

Science Fair Guide

RESOURCES FOR PARENTS

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Welcome to the World of Science Fairs!

The *Science Fair Guide* is designed to direct teachers, students, and parents through all phases of a science project, preparing a student to participate in a science fair. A science project serves more than one purpose. The most obvious goal is to extend a student's understanding of science. Science is hands-on by nature, and there is no doubt that hands-on experiences facilitate the learning process.

The purpose of Resources for Parents is to help you guide your student through a science project using the following five phases, which mirror the scientific method:

- Phase 1: Generating an Idea
- Phase 2: Research and Planning
- Phase 3: Data Collection and Analysis
- Phase 4: Writing a Report
- Phase 5: Creating and Exhibiting a Display

The Scientific Method The scientific method allows scientists to further the advancement of knowledge in a strategic and unified manner. When students use the scientific method to design and execute a project they use the same steps that professional researchers use to glean new information about the world.



THE SCIENTIFIC METHOD

The steps of the scientific method that your child will be using appear below. Each step is explained in greater detail in Phases 1–5 of Resources for Students.*

- Purpose:** developing an investigative question
- Hypothesis:** making an educated guess about the answer to the investigative question based on research
- Experiment:** testing the hypothesis, collecting data, and making observations
- Analysis:** organizing data from the research and experimentation and looking for patterns
- Conclusion:** determining if the hypothesis is supported or disproved by the experimental results
- Communicating the Results:** sharing the conclusion with others

*In Chapter 1 of your child's textbook, these steps are called Ask a Question, Form a Hypothesis, Test the Hypothesis, Analyze the Results, Draw Conclusions, and Communicate Results.

Building Scientific Confidence Most importantly, science projects make science more fun and relevant to the student. Every student, regardless of aptitude, can benefit from planning and executing a science project. A science project can be a great way to spark a student's interest in science or to help a student develop a broader interest in research.

Philosophy of Science Fairs

Science fairs range in scale from a single class of students showing one another their projects to an international event offering scholarship money as prizes. From the largest science fair to the smallest, science fairs generally share a common philosophy and similar values:

- emphasis on using the scientific method
- investigation by experimentation (inquiry-based learning)
- development of critical thinking skills
- opportunity for a positive learning experience
- extension of formal science education

How to Help as a Parent

It is up to the student to decide what to study. You can help by motivating your child and listening to his or her ideas. However, it is crucial to remember that it is up to your child to design and execute the entire project. Judges at a science fair take particular care to note that the work is the student's and that the student understands the topic, the research, the experiments, the analysis of data, and the conclusion. The judges expect that the student has received some help from another person, such as a parent or teacher, and that such help will be credited in the display.

Support the Troops Your child may need more attention than a teacher can give to each student in a large class. Some class time will be devoted to researching at the library; however, your child may find it helpful to do more library research outside of school. Expect your child to spend time brainstorming, researching, planning, experimenting, analyzing data, writing a report, and constructing a display. You may offer to spend time with your child at the library. You can also help by encouraging your child to record everything in his or her science project journal, such as notes from brainstorming, sources used during research, and observations made during data collection.

Your child has been told that an adult must be present during all data collection. Please supervise the experimental phase for safety purposes. You may refer to the Safety Guide to help avoid accidents during data collection.

When You Should Help It is very easy to take control of a student's project, especially if you think it should be done differently. Remember that this project is a learning experience for your child, and he or she will not benefit from a project performed by you. If your child is performing all the necessary tasks to an acceptable standard and is not requesting assistance, your job is to supervise. If your child asks for help, appears to be struggling, or is performing below acceptable standards or with disregard for safety measures, then you may wish to offer assistance.

Judging

The criteria on which a science fair is judged can vary, and most judges evaluate projects using the following criteria:

- use of scientific thought
- creativity of approach
- thoroughness of investigation and research
- skill of experimental technique
- clarity of expression in presentation and report

Besides assessing the five categories that appear above, some science fairs reward memorable presentations or displays.

Student Understanding It is very important that the student's work be evident in the project. The scientific process and the manner in which the research was conducted tend to outweigh the actual display of information. The judges will be looking carefully to see that the student has an understanding of his or her project and is responsible for the final product. In a group project, the judges will be looking for evidence that each group member completed specified tasks that furthered the progress of the group.

Enclosed Materials

The handouts for each of the five phases will help you guide your son or daughter through each phase of the project. In preparing for the science fair, please understand that this project is a fun opportunity for independent learning rather than for competition to identify winners and losers. Coming away with a new interest in a particular subject or a new understanding of a scientific principle can be more rewarding than a prize.

A Parent's Progress Report is included in Resources for Parents on pp. 65–66. Please refer to this sheet throughout the project to make sure that your child is on track according to the timeline enclosed in the parent letter. The teacher may use the Parent's Progress Report for grading purposes.

Name _____ Date _____ Class _____

Parent's Progress Report

individual project team member

For each step of each phase of the science project, record the task due date and the date the student accomplished the task. You might want to reward your child for completing each phase.

Phase 1—Generating an Idea	Date due	Date accomplished
Student brainstormed five possible subjects.		
Student came up with two investigative questions for each topic.		
Student consulted with teacher and parents about project possibilities.		
Student chose a suitable topic.		
Student formed a hypothesis.		
Student discussed topic and hypothesis with teacher and gained approval.		
Student recorded ideas in the science project journal.		

Phase 2—Research and Planning	Date due	Date accomplished
Student researched the hypothesis.		
Student reconfirmed or changed the hypothesis based on further research and then gained teacher approval.		
Student contacted all appropriate people before beginning data collection.		
Student recorded all details of research so far in a bibliography in the science project journal.		
Student filled out the Procedural Plan for Action and obtained necessary signatures.		
Student developed the initial plan for display materials.		

Parent comments: _____

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Parent's Progress Report, continued

Phase 3—Data Collection and Analysis	Date due	Date accomplished
Student conducted the experiment safely.		
Student chose an appropriate sample size.		
Student performed several trials of his or her experiment.		
Student collected data accurately.		
Student recorded all data and observations in the science project journal.		
Student graphed or charted data and looked for trends.		
Student prepared a written conclusion supported by the data.		

Phase 4—Writing a Report	Date due	Date accomplished
Student answered the questions on page 55.		
Student prepared an outline and discussed it with the teacher.		
Student prepared a draft and discussed it with the teacher.		
Student revised the draft according to the teacher's feedback.		
Student turned in final draft of the written report.		

Phase 5—Creating and Exhibiting a Display	Date due	Date accomplished
Student sketched possible designs for display.		
Student created a display board within the appropriate parameters.		
Student displayed the results in a clear and interesting manner.		
Student gave an oral presentation as practice for the science fair interview.		

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Phase 1—Generating an Idea: Getting Involved

DURING THIS PHASE, STUDENTS WILL:

1. brainstorm five possible subjects
2. come up with two investigative questions per topic
3. consult with teacher and parents about project possibilities
4. choose a suitable topic and investigative question
5. form a hypothesis
6. discuss topic and hypothesis with the teacher and gain approval
7. record ideas in their science project journal

At the beginning of the project, you may wish to consult the timeline that was included in the packet of information that was sent to you. Also, you may want to contact the teacher to find out the specific judging criteria and display requirements for the particular science fair that your child will be entering.

This is fun! Throughout the course of the project, especially during the beginning stages, you may remind your child that one of the main goals of the project is to have fun. While healthy competition can be exciting, the purpose of a science project is to learn science through inquiry in a hands-on experiment.

The Journal: Your Child’s Most Important Tool Your child will record everything he or she does in his or her science project journal. This includes all brainstorming lists, research notes, data, and observations. Your child will need the journal for all phases of the science project, so it is important that he or she keep careful track of it. Also, you may want to check the journal periodically as a way of keeping up with your child’s progress.

Brainstorming for Topics

During Phase 1, students will be brainstorming for scientific subjects that interest them. Subjects can be as simple as how light affects plant growth or as complex as how carotenes affect cancer growth. Students often find the pressure of coming up with a suitable idea the most challenging part of a project. You can help by acting as a sounding board for ideas or reminding your child of things that he or she has been curious about around the house. Students will need to brainstorm five possible topics and eventually develop two investigative questions for each topic.

The Investigative Question

The investigative question is what the experiment is intended to find out. This question should narrow down the topics to specific areas of interest. For example, if a student chooses biological clocks

as a topic, he or she might ask, “Does the length of time for which a hamster is exposed to daylight affect how much it eats?”

Ten Questions After every student has selected five topics, the class will visit the library to research the subjects that students have chosen. Students will create 2 investigative questions for each topic, a total of 10. It is likely that one of these questions will develop into a successful project. However, brainstorming more than one topic will allow students to change topics with little difficulty if they choose a topic that doesn’t prove fruitful.

Choosing the Best Investigative Question As it turns out, “Does the length of time for which a hamster is exposed to daylight affect how much he eats?” may be a problematic investigative question because many science fairs prohibit the use of vertebrates in any experiment. The teacher will be familiar with the specific rules of the science fair and will steer students away from experiments that would lead to disqualification. There are many testable investigative questions within a topic, and one of them will probably fit the requirements of the science fair. Another investigative question for the subject “biological clocks” that may be more appropriate for a science project is “Does the length of time for which a flowering plant is exposed to daylight affect the rate at which it produces flowers?”

The Hypothesis

Once a student has selected an investigative question, the next step is for him or her to develop a hypothesis. A hypothesis is an educated guess that answers the investigative question. After reading about flowering plants and their growth patterns, the student will be able to guess whether flowering plants have biological clocks. Two appropriate hypotheses for that investigative question would be as follows:

- The length of time for which a flowering plant is exposed to daylight affects the rate at which it produces flowers.
- The length of time for which a flowering plant is exposed to daylight does not affect the rate at which it produces flowers.

Have your child list all the possible answers to the investigative question and choose the one that is most likely to be correct according to the research he or she has done. The chosen answer will serve as your child’s hypothesis.

What If the Hypothesis Is Inaccurate? Often students feel great pressure to be right about things. If you find that your child is discouraged because the results of his or her experiment disprove the hypothesis, remind him or her that the quality of the project is independent of the accuracy of the hypothesis.

✓ If your child is involved in a group project, try to monitor his or her individual participation in the project. Consult the timeline, and check your child’s progress at the end of Phase 1.

Phase 2—Research and Planning: Getting Involved

DURING THIS PHASE, STUDENTS WILL

1. research the hypothesis
2. change or reconfirm the hypothesis with the teacher
3. contact all appropriate people
4. record all research sources in the science project journal
5. fill out the Procedural Plan for Action and obtain signatures
6. develop the initial plan for display materials

Research

By now your child has settled on an investigative question and a hypothesis, and it is time to do further research. Your child may need help with basic researching techniques both at the library and on the Internet. Further library research trips may be necessary for your child to confirm his or her hypothesis and determine how to test the hypothesis effectively. If your child has access to the Internet at home, you may want to help him or her find appropriate sites for science project research. Please continue to encourage your child by discussing the project with him or her.

Your child may wish to obtain information using other methods, such as seeking an interview with a scientist or writing a letter to a company. Encourage your child to contact all sources early in Phase 2 in order to allow plenty of time for a response.

Bibliography Students will need to prepare bibliographies for both the research project and the display, so remind your child to keep careful note of all sources. These include documentaries, interviews, Web sites, television programs, books, newspapers, and magazines. Your child is expected to record this information in his or her journal.

Procedural Plans

After a few trips to the library and some interviews or Internet research, your child will know whether he or she is comfortable with the chosen investigative question. Then, your child will consider how he or she is going to test the investigative question. Students' packets include discussions of control groups versus experimental groups and dependent variables versus independent variables. The teacher will most likely discuss these concepts in class.

Voice Your Concerns The teacher has required that your child fill out the Procedural Plan for Action on page 47 of Resources for Students. Students are also encouraged to use the Task List (page 48). The teacher will be watching for projects that require too much time or money. *If, for some reason, you think that the project is unreasonable (because of cost, workload, or lack of interest on your child's part), now is the time to contact the teacher. Soon it will be very difficult for your child to switch topics.*

The Price is Right In most cases, there will be minor costs involved in your child's science project. As your child formulates a science project, he or she will be asked to evaluate the costs involved with performing each experiment. You can assist your child with this process and help create an informative project that stays within your family's budget. In certain cases, a science fair entry fee or travel expenses may be required. In general, here are a few items you can expect your child to need:

- journal
- materials necessary for experimentation
- materials necessary for display (posterboard, markers, etc.)
- books (using the library can help avoid these costs)

Less Is More Judges often take creative use of materials into account when judging a science fair, and expensive projects probably will not be recognized as better just because they employ fancier equipment. The library and Internet provide resources with suggestions on how to make equipment using materials that are inexpensive or can be found around the house. Also, many businesses and institutions will lend equipment to young scientists. Encourage your child to write to local businesses for help in obtaining materials if the schedule allows enough time for him or her to receive a response. You may wish to consult a scientific supply company, such as those listed in the box below, in order to determine how much materials will cost.



TIP

The following is a list of a few scientific supply companies that specialize in laboratory equipment. These companies require that biological and chemical supplies be purchased by your child's school and shipped to his or her teacher.

Carolina Biological Supply Co.
2600 York Road
Burlington, NC 27215
(800) 334-5551

Science Kit and Boreal Labs
777 East Park Drive
Tonawanda, NY 14150
(800) 828-7777

WARD's Natural Science Establishment, Inc.
5100 West Henrietta Road
Rochester, NY 14585
(800) 962-2660

✓ If your child is involved in a group project, try to monitor his or her individual participation in the project. Consult the timeline, and check your child's progress at the end of Phase 2.

Phase 3—Data Collection and Analysis: Getting Involved

DURING THIS PHASE, STUDENTS WILL

1. conduct experiments safely
2. choose an appropriate sample size
3. perform several trials of the experiment
4. collect data accurately
5. record all data and observations in their science project journal
6. graph or chart the data and look for trends
7. prepare a written conclusion supported by the data

Although your child’s science teacher will plan for some in-class data collection, much of the data collection phase of the project may be done at home. Your child has been told that an adult must be present during all data collection. For your child’s safety, please supervise the data collection phase. You may refer to the Safety Guide in the student resource packet to help avoid accidents during data collection. This is a good time to review the Safety Contract with your child.

Over the next few weeks, you may want to help your child in the following ways:

- Familiarize yourself with the Phase 3 student instruction sheets, and help your child understand the importance of each technique, such as using an adequate sample size, collecting the right type of data, and performing several trials of an experiment.
- Make sure that your child is measuring accurately.
- The International System of Units (SI) is a global measurement system that helps scientists share and compare their observations and results. If there is a requirement that your child express data measurements using SI, make sure that he or she understands this requirement.
- Check your child’s science project journal to make sure that he or she is keeping a neat record of all aspects of the project.
- Assist in explaining charts, graphs, or basic concepts of analysis when necessary.
- Motivate your child by showing interest and asking questions, and allow him or her to decide how to conduct the experiment.

✓ If your child is involved in a group project, try to monitor his or her individual participation in the project. Consult the timeline, and check your child’s progress at the end of Phase 3.

Phase 4—Writing a Report: Getting Involved

DURING THIS PHASE, STUDENTS WILL

1. answer the questions on page 55 of Resources for Students
2. prepare an outline and discuss it with the teacher
3. prepare a draft and discuss it with the teacher
4. revise the draft according to the teacher's feedback
5. turn in a completed draft

When your child's teacher assigns the written report, you may want to be sure that your child understands what is expected. He or she needs to follow the rules for how long the report should be, whether it must be typed, etc., especially if a written report is required for the science fair. You may want to contact the science teacher for report guidelines. The written report will represent your child's ideas and conclusions about the project, so it should be well thought out and neat.

The Process

Students will be asked to answer the questions on page 55 of Resources for Students. The questions are designed to get students thinking about what they learned and what they enjoyed the most about the science project. After answering the questions, students will create an outline of the information to include in their written reports. Using index cards may help with the organization part of the assignment. Once students have completed their outline, the teacher will meet with them to offer constructive criticism. From there, students will create at least one rough draft.

Positive Feedback If you help your child with an outline or draft of his or her report, remember that giving and receiving feedback can be difficult for parent and child. Here are some tips to aid the process:

- You may want to mention both the strong and weak points of an outline or a draft.
- You can certainly help your child with neatness, spelling, and grammar, but the ideas and writing should be his or her own.
- Remind your child to cite all sources he or she used. In the bibliography, your child should also acknowledge the help he or she received from parents, teachers, and other people.
- Be aware that your child's writing ability can affect the overall presentation of information. Imperfections in writing style may overshadow the scientific content. You may wish to check your child's report to ensure that it is factual and organized.

What to Include in the Written Report

Most scientific reports follow the same order as the steps of the scientific method, explaining the entire experimental process from beginning to end. Student reports should be ordered as follows:

- Your child may include some background information about the topic before stating the purpose and hypothesis of the project.
- A description of the procedure comes next, followed by the data acquired during the experimentation.
- Your child may choose to include charts, graphs, or photographs, but it is best to save most figures for the display.
- Last, your child will describe the conclusions that resulted from the data analysis. The conclusion is also the place to address some of the questions asked on page 55 of Resources for Students.
- You might also encourage your child to include suggestions for further study or a brief description of how he or she would do the project differently next time.
- Invite your child to have fun with the written part of the project.

✓ If your child is involved in a group project, try to monitor his or her individual participation in the project. Consult the timeline, and check your child's progress at the end of Phase 4.

Phase 5—Creating and Exhibiting a Display: Getting Involved

DURING THIS PHASE, STUDENTS WILL

1. sketch possible designs for the display
2. create a display board within the appropriate parameters
3. display results in a clear and interesting manner
4. give an oral presentation as practice for the science fair interview

The Display Board

The purpose of a display is to present the information in the clearest manner possible so that the judges will be able to recognize quickly that the student performed a successful science project. You may want to encourage your child to be creative with borders, fonts, and layout, but have them make sure that a judge would find it easy to read the information contained in the display. Illustrations should be informative, not just decorative. A sleek, mature, and professional style can impress the judges, but they prefer presentations which are unique and clearly a product of the student.

Portable A display board can have a large middle section and two smaller “wings” on the left and right. This design allows the display to fold up, making it more portable. If the science fair is located far away, you might ask other parents to share the expense of renting a moving truck or trailer in order to save many families the worry of transporting displays that don’t fit comfortably into cars.

HOW CAN I HELP?

- Encourage your child to sketch out a design before he or she begins making the display.
- Check charts and graphs for accuracy and readability.
- Make sure that the information shown is relevant to the purpose, hypothesis, and conclusion.
- Remember that judges are looking for conclusions based on experimental evidence, not on opinions.
- Give your child a pep talk before the interview.
- Tell your child some tricks that you use to remain calm and focused.

Preparing for the Interview

Find out if your child needs to make a presentation to the judges at the science fair. The presentation summarizes each step of the science project: why students chose their subject, a statement of the hypothesis, what type of data was collected, a brief summary of the data, and the conclusions that students came to when they analyzed the data. Your child may also discuss how he or she would do the experiment differently if he or she were to start over again or what other questions arose during his or her research.

Practice Makes Perfect If your child practices a few times he or she will have a great advantage over students who haven't rehearsed. Your child could practice by explaining the project to your family and friends. During the interview, the judges will likely ask the student a few questions. If you ask a few questions during your child's practice presentations, he or she may feel more comfortable answering the judge's questions.

✓ If your child is involved in a group project, try to monitor his or her individual participation in the project. Consult the timeline, and check your child's progress at the end of Phase 5.

Be Supportive

Hopefully, every student will be recognized for his or her effort at the science fair. To show your support for your child, try to attend the science fair if possible and be proud of his or her individual effort and the part you played in his or her growth as a student.