SUPER SCIENCE FAIR SOURCEBOOK

MAXINE HAREN IRITZ

GREAT TEACHER RESOURCE GUIDE

INCLUDES PROJECTS

REPRODUCIBLE CHARTS, FORMS, AND CHECKLISTS

Super Science Fair Sourcebook

Maxine Haren Iritz

LEARNING TRIANGLE PRESS

Connecting kids, parents, and teachers through learning

An imprint of McGraw-Hill

New York San Francisco Washington, D.C. Auckland Bogotá Caracas
Lisbon London Madrid Mexico City Milan Montreal New Delhi
San Juan Singapore Sydney Tokyo Toronto

McGraw-Hill

A Division of The McGraw-Hill Companies

pbk 6 7 8 9 CUS/CUS 09876543

Library of Congress Cataloging-in-Publication Data

ISBN 0-07-032849-8

McGraw-Hill books are available at special quantity discounts to use as premiums and sales promotions, or for use in corporate training programs. For more information, please write to the Director of Special Sales, McGraw-Hill, 11 West 19th Street, New York, NY 10011. Or contact your local bookstore.

Acquisitions editor: Judith Terrill-Breuer
Editorial team: Robert E. Ostrander, Executive Editor
Sally Glover, Book Editor
Jodi L. Tyler, Indexer
Production team: Katherine G. Brown, Director
Lisa M. Mellott, Coding
Janice Ridenour, Computer Artist
Toya B. Warner, Computer Artist
Rose McFarland, Desktop Operator
Design team: Jaclyn J. Boone, Designer
Katherine Lukaszewicz, Associate Designer

SFP2
0328498

A word to parents

It has been eight years since I worked on my very first science project book. That book, "everything you've always wanted to know about science projects," was followed by two more books that described and analyzed student projects on the beginning and advanced levels.

Since then, much has changed, but more has remained the same. Computers, which were simply an aside in my first book, have since become so much faster, more sophisticated, and accessible that for many students, computers are a powerful tool when working on a science project. However, many of the factors that were important eight years ago (and before that) are still important now—thorough research and experimentation, good record keeping, interest, integrity, and dedication. Therefore, this new sourcebook addresses students with and without access to computers. The science fair experience is of great value in so many ways that it should be available to all students, even those with limited resources.

As has been true for the last 40+ years, Americans are concerned about education, especially math, science, computers, and engineering. We've found out that even under the best of circumstances, education often doesn't always keep up with technological advances. As a result, loss of jobs, economic decline, and a sense of displacement from society often create greater demands on parents, students, teachers, and the educational experience as a whole.

These days, it seems that education is like the weather; everyone complains about it. "Can't read, can't write, can't compute, can't function" seem to be the common gripes. Without engaging in an editorial, I believe that if any of these critics visited a local science fair, they would be forced to reconsider their opinions.

One way to encourage and reward an active, hands-on interest in science is the annual science and engineering fair. Now a feature of elementary, intermediate, and secondary schools, science projects call upon students to integrate many facets of their talents, abilities, and acquired knowledge.

Projects exhibited at a science fair require students to do research and conduct experiments in order to prove a hypothesis. When finished, these projects, together with displays, are entered in individual school fairs, where winners from each category advance to a regional science fair. The most outstanding projects proceed to state or international competitions, where recognition, scholarships, trips, and other prizes can be considerable.

As parents, you're probably reading this book because your child is planning to do a science project and is looking forward to competing in a science and engineering fair. For some students, the project is an unwelcome chore, required for a grade in science class. Others, already interested in some aspect of science, are looking forward to doing their projects.

Although valuable and rewarding, a science project requires a major commitment of time and effort for the better part of a school year. If it is a first project, it is most likely the largest single effort the student has ever made. Along the way, first-timers need encouragement, moral support, and often some very specific assistance.

Preparation can often take up to a year of intense effort, from the crucial first step, the selection of a topic appropriate to the interests and abilities of the student, to the construction of the display at the project's conclusion. Errors can be costly, both in terms of money spent for supplies and equipment and the time and energy diverted from the ultimate goal.

Parents are essential to the success of a project, especially for a first-timer. Unfortunately, many parents might not know how to best help their youngsters, especially if parents have never done a project themselves. One goal of this book is to help parents help their youngsters achieve not only success, but also enjoyment and satisfaction from the entire science fair experience. Teachers, although an important resource, are often so busy with their many students and their projects that they are spread rather thin and cannot always deal with the detailed problems of each student's experiment.

This book presents a clear guide on how to complete a successful science project. To do so, the text leads you through the steps involved, giving some concrete examples from "real-life" projects. The book also includes information and advice from teachers, judges, participants, and their families, advice geared towards guiding you down the easiest road to success and helping your child avoid the pitfalls. From the very first step, choosing a topic, until judging day at the science fair, this book covers just about anything and everything you need to know.

Whether or not your children decide to focus on careers in science, computers, or engineering, you'll find that the experiences your children have and the lessons they learn while doing a science project will have lasting benefits. One young man who worked on several science projects in junior and senior high school was faced with a large sociology project during his freshman year in college. Most of his classmates were in a panic, but he was quite calm. "It's just another science project," he said.

NOTE: Before you plan an experiment using live vertebrates or tissue samples, check your state and local regulations.

Contents

1
Introduction

At least half of you students reading this book are hoping that it will create a miracle and show you how to quickly and painlessly create a winning science project. It seems so overwhelming, with so many things to do. Besides, it might be half of your science grade. So this is stress!

Some of you might be among the lucky ones who want to do a project. Perhaps you're interested in some area of science and already have chosen your project idea. Maybe you just like to compete and match your abilities against your peers.

Whatever your reasons or motivation, if this is your first project, it might be your first independent study. Working on your own is one of the most important benefits of doing a project. Although you'll have help from parents, teachers, and other resources, this project will be entirely your responsibility (in many cases, you'll even be responsible for finding help). You'll do the planning and scheduling as well as executing the research and experiment. Although you will use many of the procedures and techniques that you've learned in science lab, you'll have the freedom to set your own pace.

The first, and possibly the most important, phase of the project is selecting your topic. This gives you the opportunity to investigate the ISEF categories and explore the general topics included in the various scientific disciplines. While going through the process, you'll find out which topics interest you the most. Perhaps you'll learn about subjects you never thought about before.

Another important element is the background research paper. Throughout high school and college, you'll be graded on the ability to write a well-researched and presented paper. For many of you, the research paper will be graded not only by your science teachers, but also by your English teacher.

Completing a project will give you real "on-the-job experience" in carrying out an experiment using sound scientific methods. In your school labs, your teachers generally specify the steps to follow for each experiment and provide the

materials you need to work with. Teachers are always on hand to ensure that the procedure is carried out safely and properly.

When completing your project, you must design your experiment, find the materials, specify the procedures, safely do the experiment, and record and measure your observations, making sure that you properly adhere to scientific methods.

When the experiment is finished, you'll have to compile and tabulate your results. To do this, you might need mathematical or statistical skills, as well as the ability to graphically show your results. Finally, you'll develop your conclusions based on the results of the experiment. This will demonstrate your ability to relate the facts you have researched with the results of your experiment.

In your concluding statement, you can also speculate on the possible benefits to society that your results might present. Here you can also mention any plans you might have to continue working in that area. Sometimes, students become so fascinated with their subject area that year after year, they continue expanding on their research topic until, by the time they're 12th graders, they've become experts in their field.

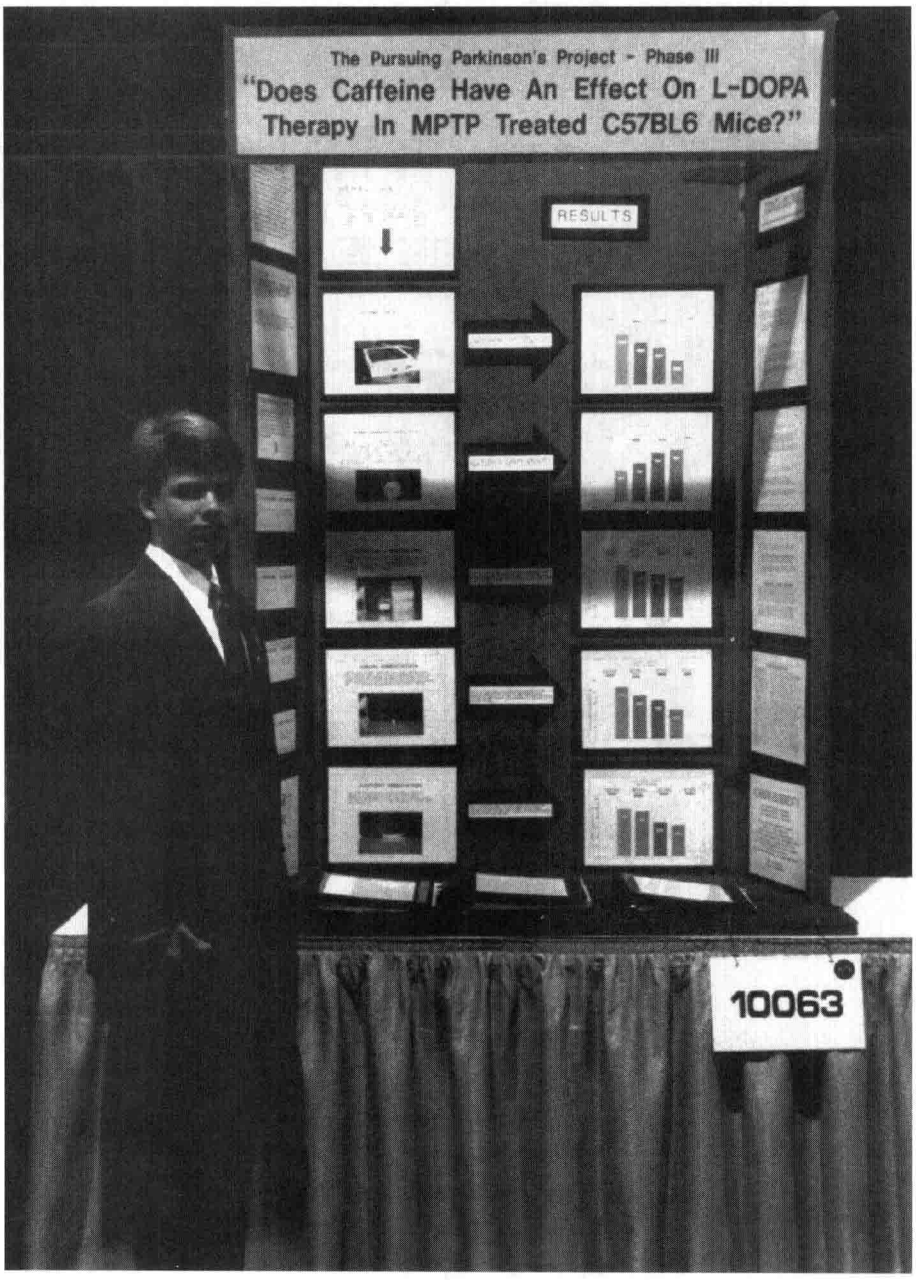
One young man, Benjamin C. Preisner, started in ninth grade with a project to determine if caffeine produced color changes in frogs. That summer, he saw a television special on Parkinson's patients, put the two ideas together, and began a series of projects on the effect of caffeine on Parkinson's patients. Each project generated more interest, including grants from the United Parkinson's Foundation and the National Parkinson's Foundation. Figure 1-1 shows Ben's project display.

Doing a science project might satisfy the artist in you, too. Creating a display, which will illustrate and present a summary of your project, should show you and your work to its best advantage. Producing an effective backboard will call on your design, artistic, and photographic skills. Figures 1-2 and 1-3 show some attractive and original project displays.

If this is your first science fair, you're probably wondering what judges look for. At all levels, judges agree that the steps and methods used in the experiment are usually more important than your results or whether you prove your theory.

If you advance beyond your school fair, you'll probably get to spend a few days at the city, county, or state fair. There, fair organizers usually offer guided tours to areas of interest, such as museums, hospitals, universities, or laboratories. Professionals are sometimes available for counseling about scientific careers. Finally, you'll also get the chance to meet new and interesting people. In the process, you'll discover within yourself a poise and grace you never knew existed.

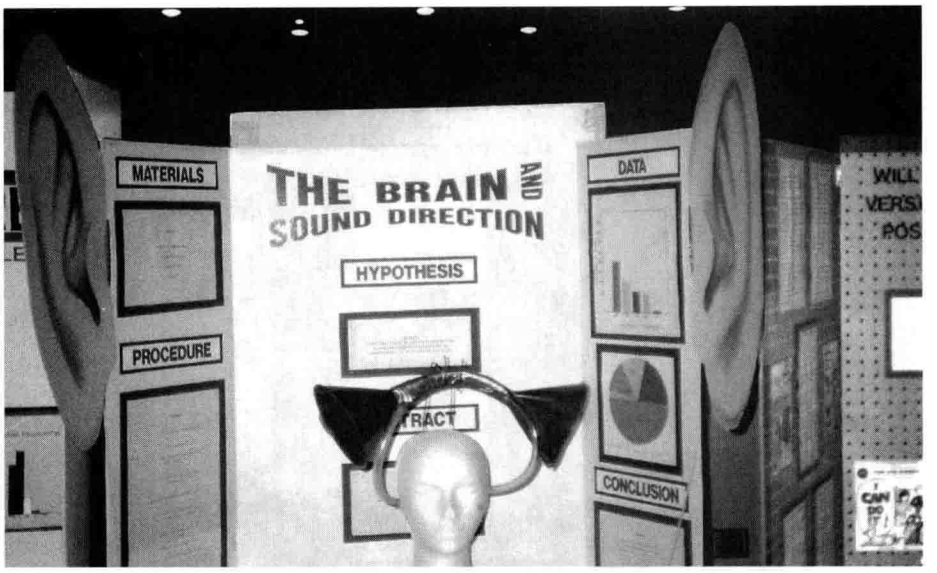
Although it is by no means necessary to have a home computer to do a successful science project, I have described, in extensive detail, how to use the computer to make your work easier, suggesting ways to use your system at all stages of project development. For those of you who do not have your own system, several students said they were able to use their school computer labs after hours or on Saturday.



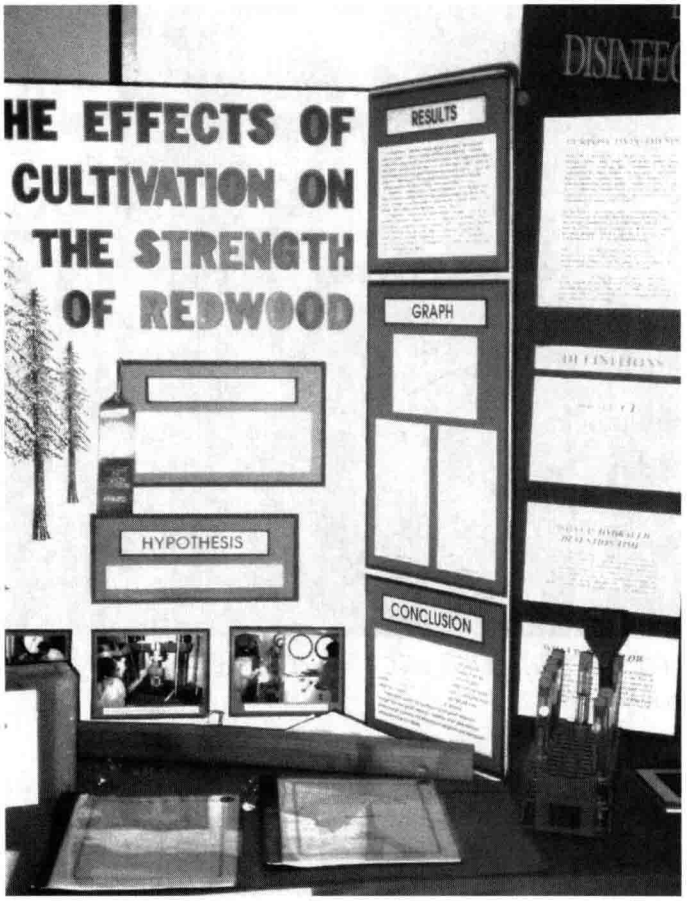
1-1 *Does Caffeine Have an Effect on L-Dopa Therapy in MPTP Treatment in Mice?—Backboard.*

Although we are definitely in the information age, I don't want anyone to think that a computer is required for success. I've included several winning projects that were done manually on a limited budget.

For many of you, a science project is the largest, most complex piece of work you've ever attempted. Although the individual parts of the project might not be difficult, to complete the whole task you'll need to use a combination of



1-2 *The Brain and Sound Direction—Backboard.*



1-3 *The Effects of Cultivation on the Strength of Redwood—Backboard.*

skills, some of which you never even knew you had. Other attributes, such as creativity and flexibility, are a little harder to pin down, but these are qualities that will also be helpful. If you don't start the project with these abilities, you'll have many of them by the time you finish.

While you're working on your project, you'll also develop a better knowledge of yourself. With so many different aspects of a science project, you'll learn whether you love research, hate libraries, are afraid of handling chemicals, get excited when the statistics come out just the way you want them, relate to plants, or get turned on creating an attractive display.

You'll also get a strong feeling for the way you like to work: Thursday the 23rd between 2 a.m. and 4 p.m., or any time between the first day of school and President's weekend? Some people like a firm, structured schedule, with every task broken down to its smallest element and assigned to a specific time slot. Others are very well disciplined and can pace themselves and set their own goals. There are those, however, who like to live dangerously. They perform well only when they have a fast-approaching deadline, with more work than they can reasonably handle (to the frustration and panic of their parents and teachers). Some people prefer to do one task at a time, and others can work on many things at once. For most of you, a science project is the first opportunity to learn how you work best.

This book presents fully developed science projects in a variety of categories. However, the projects are grouped to illustrate the many ways you can get science project ideas. Incidentally, all the projects shown are actual projects that students have developed, from day one to science fair, and through all the steps in between. As you will see, some of these projects are fairly easy to do, while others are quite complex. Not all of these projects are top prize winners, but they are all top-notch projects done by students just like you.

You'll see every step in the development of these projects—from vague concept to science fair display. For each project, you'll learn how students found their topics, conducted project research, and developed the questions and hypotheses.

You'll see how students got organized to begin their experiments, and bought, begged, borrowed, or built their supplies and materials. By seeing how others succeeded, you'll also learn how to conduct an experiment or write and test a computer program. You'll see the results and find out how each student reached his or her conclusion. We'll also illustrate how each experiment, device, or program was displayed to its best advantage. Finally, we'll include some helpful hints for organizing and working on your own projects.

This book was written for you, the student, to make the science project experience an enjoyable and fulfilling educational experience. Because it is probably your first undertaking of this type, you might doubt whether you can do it. Many other students have approached their projects with the same mixture of fear and uncertainty. However, with an open mind, a lively curiosity, and a willingness to dig in and work, they have created effective, scientifically acceptable, award-winning projects.

For many of you, the learning will extend far beyond the areas of science to writing, art, mathematics, and research. I hope you will also find a true sense of pride, confidence, accomplishment, and a true joy of learning.

Like any other long-term effort, a science project is filled with many small victories, false starts, bursts of activity, periods of procrastination, sleepless nights, and stomachs full of butterflies. Through it all, regardless of awards or grades, everyone who completes a project is a winner.

Remember that the main objective is learning. One student, who worked on a large-scale project for several years, said, "Spending so much time on a science fair project might be hard to imagine, but if you're intensely curious about something, the time you spend answering it for yourself will give you more knowledge and experience than you would have gotten from a text. The purpose of science is to help us understand everything around us and within us. Do your project knowing that your time was spent well, developing a greater understanding of who you are, where you are, and what your purpose is here." Look at your science project not as an assignment but as an adventure. Happy exploration!

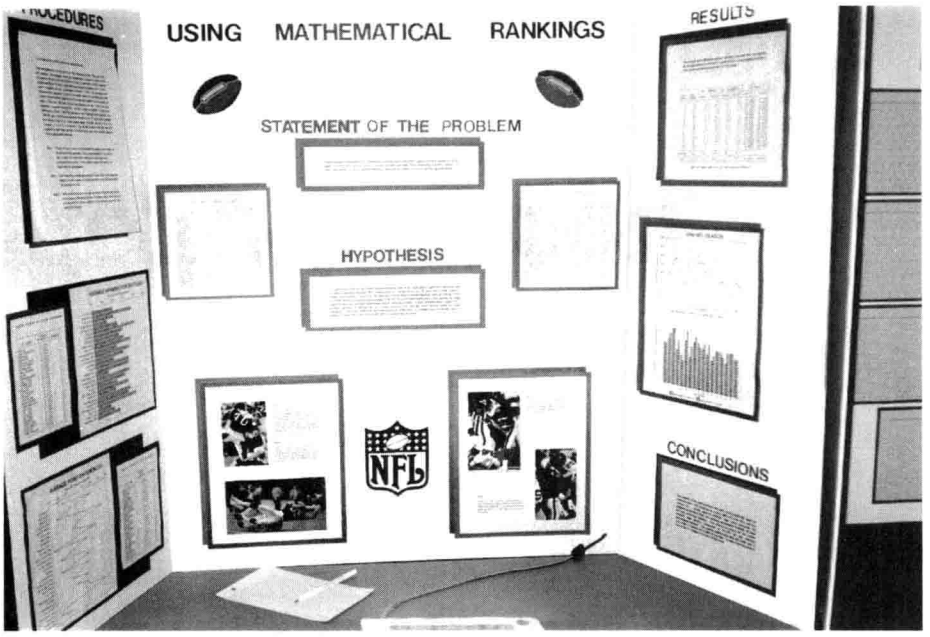
2
Choosing a topic

All science projects begin with an idea, an inspiration, and the ability and enthusiasm to complete a project. Actually, for many of you, science project ideas start even before that, when your science teacher announces that you will do a project if you have any hopes of passing the class. So before you even take the first step, you should get yourself mentally prepared to accept the challenge.

Probably the hardest part of any project is finding a topic. You don't want something so simple that even a child of four could do it, but neither do you want something that requires the talents of a rocket scientist. You don't want to rehash a topic that's been entered (several times) in every science fair since your mom was in school, but you can't pick something so obscure that you can't find any information. If there is one factor that is essential to the success of all science projects, it is the choice of topic. Some of the exhibitors, especially those competing for the first time, said that finding a subject was the most difficult part of the entire experience. Most students wanted an idea that was original, or at least not overdone. Everyone wanted a concept that excited their curiosity, but they also wanted an experiment that wouldn't be too difficult.

The best project idea for you is one that you're interested in. You will be involved with your science project for almost the entire school year. If you find a topic that's interesting, you'll probably have fun, too. And if you're having a good time, the odds are that you'll finish successfully.

Okay, so you're interested in sports, music, cars, food, and boys (or girls). And so is everyone else, which brings us to the next problem—finding something unique. You might have a particular hobby or interest that will give you an idea. Do you play chess, water-ski (or snow-ski, for that matter), fish, or sew? There might be an idea in one of those pursuits. For example, see chapter 3 for a discussion of some projects, in all categories, based on sports. Figure 2-1 shows the project display for a "sports" project.



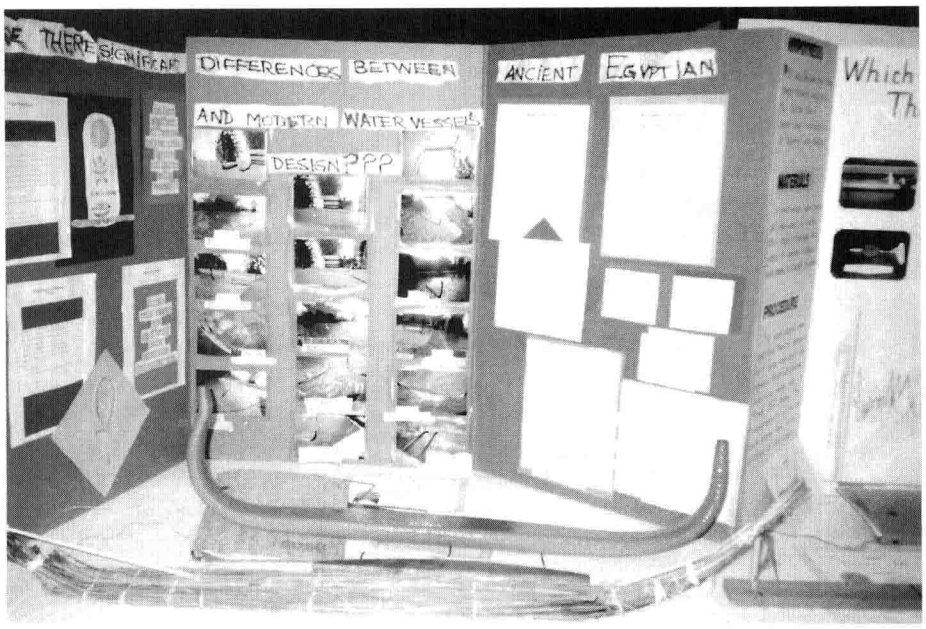
2-1 *Using Mathematical Rankings—Backboard.*

One way to find out if your idea is original is to look at programs from previous science fairs to see what's been done frequently. Your teachers will also be glad to tell you what projects they don't want to see. If you're lucky, you'll get a list of "banned" projects before you're committed to a topic.

Some of the best sources of ideas are your math, science, or computer classes, especially something you're currently studying. This way you'll already know something about the topic. Also, your textbook might contain additional sources of information. However, don't limit yourself to math, science, and computer classes. Even classes in social science might suggest an excellent topic idea. For example, a class discussion on subliminal advertising led to an animal behavior experiment that measured the effect of sound on mouse appetite. History courses that deal with prehistory might lead to a project dealing with fossils, ancient ship design, or dating ancient artifacts, as shown in Fig. 2-2.

Another place to look for an idea is in your family. There's nothing wrong with doing a project on the strength of different types of wood if your mom is a carpenter. For most projects, you'll need some sort of assistance, and there's no place like home! Some students have developed excellent projects because they became interested in a parent's profession or hobby. As long as you don't have someone else doing your work, there's nothing wrong with getting your idea or inspiration from someone you know.

A word of warning, however. Well-meaning friends and relatives might propose or try to impose ideas, and even offer their assistance. Before you make a decision, be sure that you want to do this project and that you have the ability to complete it on time. A project that relies solely on the knowledge and work of parents, friends, and relatives will not help you to achieve any of your goals in doing a project. If you are uncertain, discuss the idea with your teacher or ad-

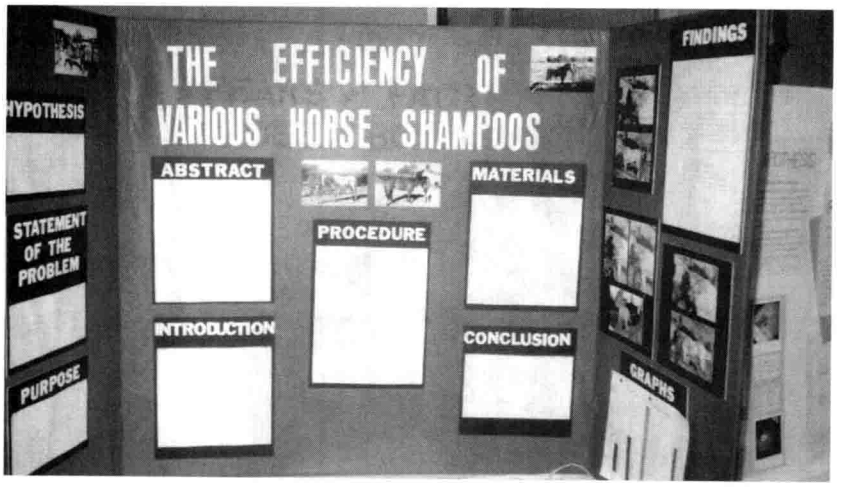


2-2 *Ancient Egyptian and Modern Vessel Design: Are There Significant Differences?—Backboard.*

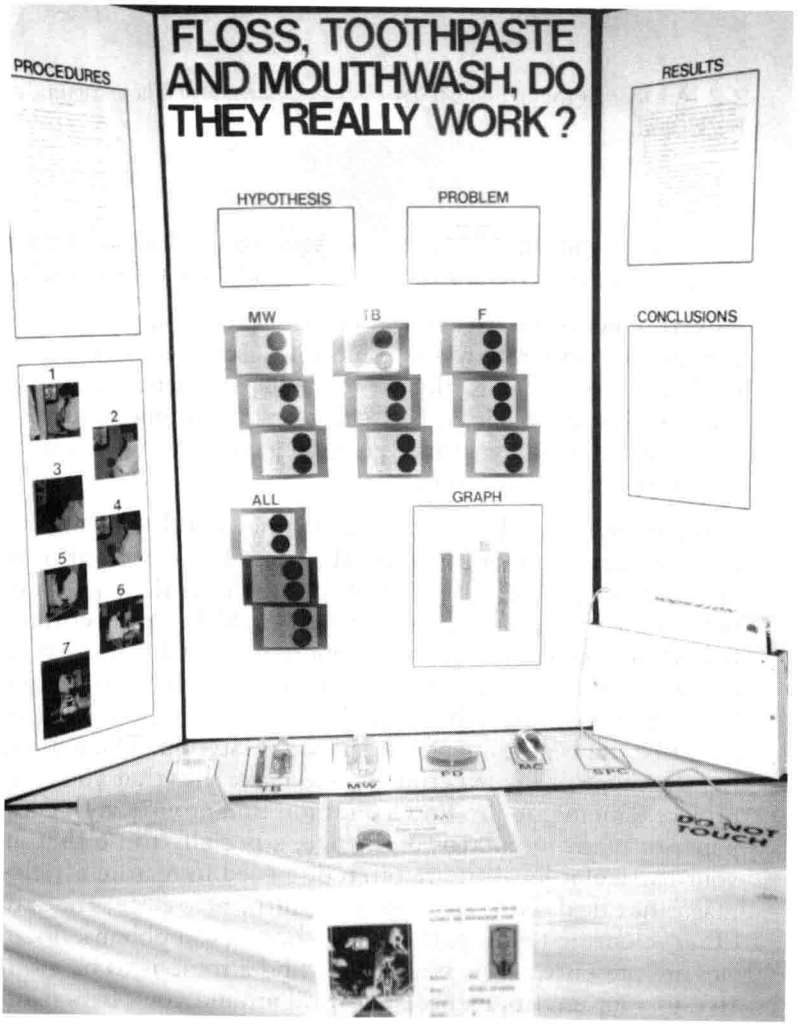
viser. He or she will be glad to talk with you and might even point out something (either positive or negative) that you hadn't yet thought of.

Advertisements are excellent sources of project ideas, and today's TV jingle can be the inspiration for tomorrow's science project. "Whiter, cleaner, brighter," says the ad. Really? How? Perhaps a science project will show you. In some local science fairs, a new category in consumer and product testing has been created to address this type of project. Figures 2-3 and 2-4 show projects that deal with product testing.

Many students get their ideas from the news of the day and often want to use their projects to right some social wrong. It's important to realize that your eighth-grade project will probably not discover the cure for cancer or fix the hole in the ozone layer. However, you could do a project that addresses some important concerns on a smaller, more local scale. You can certainly analyze the smog or pollution in your area, or try to measure the effects of secondhand smoke, as you will see in chapter 15. Also, the work that you do now might be the beginning of greater efforts later on. The main reason for limiting the scope of the experiment is to make sure that you can actually do the project. You might also find a question that arouses your curiosity in a newspaper or magazine. Areas of science, especially those that are important in your particular locality, are often discussed in feature articles. Weekly news magazines deal with the areas of health, aerospace, the environment, and other scientific fields, particularly when new problems, discoveries, or theories are presented. The best way to find a topic is to be aware of and receptive to your environment. The world around you offers many opportunities for topics.



2-3 *The Efficiency of Various Horse Shampoos—Backboard.*



2-4 *Floss, Toothpaste, and Mouthwash: Do They Really Work?—Backboard.*