



Waynesville R-VI School District Science Fair Guide Spring 2015

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Science Fair Guide

Students -- We hope you are excited about your science fair project. Like many things in life, the more effort you put into it, the more you will get out of it. A good project is always challenging and fun. We know how hard you will work to develop and complete an outstanding science fair project. We are continually amazed at the extraordinary work pre-college students can do. We hope you have lots of fun as you explore your topic and develop your project. We hope your project and your success with it will spur your interest in pursuing a technology career.

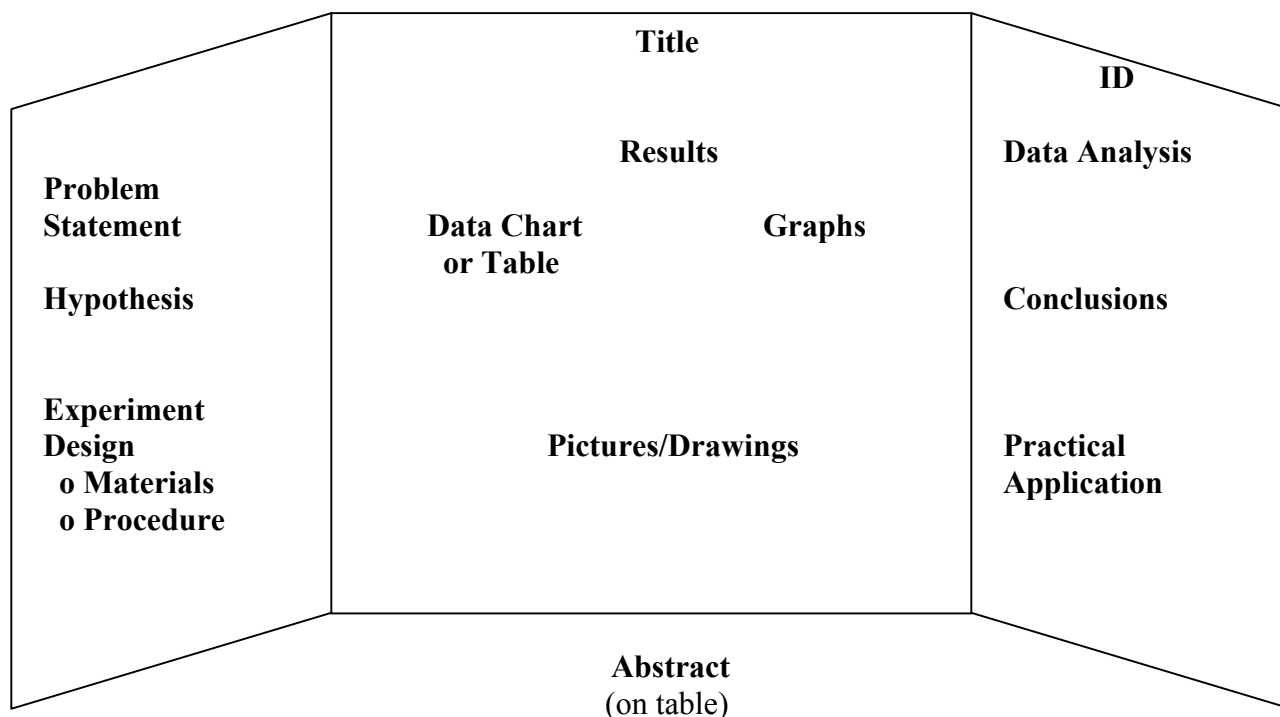
Teachers, Parents, Judges and Supporters -- Thank you for volunteering and making science fairs possible. We appreciate your personal contribution of time, energy and enthusiasm.

We encourage teachers, parents and friends to help the students with their science projects. Some students will get lots of help, and others not so much. Students in both groups can be successful. During the Level 1 interviews, the judges will be asking the students to brief their projects and will ask questions to ensure that each student has a full understanding of his/her project.

Science fairs are great opportunities to reach out to our youth and give them a chance to experience the excitement and adventure of scientific discovery, experimenting and reporting of findings. If we can get kids excited about science, technology, engineering and math, they then may seriously consider technology careers. If we can get more kids to pursue technology careers, we can once again be confident that our country will continue to be a technology leader in the world – a key to our quality of life and greatness as a country.

Creating a Display Board

Science fairs require a three-panel, free-standing display board as part of the exhibit. Each of the following topics must be included on the display board:



1. Title. A title must reflect the project idea and should be stated in a clear and creative manner to capture the reader's interest. The specific independent (IV) and dependent variables (DV) may be included in the title.

2. Problem Statement. The main idea of the project will be clearly defined through the problem statement. The problem is stated as a question. The problem statement will explicitly identify the IV and DV. The Problem Statement must include additional sentences which state, "The IV is _____. The DV is _____. The control is _____. The constants are _____."

3. Hypothesis. A statement of what the student thinks will happen. This is an educated guess, based on their research. The IV and DV will also be clearly identified in this section. The hypothesis must be in the form of an If, Then statement.

4. Experiment Design. This section must include the **materials list** and a detailed step-by-step **procedure** for testing the hypothesis. Be sure the procedural steps are numbered, all the materials listed are included in the procedures, constants are defined, and all materials identified in procedure are in list of materials. **Five trials** must be completed.

5. Results. The center section of the display board must have sufficient **data tables** and **graphs** to communicate the findings, and to show the extent to which the data supports the research and conclusions. This section will also include **pictures and/or drawings** to further explain the project. Students should not be identifiable in any pictures utilized on the science fair board.

6. Data Analysis. Student summarizes in paragraph format what the data reveals. In this section the student needs to confirm or refute the predictions he/she made in his/her hypothesis based upon the data. Unexpected data results will be identified and discussed.

7. Conclusions. This is a summary, in paragraph format, of major findings and the extent to which the results support the hypothesis. The conclusion must clearly answer the question asked in the problem statement. Also include what could have been done to improve the project.

8. Practical Application. This section will answer the question: How can student use what he/she has learned in a real-world experience?

9. Abstract. An abstract is a brief summary of the student's project placed on the table in front of the display.

10. ID. An identification number (ID) will be shown on the top right front of the display board. This number will be assigned by the school. It will be unique for each student participating in the fair.

11. Pronouns. No pronouns should be utilized in any section of the science fair project.

See **Level 1 Rating Criteria** sheet on page 11 for additional information.

Guidance on Developing a Specific Research Problem

Your project will compete in one of three areas: Earth (Geology), Life (Biology) and Physical (Chemistry/Physics).

You can find research topics in many places. A Google search on the Internet for science fair topics will come up with hundreds of topics. You can also find topics in the library. Your teacher may have resources in the classroom to explore. Family and friends may make suggestions if asked.

Projects may include human subjects, animals and potentially hazardous materials **only if** the student and parents fully comply with procedures of the Ozark Science and Engineering Fair and have teacher's permission. All additional permissions must be obtained prior to beginning the science fair project. Projects cannot involve blood, alcohol, tobacco or explosives. They cannot create a situation where the safety of the student or an observer is threatened.

These procedures are found at

http://www.k12science.missouristate.edu/OSEF/enter_the_fair!.htm

Demonstrations (e.g., How a volcano works) and any kind of comparisons (product or brand) are not acceptable projects.

Once you narrow your consideration to two or three best topics, select one:

- that is exciting to you and should be exciting to those who will view your project display.

- for which you can develop a non-trivial hypothesis about the topic and you can design a practical experiment.

Here is a list of specific words you will need to know:

1. Independent Variable (IV). The variable you change, or purposely manipulate in an experiment.

2. Dependent Variable (DV). This is the variable that responds as a result of changing the independent variable.

3. Control. This is the standard for comparing experiment results. The experiment setup either does not contain the independent variable or provides a baseline value for the independent variable. For example: if you were testing different fertilizers on plants, then you have one plant group that you would feed plain water. The plant group that was fed only water would be your control.

4. Constants. These are factors in experiments that are kept the same and not allowed to change or vary. For example: if you were testing different fertilizers on plants then the things that you would want to keep constant would be same soil, same amount of light, amount of water, container size and shape, etc.

5. Quantitative Data. This is data that is measured or identified on a numerical scale. All experimental data collected must be quantitative data. Use metrics where applicable.

Guidance on Constructing a Display Board

1. Type or neatly print. Information must be easy to read.
2. Place all typed materials on colored backing such as construction paper. Leave a border around the edges. Boards can be decorated, but please remember that this is not an art project. The content is the main focus. Remember you are being judged on the science and not the show.
3. Display labeled photos showing the procedure or results. Focus pictures on the items in the experiment. If you have pictures of anyone else other than yourself or your family members, you must have their written permission. The completed permission slips should be given to your teacher to be placed in your science fair folder.
4. Use large letters for titles and headings.
5. Before gluing everything on the backboard, lay the board down and arrange everything.
6. Make sure the project has no misspelled words. Double-check your math.
7. Your display board should follow the layout on page 3. All materials must be fully contained within the dimensions of the display board. No additional panels should be added to the board.

8. Pay special attention to the labeling of graphs, charts, tables, diagrams, and photographs. Anyone should be able to understand the visuals without further explanation.

Guidance on Writing a Procedure

This section will help detail the methods you use to make observations, collect data, and design your experiment.

1. Visualize the process and think it through before you begin writing.
2. Decide how the data will be collected. How will you measure? All units of measure must be in **metrics**.
3. Provide great detail. Identify the constants. The procedure should allow anyone to conduct the experiment and obtain the same result.
4. Show proper sequence of the tasks. List steps so it is easily readable. Number each step. Do not write the procedure as a single paragraph.
5. Include repeated trials. Remember, there needs to be a minimum of **5 trials** to conclude the data are reliable and valid. In the study of plant growth, it's recommended that you use seeds instead of plants that have already germinated and well into the growth process. A minimum of 5 seeds for each test group is required (If you have three test groups, then there should be a minimum of 15 seeds planted).
6. You may want to take pictures of this process to use on the display board.

Guidance for Creating Data Tables

1. Experiments will include repeated trials. The minimum number of trials is five.
2. Give your table a title.
3. Be sure to label the units used on the independent and the dependent variables. All units of measure must be in metrics.

Guidance on Graphing

Graphs communicate and summarize data in the form of pictures. A graph is an exact picture of the information in the data table.

The three most common types of graphs used in science are line, bar and circle graphs. The type of graph used will depend on the type of experiment that you are conducting. Line graphs show trends in data and when you are interested in how something has changed over time. Bar graphs are useful when making comparisons between things. Circle graphs are used to compare percentages.

1. Use graph paper or a computer program capable of graphing.
2. The dependent variable is placed on the vertical y axis.
3. The independent variable is placed on the horizontal x axis
4. Each axis is given a label which describes the variable.
5. The units are placed next to the label and are separated from the label with a forward slash, Example: Height of plants/cm.
6. The graph is given a title that reflects the independent and dependent variable,
7. Make sure the graph is neat.
8. The title shows the relationship between the dependent and the independent variable.
9. The data is plotted correctly.
10. The graph should include a data key to identify the data being measured.
11. Numbered scales have uniform intervals. This is called the scale range.

Guidance on Writing the Conclusion

In this section you should interpret your data and offer conclusions. Basically, you are summarizing the findings of your experiment and answering the question you asked in the problem statement. Use the following questions to help writing the conclusion:

1. What was the purpose of the experiment?
2. What were the major findings?
3. What happened to the dependent variable as you made a change in the independent variable?
4. Did the data support or negate the hypothesis?
5. If the hypothesis was negated, what could be the possible reasons?
6. What would you do to improve the experiment?

Answer the questions in paragraph form. Your paragraph should flow easily, be straightforward, and simple to understand.

Guidance on Writing the Abstract

An abstract is a brief summary of your project. The abstract should be written after research and experimentation have been completed.

1. The length should be limited to 250 words and must fit on one page.
2. The project's title should be near the top along with the student's ID number and the name of the school.
3. Your hypothesis (or purpose) for the project should be stated first.
4. Procedures used to conduct the experiment should be summarized.
5. State your conclusion, listing the results of your data.
6. A list of references will be attached to the abstract. There needs to be a minimum of five references. The reference citations need to be in Modern Language Association (MLA) format, American Psychological Association (APA) format, or any other standard format. References need to be a combination of books, Internet, magazine articles, etc. Personal interviews (limited to 2) may be included as a reference.
7. The abstract should be placed on table in front of the display board.

Guidance on the Interview

Congratulations if you are asked by the judges to be interviewed. This means that you have been recognized as a Level 1 participant and you are on the short list for a place award.

Several judges will interview you at the same time. The intent of their questions is to see how much you know about your project and to clarify some aspects of your project that may not be clear to them. Their first request will be to ask you to tell them about your project. You will have three minutes. You may want to discuss why you picked the topic, how you performed the experiment, what were the results, and what challenges you faced in completing the project. Do not just read from your display board. The judges may then ask specific questions about your project. Judges may also ask how you would change the project if you were to conduct the experiment again and if your findings have lead you to consider other research outside your initial project.

The intent of the interview is not to see how well you speak in public; it is for you to describe how you conducted your project. There is no need to be nervous. Be sure to look at the judges as you speak. The judges enjoy these interviews, and most of the kids enjoy talking about their projects.

The Judging Process Building Level Fairs

There are normally at least three teams of judges, a team each for the three science topic areas, Earth, Life, and Physical. A team may be two or more judges. The judges will use this guide as their judging criteria. The best projects will comply with the guidance in this guide.

At the start of the fair, the judges will meet with the building coordinator to review how the fair will be conducted and answer questions. The exhibit hall will be cleared of all personnel who are not judges so that the judges are not distracted and can converse freely with each other.

An initial review round will be made of all projects to determine initial ratings. Three levels of recognition will be assigned during this round. Level 1 rating, will be given to those projects that are neat and visually pleasing and include all the components and requirements described in this guide. Level 1 projects may have minor corrections to make to improve their projects for the next level of competition. Level 2 rating will be given to those projects that may be neat and visually pleasing but have weaknesses in one or more of the components and requirements described in this guide. Level 3 rating will be given to those projects that have components or requirements described in the guidelines that are missing or incomplete and are somewhat neat and visually pleasing. A Certificate of Participation will be given to those projects that are not neat or visually pleasing and do not meet any or very little of the components and requirements described in this guide.

After the initial level ratings are assigned by the individual teams, all judges will examine the Level 1 nominations. Projects not deemed to meet Level 1 criteria (all 12 components must be present), are given a Level 2 rating and returned to the floor. All projects meeting Level 1 criteria (with concurrence from all the judges) are then considered confirmed Level 1 projects and are given Level 1 certificates. Judge may also reevaluate Level 2 projects (to include conducting interviews) to see if there are quality projects that have been missed. Once the judge team reaches consensus and gives a Level 1 rating to a project, it will not be downgraded (however, it does not have to place). If a Level 2 is reevaluated, the judge team reaches consensus and recommends a Level 1 rating, it will be given a Level 1 rating.

After verifying that projects meet Level 1 Criteria, the students are called in for interviews. The purpose of the interviews is to ascertain the student's knowledge of the experiment, understanding of the process and results, and to answer any questions. The student will be asked to give a 3 minute summary of the project (how they got the idea, summary of the experiment, results and conclusions, and ideas they would have about improving the process were they to do it again). Students are also asked if their project has led them to want to do further research. After the student's presentation, the judges may ask clarifying questions.

Judges take notes during interviews and discuss projects when all interviews are completed. Judges then work to build consensus as to which project receives 1st-6th place ribbons, justifying their reasoning for each selection.

Normally three to six places are awarded in each science area. If there are not enough quality projects to allow assignment of six places, fewer may be awarded. The number of ribbons awarded is decided by consensus by all the judges.

Best In Show is chosen from the first place in each of the 3 categories. Through discussion, judges again work to build consensus as to which project has earned Best in Show.

Once the judges reach consensus on the place assignments, they will meet a final time with the building coordinator and answer any questions they may have. The judges will also prepare improvement recommendations (tweak sheets) for each project that places. These recommendations will go to the student (copy to teacher and to the judge coordinators) to help the student prepare for the next competition level. The judges will then be dismissed. They will be asked to not discuss details of the process or the results with anyone.

The Judging Process District Fair

All students who receive ribbons at the building level fairs are encouraged to compete in the district level fair. Students should use recommendations for improvement to tweak their projects prior to the district level competition.

There are three categories again for the competition, Earth, Life, and Physical Science. Three places are given in each category along with a Best in Show.

For all projects at the district level, judges will fill out the one-page Level 1 Rating Form, assigning point values to each of the components. For each component rating, a "high range" is defined. All elements in that component must be present in order for that component to be rated in the high-end range. If any of the required elements is missing, the rating applied should be less than the high-end range. For example, for the Data Chart component (0-10 points, high-end range 7-10 points), if everything was perfect, but averages were not computed, the highest possible rating for that component would be 6 points. The rating form is purposely designed to identify and differentiate the very best projects.

After all rating forms are filled out, the students are called in for interviews. The purpose of the interviews is to ascertain the student's knowledge of the experiment, understanding of the process and results, and to answer any questions. The student will be asked to give a 3 minute summary of the project (how they got the idea, summary of the experiment, results and conclusions, and ideas they would have about improving the process were they to do it again).

Students are also asked if their project has led them to want to do further research. After the student's presentation, the judges may ask clarifying questions.

After the interview, the individual judges may modify their component scores based on what they heard during the interview. Initial scores may be increased, decreased, or unchanged as a result of the interview, but the high-range criteria should still be followed. After the judges have finalized their individual scores, the total points are determined and the top five projects in each category are identified. Judges will then work to build consensus on 1st-3rd place in each category and Best in Show.

Level-1 Rating Criteria

Project: _____ **Category:** _____ **Student ID:** _____

Component (Max points)	Elements Required to Earn High-End of Point Range (if missing <u>any</u> element, rating should be <u>less than</u> high-end range)	High-end Range	Assigned Points
Title (5 points)	Clear, clever, imaginative , tied to project idea, neat:	4-5	
Problem Statement (10 points)	Clearly stated as a question, DV, IV, control, and constants correctly and explicitly defined, focused on main issue without extraneous detail. Idea is original and imaginative , not just a repeat of some Internet project.	7-10	
Hypothesis (5 points)	Statement of what the student thinks will happen, based on cited prior research . DV and IV correct and explicit. Must be in form of If, Then Statement.	4-5	
Experiment Design (15 points)	Material list is complete and without extraneous information. Detailed, numbered, step-by-step process is tied to the problem. Process is tight and repeatable from the written information provided. Measurements are metric . Five trials are used. Focus is on a single set of DV & IV. Constants are defined. Design includes specific elements to keep focus only on those variables being measured. Steps are included to ensure that defined constants do not influence experiment .	10-15	
Data Chart (10 points)	All trials shown clearly. All rows and columns clearly labeled. Data organized and easily understood . Averages are computed.	7-10	
Graphs (10 points)	Correct type of graph is used for type of data. IV is shown on x-axis, DV on y-axis. Labels are clear; color is used to clarify. Averages are shown. Design of graphs clearly shows trends .	7-10	
Pictures / Drawings (5 points)	Pictures/drawings clearly show process. Presentation is neat, sequenced in order, and complements the written process description. Does not contain any distracting or misleading information.	4-5	
Data Analysis (10 points)	Interpretation of the data results, not just a restatement of the raw data. Trends are identified. Outliers are noted, and possible reasons for outliers are provided. Unexpected results are discussed.	7-10	
Conclusion (10 points)	Clearly ties data analysis to original question and hypothesis. Includes ideas of how the experiment could have been improved , with rationale .	7-10	
Practical Applications (5 points)	Imaginative, tied to real-world issues, relates directly to lessons learned in this experiment. Practical . Evidence of some level of cost/benefit thinking .	4-5	
Abstract (5 points)	A well-written summary (not a full report) of the experiment and the results. Limited to a single page with no more than 250 words. At least 5 references from a variety of sources.	4-5	
Interview (10 points)	Student shows a clear understanding of the project and references hands-on specifics. Acknowledges assistance from appropriate resources. Doesn't read the project to the judge.		

Total Points: _____

Additional Information

Science Fair Project Categories

The following are science fair project categories broken into the three categories we use:

Earth Science includes:

Earth and Space Sciences

The science of the earth and the science of the universe.

Examples: astronomy, geology, seismology, physical oceanography, meteorology

Engineering Science Applications (also included in physical)

The application of scientific knowledge for practical use.

Examples: civil, electrical, chemical, mechanical and petroleum engineering

Environmental Sciences

The study of the conditions that influence life on earth.

Examples: air and water pollution, population growth, extinction of species, depletion of vital resources, climate changes

Life Science includes:

Behavioral and Social Sciences

The science of human activities.

Examples: economics, anthropology, psychology, sociology, archeology

Biochemistry

The science of the chemical processes of living things.

Examples: Molecular biology, cell metabolism, genetic code, biological psychiatry, pharmacology

Botany

The science of plants.

Examples: agriculture, horticulture, forestry, floriculture, arboriculture

Medicine and Health

The science of preventing, diagnosing and treating diseases.

Examples: Cardiology, ophthalmology, nutrition, dermatology, oncology, internal medicine, pediatrics

Microbiology

The science of microorganisms.

Examples: bacteriology, virology, protozoology

Zoology

The science of animals.

Examples: ornithology (birds), herpetology (reptiles and amphibians), Mammalogy (mammals), ichthyology (Fish), entomology (insects)

Physical Science includes:**Engineering Sciences**

The application of scientific knowledge for practical use.

Examples: civil, electrical, chemical, mechanical and petroleum engineering

Chemistry

The science of the properties, compositions and reactions of matter.

Examples: organic chemistry, inorganic chemistry, physical chemistry, metallurgy

Computer Science

The study of computers including their use, operation and design.

Examples: software development, computer engineering, artificial intelligence, simulations, graphics

Mathematics

The study and application of the logical relations of sets.

Examples: arithmetic, algebra, geometry, statistics, operations research, calculus.

Physics

The science of matter and energy.

Examples: statics, dynamics, electricity, magnetism, light, thermodynamics, and atomic, nuclear and solid state physics

Variables**Definition 1: Independent variable**

If one were to measure the influence of different quantities of fertilizer on plant growth, the independent variable would be the amount of fertilizer used (the changing factor of the experiment).

Definition 2: Dependent variable

The dependent variables would be the growth in height and/or mass of the plant (the factors that are influenced and measured or recorded in the experiment)

3: Controlled variables

In this experiment would be the type of plants used, the type of fertilizer, the amount of sunlight the plant gets, the size of the pots, etc. (the factors that would otherwise influence the dependent variable if they were not controlled).

Judging Science Fair Projects

The criteria listed below are the most important criteria which science fair judges use to evaluate science projects.

Creativity

Demonstrating originality with your topic choice.

Demonstrating originality in each phase of project development.

Skills

Following provided science fair guidance.

Conducting experiments.

Collecting, documenting and presenting the data.

Possessing knowledge about the project equipment.

Accuracy.

Thoroughness

Being knowledgeable about the scientific literature about your topic.

Repeating your experiments multiple times to verify results.

Documenting all phases of the project.

Clarity

Presenting data, analysis, interpretations, explanations and conclusions in an orderly and understandable manner.

Being articulate in your oral presentations.

Neatness

Keeping all project materials clean and orderly.

Being well groomed for your oral presentation.

Integrity

Acknowledging sources of information- never plagiarize.

Acknowledging direct assistance from your monitor and professional scientists, engineers and mathematicians.

Results

Concluding your project with relevant, valid, scientific, mathematical and/or engineering information.