veterinarian's certificate of health is required for dogs, cats, and other large mammals.

13. Care should be taken to prevent contamination of an animal's food.

14. All animal cages or other types of enclosures should be constructed with appropriate door catches to prevent the escape of the animal or its accidental release by a spectator.

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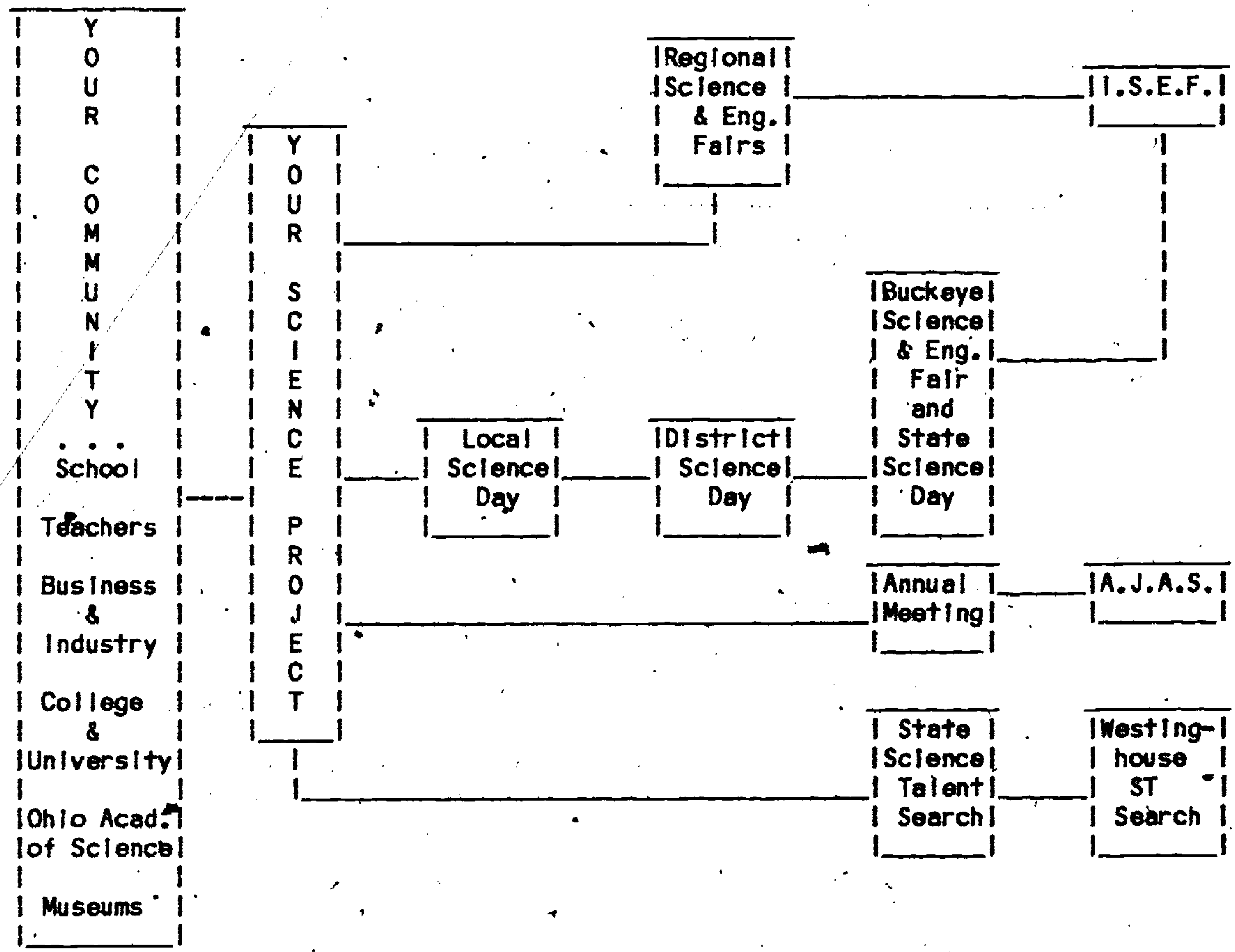
Appendix A

YOUTH SCIENCE OPPORTUNITIES



The common element in all of these youth science opportunities is a carefully planned and well researched science project.

Appendix B

REGIONAL AND

INTERNATIONAL SCIENCE & ENGINEERING FAIRS

Ohio has several regional science and engineering fairs where students may qualify for participation in the International Science and Engineering Fair, (ISEF). SPECIAL RULES apply to regional fairs and the ISEF.

For a set of rules and other information about these two opportunities write:

Science Service
1719 N Street, N.W.
Washington, D.C. 20036

Science Service will also provide information about the Westinghouse Science Talent Search.

STUDENT PROJECT GUIDE SHEET

1. Time Schedule - Projects should be started as soon as possible and a schedule maintained in order to ensure competition of all project components.

2. Project Ideas - Check all available sources for possible project ideas. Consider hobbies, special interests, and current societal issues.

3. Identify a problem - Students must consider the realistic implementation of the experiment. Design of the investigation and the statistical treatment should be considered simultaneously. Questions such as how the data will be collected, analyzed and evaluated should be considered.

4. Stating Hypothesis - A hypothesis is formed to answer the stated question. It suggests a prediction that can be tested or observed under experimental conditions.

5. Locate Information - A thorough review of the literature is necessary. Be sure to include current science periodicals, current non-fiction books, and interviews with specialists.

6. Collect and Organize Data - Consider methods and procedures that will be used to collect data. List and locate materials that are necessary to complete the experiment. Keep a detailed written diary of all observations, procedures, etc. Include date, time and all other relevant information.

7. Analyze and Interpret Results - Use graphs, tables, and diagrams to determine relationships between variables. Consider sampling, reliability, and a type of statistical comparison.

8. Research Report Content - A complete explanation involving the scientific methodology, and the literature researched should be included. An abstract, tables, and graphs aid in summarizing research porjects.

9. Display - Accuracy of displayed information is very important. The display should represent the sequence of the project. A concise representation of the experiment should also be present.

10. Presentation - Students should be knowledgeable concerning the research aspects of their study as presented in their written paper, the scientific methodology of their investigation, and all data and vocabulary used on their display. A brief comprehensive summary of the project will be given orally by the student at the time of judging.

<u>11. Checklist</u> - Confidence of students in communicating their research study will be enhanced by following these do's:

1. Do have a complete scientific study of a question: cite problem, hypothesis, procedure, and results to demonstrate use of a scientific method approach.
2. Do have accurate written data collected to be referred to or inspected.
3. Do have data summarized in tables, charts, and graphs for easy reference in showing relationships.
4. Do have reference to the sampling and validity of the study to demonstrate knowledge of such factors and their impacts.
5. Do have some statistical analysis when referring to significant results or outcome.
6. Do offer some conclusions resulting from your study, being careful not to over generalize your outcomes.
7. Do consider further questions for investigation that have been generated by your investigation.
8. Do have sound, basic knowledge of the theories and principles in the field of science in which you have completed your investigation.
9. Do consider revisions that may improve your study.
10. Do practice your presentation in a logical sequence.
11. Do be confident and proud of your accomplishments!

PROJECT COMPONENTS

1. AN IDENTIFIED PROBLEM/QUESTION IN WHICH THE STUDENT HAS DESIGNED AN EXPERIMENT TO TEST HIS/HER HYPOTHESIS

2. A DETAILED RESEARCH REPORT

   a. Title page
   b. Table of contents
   c. Abstract (approx. 250 words)
   d. Introduction-(problem and hypothesis to be investigated)
   e. Methods and materials used to study problem
   f. Analysis of collected data to infer results
   g. Conclusions and implications for further research.
   h. Graphs, tables, diagrams, to illustrate investigation
   i. References

3. A PHYSICAL DISPLAY

   a. 3-6 poster display - totally self-supporting
   b. Exhibit tables, diagrams, graphs, models, etc.
   c. Dimension - 3 ft. wide - 7 ft. from floor
   d. Posters should be printed - neat - spelling correct

4. AN ORAL PRESENTATION

   Students should use note cards rather than memorization in preparing an explanation of their investigations. Background information, methods used, data collected, and all visuals should be discussed.

JUDGING CRITERIA

	SUPERIOR	EXCELLENT	GOOD	SATISFACTORY
KNOWLEDGE ACHIEVED	10-9	8-7-6	5-4-3	2-1
EFFECTIVE USE OF SCIENTIFIC METHOD	10-9	8-7-6	5-4-3	2-1
CLARITY OF EXPRESSION	10-9	8-7-6	5-4-3	2-1
ORIGINALITY AND CREATIVITY	10-9	8-7-6	5-4-3	2-1

The minimum number of points for each rating are:
Superior - 36, Excellent - 24, Good - 12, Satisfactory - 4.

CLASS INVESTIGATION

CONCEPT — Setting up an Experiment.

PURPOSE — To give students practice in setting up an experiment.

ACTIVITY — Student will choose a type of cereal e.g. Rice Krispies, and, using food coloring, dye 100 Red, 100 Green, 100 Yellow, and use 100 Natural. Student will place ten pieces of each color of cereal in a container. They will record the amount of cereal eaten of each color for ten days. They should also make several observations relating to the kinds of birds seen eating at their food station, the weather conditions, etc..

EVALUATION — 1. Student will formulate a hypothesis.

2. Student will complete a log of observations and a table of the data collected.

3. Student will analyze results and state conclusions.

AMOUNT OF FOOD EATEN

Day of Observation

Cereal Color	1	2	3	4	5	6	7	8	9	10	Total
Red											
Green											
Yellow											
Natural											

44

STUDENT WORKSHEET --INITIATING INVESTIGATION IDEAS

CONCEPT -- Initiating Investigative Topics

PURPOSE -- To generate possible scientific questions to be investigated

ACTIVITY -- 1. Students will form groups and be given a science topic (plants, animals, consumer products).

2. Each group will write a list of 10. possible questions or problems that may be investigated. For example:
Topic: Plant Growth
Question: Will the color of light affect the growth of Petunias?

3. Each group will have an opportunity to present their list to the class.

4. Class members will discuss the workability of each question and how it might be implemented in a scientific investigation.

Name______________________________

Topic______________________________

Questions or Problems

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____

NARROWING THE TOPIC

ENERGY

USES — SOURCES — PHYSICS

Natural Gas — Oil — Wind — Nuclear — Coal — Solar

Availability — Economics — Engineering — Regulations — Environmental

Project Title: "Wind Turbine Performance Assessment"

Once you have some idea of your area of interest, you should begin to narrow the topic.

A serious error of the first time researchers is trying to do too much. You'll be able to do a better job if you narrow your topic.

For example, let's say you choose energy as a general area of interest. In order to formulate a question or problem, you need to understand that information can be broken down into smaller units. Soon you'll reach an area that is limited enough to allow you to proceed until you begin to exhaust the available sources of information.

The broad subject of energy may be divided into

- Uses
- Sources
- and the physics of energy.

Sources may include natural gas, oil, nuclear, coal, solar, and wind. If you are particularily interested in wind you'll soon discover that you can be even more specific.

Projects on wind may be concerned with availability, economics, environmental aspects, regulations and engineering.

Engineering may be limited to the problem or question of:

"How will blade design affect performance of a wind turbine?"

Appendix H

LIBRARY CHECKLIST

NAME: ______________________

SCIENCE AREA: ______________________

TOPIC: ______________________

TITLE: ______________________

KEY WORDS: ______________________

CHECK

1. CARD CATALOG
   author, title, and subject of circulating non-fiction and non-circulating reference books

2. INDEXES
   author's name and subject heading
   Readers Guide to Periodical Literature

3. NEWSPAPER AND MAGAZINE INDICES

4. SCIENCE ENCYCLOPEDIAS

5. HANDBOOKS
   Chemistry and Physics and others

6. ABSTRACTS
   Biological, chemical, mathematical, social sciences, environmental, energy

7. JOURNALS

8. COMPUTERIZED DATA BASES
   including on-line card cataloges

7. VERTICAL FILE
   collection of brochures, magazine articles and other resource materials on a specific subject area

TIME LINE FOR SCIENCE DAY PARTICIPANTS

	DUE DATE	DATE COMPLETED
1. Preview sample projects		
2. Have an understanding of judging criteria and project categories, fair rules.		
3. Review scientific method approach		
4. Complete a simple experiment		
5. Identify problem or question		
6. Review literature, log		
7. Formulate the hypothesis		
8. Design and implement experiment		
9. Organize data from experiment		
10. First draft of research report		
11. Construct graphs, tables, diagrams		
12. Write abstract		
13. Complete title page, table of contents, reference listing		
14. Plan poster display		
15. Develop oral presentation		
16. Present Project		

Appendix J

STUDENT RECORD SHEET

CODES

Alpha________Numeric________
Category________________

NAME______________________________CLASS ____________________

IDENTIFIED PROBLEM____

HYPOTHESIS ____

EXPERIMENT: materials ______ workability _____ time involved _____

PRELIMINARY OUTLINE Completion Date____________ Quality____________

LITERATURE SEARCH

Notes			References		
Date	Quality	Quantity	Type	Quantity	Form

REVISED OUTLINE Completion Date____________ Quality____________

EXPERIMENTAL DESIGN Materials Located____________ Date Started________

COLLECTION OF DATA

	Quantity	Quality
First Check		
Second Check		
Third Check		

INTERPRETATION OF DATA Tables__________ Figures__________

CONCLUSIONS AND IMPLICATIONS Completion Date__________ Quality__________

FIRST DRAFT Completion Date__________ Quality__________

PHYSICAL DISPLAY Completion Date__________ Quality__________

FINAL DRAFT OF RESEARCH REPORT Completion Date__________ Quality__________

ORAL PRESENTATION Completion Date__________ Quality__________

SAMPLE LOG BOOK ENTRY

Date 3-15-84
64th day of experiment

Test tube	original pH	Observations pH	Observations / weight difference
A_1	4.3	8.1	.02453
E_1	4.3	8.0	.01441
A_2	4.4	7.8	.02241
B_1	4.4	7.9	.01935
A_3	4.9	7.7	.01207
B_2	4.9	7.8	.01980
C_1	5.0	8.0	.01934
E_2	5.0	8.1	.01304
D_1	5.1	8.0	.02017
E_3	51	8.1	.02910
B_3	5.5	8.5	.01907
D_2	5.5	8.2	.01611
A_4	5.7	6.1	.01649
B_4	5.7	5.8	.00953
B_5	5.8	7.6	.01940
C_2	5.8	7.7	.01653

SAMPLE TITLE PAGE

TITLE REFLECTING THE PURPOSE AND RESULTS OF

YOUR INVESTIGATION

to

The Ohio Academy of Science

by

George M. Smithman
4455 Kendall Avenue
Central City, Ohio 43xxx

May 10, 19xx

Research Supervisor: Mr. John Mauderly

English Advisor: Miss Denise Dagot

Central City High School
462 Main Street
Central City, Ohio 43xxx

SAMPLE TABLE OF CONTENTS

SAMPLE ABSTRACT FORM

An abstract should be prepared for each student report. It should be on a separate sheet of paper, immediately after the Table of Contents. The abstract should be a concise summary of the contents of the report, not merely a general description of what the report is about. Abstracts should not exceed 250 words. All important facts and their implications should be stated briefly, but words should not be used so sparingly as to leave ambiguity. Tables and graphs should not be included. New techniques or new apparatus and their functions should be mentioned. New constants, critical data or formulae should be included. Names of new species should not be listed in the abstract. All organisms, chemicals, etc., should be designated by full scientific names.

SAMPLE REFERENCE LIST

(1) Andrews, Deborah C. and Blickle, Margaret D., Technical Writing: Principles and Forms, Macmillan Publishing Co., Inc.; New York, NY, 1978

(2) Barrass, Robert, Scientists Must Write, John Wiley and Sons, Inc.; New York, NY, 1978

(3) Brusaw, Charles T., Alred, Gerald J. and Oliu, Walter E., Handbook of Technical Writing, St. Martin's Press, Inc.; New York, NY, 1976

(4) CBE Style Manual Committee, CBE Style Manual: a guide for authors, editors, and publishers in the biological sciences, 5th ed. revised and expanded, Council of Biology Editors, Inc.; Bethesda, MD, 1983

(5) Cremmins, Edward T., The Art of Abstracting, ISI Press; Philadelphia, PA, 1982

(6) Day, Robert A., How to Write and Publish a Scientific Paper, ISI Press; Philadelphia, PA, 1979

(7) Hutchinson, Lois I., Standard Handbook for Secretaries, 8th ed., McGraw-Hill Book Company, Inc.; New York, NY, 1973

(8) Lesikar, Raymond V., How to Write a Report Your Boss Will Read and Remember, Dow Jones-Irwin, Inc.; Homewood, IL, 1974

(9) Mathés, J. C. and Stevenson, Dwight, Designing Technical Reports, The Bobbs-Merrill Co., Inc.; Indianapolis, IN, 1976

(10) Michaelson, Herbert B., How to Write and Publish Engineering Papers and Reports, ISI Press; Philadelphia, PA, 1982

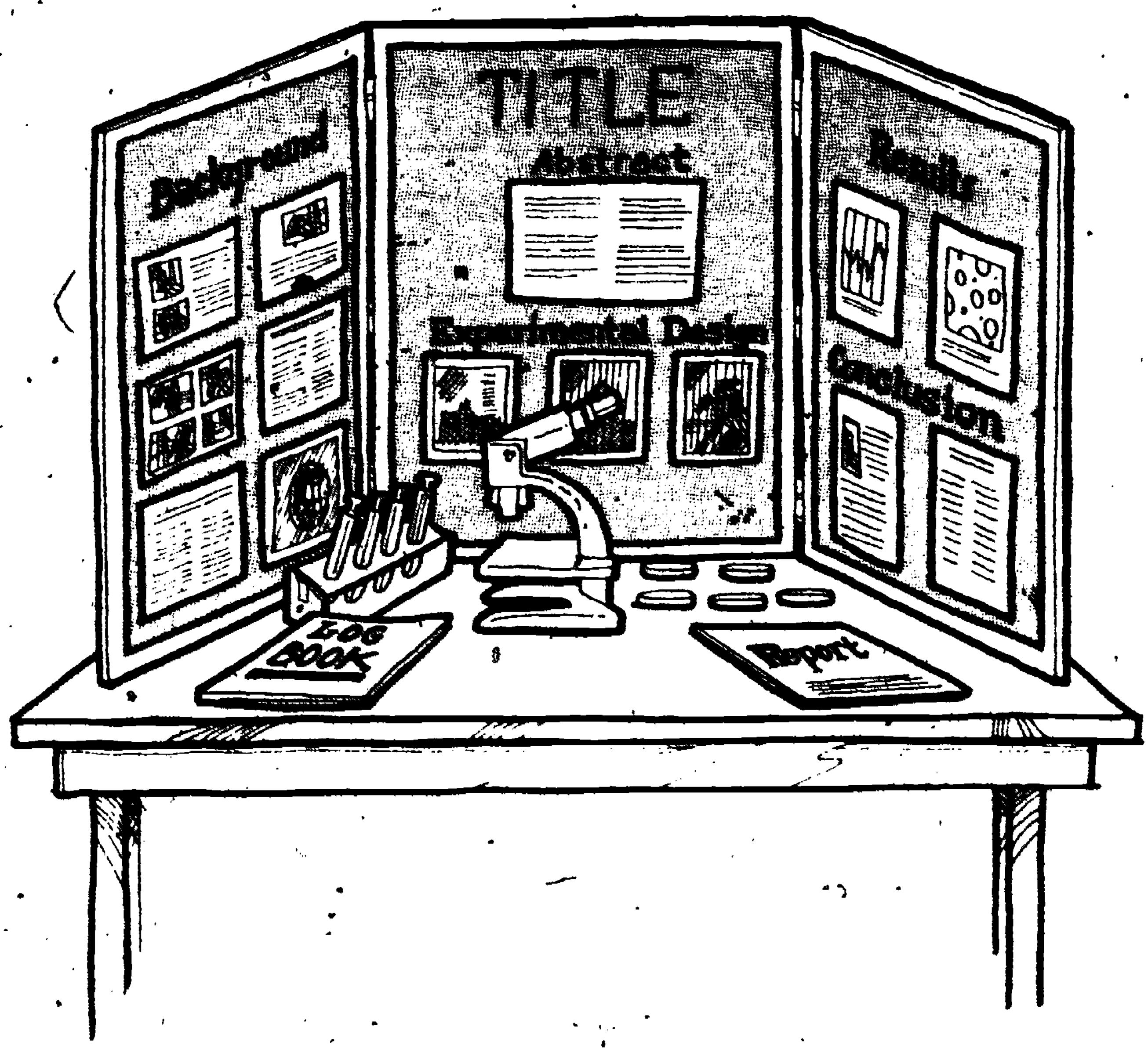
(11) O'Hayre, John, Gobbledygook Has Gotta Go, No. 0-206-14, U.S. Department of the Interior, Bureau of Land Management; U.S. Government Printing Office; Washington, DC, 1966

(12) Roman, Kenneth and Raphaelson, Joel, Writing That Works, Harper & Row, Publishers; New York, NY, 1981

(13) Strunk, William, Jr. and White, E.B., The Elements of Style, Macmillan Publishing Co., Inc.; New York, NY, 1959

(14) Turabian, Kate L., A Manual for Writers of Term Papers, Theses, and Dissertations, 4th ed., The University of Chicago Press; Chicago and London, 1973

POSTER DISPLAY DIAGRAM



A typical display at a science day should have the following elements:

- Title
- Abstract
- Experimental Design
- Background information including problem and hypothesis
- Results including tables and graphs of data
- Conclusion(s)
- Technical Report
- Log book
- Equipment, samples or other items from your experiment

TIME LINE FOR SCIENCE DAY DIRECTOR

FOUR PLUS MONTHS PRIOR

1. Start student project work
2. Ask support from parent organization (volunteers, awards, "snacks" for judges)
3. Confirm date and place at least two weeks prior to District Science Day.
4. Prepare judges' source listing

TWO MONTHS PRIOR

1. Begin contact with judges
2. Order materials necessary
   a. judging cards
   b. certificates
   c. award seals, ribbons, other
3. Acquire supplies
   a. name tags
   b. pencils, pens, markers
   c. folders for each judge
   d. stamp for ratings
   e. masking tape, scissors
   f. stapler, paper clips
4. Check facilities
   a. gym or place of event--public address system
   b. judges meeting room
   c. room for tallying judges' cards
   d. award presentation--public address system
5. Entry forms due (5 weeks prior for local science day)

ONE MONTH PRIOR

1. Mail letters to judges
2. Design floor plan
3. Produce and assemble printed programs

4. Make space assignments

5. Complete judging cards

6. Display awards

7. Contact media

8. Type certificates

9. Complete name tags for participants, judges and officials

10. Confirm list of volunteers (time available & preferred task)

11. Conduct poster sessions for participants

ONE WEEK PRIOR

1. Review entire schedule with participants — offer encouragement and support.

2. Assign judges to projects.

3. Assemble judges' folders.

4. Recontact media

SCIENCE DAY

1. Meet with volunteers

2. Issue participant name tags

3. Project set-up
   a. Use adding machine tape and rule 30" sections marking space numbers. Place the numbered tape on the floor the night before.
   b. Call students in to the Science Day area according to space number at the local level. Students will be given an exhibit number at district and state levels at the time of registration.

4. Distribute programs to participants

5. Judges' briefing

   a. Folders arranged in alphabetical order - Name tag paperclipped to folder.
   b. Review judging criteria and procedures
   c. Discuss floor plan for locating projects.
   d. Superior rating 36-40 points necessary for advancement

6. Tallying room

   a. Recheck totals—average cards (if two judgings)
   b. Type <u>or</u> stamp ratings on certificate
   c. Adhere seal on certificate
   d. Complete listing for other awards and superiors
   e. Designate District Winners

7. Awards program

   a. Recognize all students individually (certificate)
   b. Distribute ribbons and/or trophies if applicable
   c. Name superiors eligible for District competition
   d. Make special awards
   e. Thank all teachers, volunteers, judges for their participation
   f. Issue Summary news release

SAMPLE SCIENCE DAY SCHEDULES

WEEKDAY

8:45 - 11:00	Project Set-Up
11:30 - 12:30	Judges Luncheon and Briefing
12:30 - 3:00	Judging Projects
7:00 - 8:00	Visitation of Projects
8:00 - 8:45	Award Ceremony

SATURDAY

8:00 - 9:30	Project Set-Up
9:00 - 9:30	Judges Meeting
9:30 - 11:30	Judging on Projects
11:30 - 1:00	Visitation of Projects
1:00 - 1:45	Award Ceremony

Time allotments may need adjustment depending on the number of projects and judges available.

Appendix S

SOURCES FOR JUDGES

I. SCHOOL ADMINISTRATIVE OFFICE

A. Superintendent
B. Assistant Superintendent
C. Curriculum Supervisors
D. School Board Members
E. Principals
F. School Nurses

II. PERSONNEL FROM SURROUNDING DISTRICTS

A. Teachers
B. Principals
C. Curriculum staff

III. COMMUNITY

A. Medical Fields
1. Optometrists
2. Veterinarians
3. Dental Hygienists
4. Dentists
5. Doctors
6. Nurses
7. Pharmacists
8. Lab Technicians

B. Business Fields and Technical Fields

1. Manufacturers
2. Public Utilities
3. Research and Development Laboratories
4. Engineering Consulting Firms
5. Architects

C. College, University, and Technical and Vocational School Personnel

D. Government

1. City and County engineers
2. Water and Sewage Treatment Personnel
3. Agricultural Agents and Health Departments

E. Senior Citizens Organizations

F. Scientific, Trade, and Professional Organizations

JUDGING CANDIDATES

NAME	ADDRESS	PHONE #	SCIENCE AREA	COMMENTS

Appendix U

STUDENT ENTRY FORM

STUDENT ENTRY FORM DUE DATE____________

Name ______________________________________

Homeroom ____________________

Grade ____________________

Project Category: (circle one) Behavioral and Social Sciences, Biochemistry, Botany, Chemistry, Earth and Space Sciences, Engineering, Environmental Sciences, Mathematics, Computers, Medicine and Health, Microbiology, Physics, Zoology

Project Title: ______________________________________

Project Hypothesis: ______________________________________

____

____

____

....

STUDENT ENTRY FORM DUE DATE ____________

Name ______________________________________

Homeroom ____________________

Grade ____________________

Project Category: (circle one) Behavioral and Social Sciences, Biochemistry, Botany, Chemistry, Earth and Space Sciences, Engineering, Environmental Sciences, Mathematics, Computers, Medicine and Health, Microbiology, Physics, Zoology

Project Title: ______________________________________

Project Hypothesis: ______________________________________

____

____

____

TALLY ROOM: MATERIALS AND TASKS

Materials:

- Extra signed but blank certificates
- Sharpened pencils
- Pens (green, red, blue ink)
- Containers for separating judging cards
- Staplers
- Paper Clips
- Ink pads and rubber stamps of the ratings - Superior, Excellent, Good, and Satisfactory

Tasks:

1. Determine final rating from judges cards
2. Red, green, or blue pen may be marked on cards for easy identification of rating.
3. Stamp rating on student's certificate
4. Place Academy Seal on Certificate:

Blue	Superior	40-36
Red	Excellent	35-24
Green	Good	23-12
Black	Satisfactory	11- 4

5. Arrange certificates in the order in which they will be presented.

NOTE: Select personnel that function well under stress.

Appendix W

SAMPLE PRESS RELEASE

Use school letterhead

CONTACT:
(Type your name
and phone
number here)

XYZ LOCAL SCIENCE DAY
SET FOR (FILL IN DATE)

For Immediate release

CITY (type date here) - The Ohio Academy of Science and (type name of sponsor or school name) today announced that (type number of students) will display the results of their research projects at the (type name of local science day) on (type day of week and date) at (type location). The projects may be viewed by the public from (give times), and the awards ceremony will be held at (give time) in (give room or auditorium).

The director of this year's event is (give name, and affiliation (school, grades and subjects taught) who said, "(quote yourself with something short and sweet)."

Superior winning students from (give name of science day) will attend (give name of District Science Day) at (name of college) on (date), an event also sponsored by The Ohio Academy of Science, where the students will qualify to attend State Science Day at (give name of college) on (date).

-end-

Note: To improve your release you may list more details on additional pages such as names of students, special awards planned, a plea for recruiting judges, or anything else to add realism to the release. Use a similar release immediately after your event to summarize the names of winning students, especially those who will attend district science day.