Teacher's Guide to Science Projects

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Introduction

Remember how you discovered your own love of science. Probably it was a time where you were investigating the answers to a scientific question that was important to you. Doing an inquiry-based science project fosters enthusiasm for science while also improving knowledge and skills.

Science Buddies has created this guide as a starting point to implement a science project program in your classroom. Science Buddies is a nonprofit organization that provides free science fair project ideas, answers, and tools for teachers and students in grades K-12. The goal of this guide is to give you tools to overcome some common science project challenges.

Less Time-Consuming Ways to Showcase Projects

First, leading your students as they tackle science projects doesn't take as much time as you think. This guide will present easy ideas to showcase projects without the additional work of a full-fledged science fair. These easier ways range from presentations in class to a basic expo without judging and scheduling headaches. However, if you want to put on a fair, we have other resources to help you with that.

Tools to Guide Projects

Second, we will provide tools to help your students to do their projects over the long-term, with quality results. These tools include worksheets that take your students through the scientific method step by step and grading criteria forms that make evaluating projects easy.

In Support of Standards

Third, we will demonstrate how science projects help you meet, not detract from, science education standards.

Audience for This Guide

This guide is aimed at a teacher who:

- Has never run a science fair or expo before.
- May not have assigned science projects before.
- Teaches grades 6-8.

Alternative Ways for Students to Wrap Up Their Projects

This guide will present you with four ways to have students communicate the steps and results of their science projects. You can mix and match them as you see fit for your situation:

- Final report: A summary of all steps taken in the scientific method
- Oral presentation: A five to ten-minute presentation by each student to the class
- Display board: A classic science project summary, typically a large three-paneled board
- Science expo: A one-day showcase of project display boards without judging

Benefits

A science project can give your students their first chance to design their own learning experience, one that allows them to innovate just as scientists do in the real world. Each student will:

- Use the scientific method to answer a question.
- Get the chance to choose the area for his or her project.
- Improve math skills by analyzing data and creating graphs.
- Improve reading comprehension and writing skills by doing background research and writing a research paper.
- Learn to manage his or her time through a multiple-step project.

Projects are not just feel-good exercises. We know that you are most likely under pressure to teach to standards, and projects can be powerful ways to achieve standards related to scientific inquiry, as defined by The National Research Council.

Connecting to the Standards

Teaching Standards
Standard A: Teachers of science plan an inquiry-based science program for their students.
Standard E: Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.
Content Standards
Grades 5-8, Content Standard A: Science as Inquiry
Students in grades 5-8 should be provided opportunities to engage in full and in partial inquiries. In a full inquiry students begin with a question, design an investigation, gather evidence, formulate an answer to the original question, and communicate the investigative process and results. In partial inquiries, they develop abilities and understanding of selected aspects of the inquiry process. As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry:
    - Identify questions that can be answered through scientific investigations
    - Design and conduct a scientific investigation
    - Use appropriate tools and techniques to gather, analyze, and interpret data
    - Develop descriptions, explanations, predictions, and models using evidence
    - Think critically and logically to make the relationships between evidence and explanations
    - Recognize and analyze alternative explanations and predictions
    - Communicate scientific procedures and explanations
    - Use mathematics in all aspects of scientific inquiry
- Understanding about scientific inquiry (divided into seven categories)

(National Research Council 1996)

How to Use This Guide

This guide provides two timelines to guide you and students through doing a science project:

- Teacher Timeline: Steps to guide students and plan additional activities, such as an expo
- Student Science Project Schedule: Steps and list of assignments for students

You will find tips on the following pages regarding each of the Planning Activities and Student Assignments listed on the Teacher Timeline. These tips reflect the experience of Science Buddies staff working with many science project programs across the country. After the tips, a Science Expo Planner describes all of the steps for putting on an expo.

In the Appendix you will find two types of useful tools:

- Worksheets for students to complete for many of their assignments
- A letter and guide for parents

This guide defines a science project as an educational assignment that requires students to work independently using the scientific method, which includes the following steps:

- Ask a question
- Do background research (includes writing a background research paper)
- Construct a hypothesis
- Test the hypothesis by doing an experiment
- Analyze the data and draw a conclusion
- Communicate the results

Teacher Timeline

Time	Planning Activity	Teacher Task	Teacher Due Date
At least one month before start	Do initial program planning. Part I: Set goals.	Decide on goals and requirements.	
	Part II: Set the schedule.	Determine program start and end dates.	
	Optional: Make initial expo plans.	See **Science Expo Planner,** Expo Step 1, set date and place.	
Week	**Student Assignment**	**Assignments to Grade / Other Teacher Tasks**	**Student Due Date**
1	Ask a question. Part I: Find a project idea.	1. Hand out **Student Science Project Schedule**. 2. Send information to parents. 3. Grade Topic Selection Wizard results/science project questions.	
2	Part II: Do project proposal.	**Science Project Proposal Form***: Assess safety, practicality.	
3	Do background research. Part I: Collect information.	1. **Background Research Plan Worksheet*** 2. **Bibliography Worksheet***	
4	Part II: Write a research paper.	1. Research Paper* **2. Research Paper Checklist**	
5	Construct a hypothesis.	**Variables & Hypothesis Worksheet***	
6	Optional: Do advance expo steps.	See **Science Expo Planner** to begin Expo Steps 2-6.	
6	Test the hypothesis by doing an experiment. Part I: Design an experimental procedure.	1. Materials List* 2. Experimental Procedure*	
7 & 8	Part II: Do an experiment.	1. Paragraph describing observations 2. Data table	
9	Analyze the data and draw a conclusion.	1. Graph 2. Conclusions	
	Communicate the results.		
+ 1	Option A: Display Board	Display Board	
+ 1	Option B: Final Report	1. Final Report **2. Final Report Checklist**	
+ 1	Option C: Class Presentation	Presentations	
+ 1	Option D: Science Expo	See **Science Expo Planner,** Expo Steps 7-10.	

* Find grading rubrics for these assignments on the Teacher Resources Page on the Science Buddies website.
Bold=a worksheet or tool provided in the Appendix.
Students must pass this assignment to go on to the next.

Tips: Guiding Student Assignments

Step 1: Do initial program planning. Part I: Set goals.

Decide the characteristics of your science project program. Then decide which activities you would like your students to accomplish.

Characteristics of Your Program

Set goals for your program. Here are some suggestions:

- Help all students participating to become enthusiastic scientists.
- Challenge students to learn the scientific method and scientific principles through experience.
- Give students the opportunity to communicate what they have learned to others.
- Others? _____

Who will participate?

- Make participation mandatory for all students in each class.
- Will all of your science classes, or only certain classes, such as an honors class, participate?
- Your decision: _____

Will you allow group projects? ☐ yes ☐ no. Consider the following:

Advantages	Disadvantages
• Fewer projects to grade • Teamwork experience • Easier if groups have succeeded before	• Difficult to assess individual contributions • Not an ideal way to test out teamwork due to science project complexity

Choose a format for source citations in the research paper your students will write. Science Buddies has format examples and sample bibliographies for both MLA and APA formats available on its website. Your school may require one of these formats or use another one entirely. If there is no school policy, confer with other teachers to decide on a uniform standard.

☐ MLA format ☐ APA format ☐ Other _____

Now decide what types of activities, in addition to the basic science project defined above, you will require for your students. Use the table below as a guide.

Choosing Options to Add to the Basic Science Project

Activity	Considerations
Science Project Final Report: A final report pulls together all information already created, including the research paper that is part of the basic science project.	• Leads students to gain and demonstrate understanding of their topic area and experiment • Requires grading and teaching time
Oral Presentation: Students discuss their projects, either with or without display boards, in front of class.	• Builds enthusiasm and pride in sharing work • Requires class time. Consider how to fit this time in with other curriculum initiatives.
Display Board: A display board, the classic way to showcase science projects, communicates a science project to others and includes sections related to all steps of the scientific method.	• Offers a format where students can use diverse talents to design and tell the stories of their projects • Can supplement presentations, as an option • Is required as part of an expo • Creates an additional cost for the project
Science Expo: A science expo is an event where students exhibit their display boards. Students need not be present when others visit their display boards.	• Emphasizes the importance of science projects. They aren't regular assignments but works worthy of viewing by others. • Requires finding an expo location, almost always within the school, for one day • Differs from a science fair. Judging does not take place, and students are not present for the whole event.

Step 2: Part II: Set the schedule.

Decide when you will kick off and end the science project program. Consider:

- Basic science projects will take ten weeks.
- Options, including the final report, presentation, display board, and science expo, will add up to three weeks at the end. See the Teacher Timeline for details.
- Discuss your plans with teachers of other subjects to avoid overburdening students. Make sure that you aren't all setting long-term assignments at the same time. Science projects, especially since they include research papers, are likely the longest assignments in the whole year.
- Set an end date before March, if you want students to go on to regional or district fairs, which usually take place at this time.

Step 3: Optional: Make initial expo plans.

Optional: Do an initial planning step to set up your expo. See the Science Expo Planner.

Step 4: Ask a question. Part I: Find a project idea.

In this step, you set assignment expectations, inform parents, and guide the first assignment.

Setting Assignment Expectations

The Student Science Project Schedule (see Appendix) is a key project management tool, both for you and the students. It directs students to complete manageable tasks in small chunks of time. And it gives you a way to review work at each step, so that students who are off track can start going in the right direction without wasting effort.

- Select the appropriate student assignments for the options (e.g., final report) that you have chosen.
- Modify the due date column according to the dates that you have selected.
- In the Appendix, find the worksheets that students hand in for many of the assignments.
- Choose whether to hand out copies of reading assignments or ask the students to read online at the Science Buddies website, depending on your students and their resources.
  Note: You are welcome to duplicate all of the Science Buddies materials for in-class use. See Terms and Conditions of Fair Use on our website for more details.
- Review the readings with your class as appropriate.

Informing Parents

Since a science project is often the biggest project that most students will undertake, it is important to prepare parents in advance. To inform parents that students require guidance at home, send parents a packet containing the following, included in the Appendix: a letter to parents, A Parent's Guide to Science Projects, and a copy of the Student Science Project Schedule.

Guiding the First Assignment

The goal of the first set of assignments is for students to find their project ideas. A key tool that facilitates finding a project idea is the Topic Selection Wizard, available on the Science Buddies website. It not only helps students uncover interests but leads them to science project questions that are inquiry-based and practical. When students are given the chance to find project ideas related to their own areas of interest, they become more committed to working on their projects long term. In addition, using knowledge they already have, they are able to come up with hypotheses and ideas for experimental procedures more quickly and accurately.

- Give class time for students to use the Topic Selection Wizard on the Science Buddies website, if you have access to a computer lab. Otherwise, ask students to do this step at home or in a school or public library offering computer access.
- Remember not to rush this step. Picking a project idea is always one of the most difficult steps for students, and it takes more time than you might imagine.
  Note: The Student Science Project Schedule allows one week for this part, plus another week below for students to finalize selecting their project ideas when filling in their Project Proposal Forms.

Step 5: Part II: Do project proposal. (First Safety Review)

- Review and approve Science Project Proposal Forms carefully and as quickly as possible. Do not allow students to begin their background research before they get your approval of the proposal. Otherwise they may expend a good deal of effort to research an experiment that is possibly unsafe, not supported by their parents, or impractical. *Definitely never allow experimentation to begin unless you approved the proposal*.
- Consider these three critical aspects in your review:
  - Parental support
  - Safety Guidelines
  - Practicality

Parental Support

Make sure that parents have signed and reviewed the Science Project Proposal Forms. Note that by signing, parents agree that they have discussed the project with their children and believe that they will follow through. Parental support for each student's project is imperative, since each student will be accomplishing many of the steps at home.

Safety Guidelines

Assess safety by reviewing students' answers on the Science Project Proposal Form, a good summary of important considerations. In your judgment, has the student answered honestly and

accurately? To evaluate each student's answers, use these Safety Guidelines. You will also use these guidelines again when you evaluate the experimental procedures that students hand in.

Safety is of primary concern for every science experiment. The good news is that most projects involve virtually no risk. Unfortunately, almost any tool or technique, no matter how safe, can be used in an unsafe manner, and at the same time, many potentially dangerous tools are perfectly safe if used in the proper way. Because of this, a list of prohibited projects is not a foolproof way to address safety. Instead consider student proposals according to three tests of safety.

Tests for Safety

Tests for Safety	Description
1. Is it safe for other people or animals that are involved?	All projects involving humans as subjects must involve minimal risk. Unacceptable risks include ingestion or physical contact with any potentially hazardous materials, and undue physical, psychological, or emotional stress, including invasion of privacy. Even if a student is simply surveying other students, you should review questions in advance, decide if the questions meet this test, and determine if a parent/guardian's consent is needed for participating students. Live animals (in particular vertebrate animals—those with a backbone) should be housed, cared for, and observed in a safe and humane manner.
2. If the student is going to another science fair after your own, does it meet the rules for that fair?	If some or all of your students will be participating in a school, city, or county-wide fair after yours, make sure that the projects meet the rules of that fair. Science fairs affiliated with the Intel International Science and Engineering Fair (ISEF) must follow very strict and detailed safety rules, often including pre-approval before experimentation begins. The Science Buddies website has an overview of these rules on the Scientific Review Committee (or SRC) page.
3. Finally, has the student addressed all other safety concerns to your satisfaction?	Make students themselves address safety issues in their project proposal, then you should evaluate: • Where will the experiment be performed? • What safety gear will be used? • Who will be supervising the experiment? Does the person supervising have common sense and/or training in the procedures being used to counteract any risks? If in doubt about the safety of the experiment, just say "no" and ask the student to choose another project.

The Science Buddies website has additional information about safety, including guidelines for some special areas such as chemistry, microbiology, and rocketry on our website. See the Tools, Techniques, and Reference Information section of the Science Project Guide.

Practicality

Since these science projects might represent your students' first experiments, assess whether the project ideas proposed are practical.

- Focus on Science Project Proposal Form questions referring to the subjects below:
  - Measurability of changes to variables
  - Valid fair test
  - Availability of materials, time, and equipment

- Use your science knowledge to assess whether the project will create a change to the dependent variable. Observing a change is more rewarding and less frustrating. While professional scientists often encounter valid experiments with negative results, this type of experiment may not be the most positive outcome for a first science project experience.

Step 6: Do background research. Part I: Collect information.

In surveys of science fair participants by Science Buddies, a wide margin felt that they learned the most from writing their research papers and doing supporting background research.

The purpose of the research paper is to give students the information to understand why their experiment turns out the way it does. The research paper should include four aspects:

- The history of similar experiments or inventions
- Definitions of all important words and concepts that describe the experiment
- Answers to all background research questions
- Mathematical formulas, if any, needed to describe the results of the experiment

Here are some tips:

- Explain that collecting information in an organized and accurate way makes writing the paper easier.
- Set a source requirement. Science Buddies recommends at least three offline sources, including one encyclopedia.
- Direct students to credible sources by giving them tips for assessing source quality—especially important for online research.

Step 7: Part II: Write a research paper.

- Remind students about plagiarism. They may have forgotten or never learned this concept.

  > **Note:** Remind students that it is acceptable to copy words, pictures, diagrams, or ideas from sources as long as they reference them with citations and quotations.

- Inform your students of which source citation format (MLA, APA, or some other) to use.
- Consider asking the English teachers at your school to teach some skills for writing a research paper, such as paragraph structure, the need to have clear transitions between paragraphs, and source citations.

Step 8: Construct a hypothesis.

- Give ample discussion time in class, and explain variables in a number of different ways.

  > **Note:** Variables are very difficult for students to understand. Even the brightest students struggle to grasp the difference between independent and dependent variables. However, once students understand the variables in their experiments, then writing hypotheses is easy.

Step 9: Optional: Do advance expo steps.

Optional: Begin advance expo steps, one month before the expo. See the Science Expo Planner.

Step 10: Test the hypothesis by doing an experiment. Part I: Design an experimental procedure. (Second Safety Review)

For this assignment, students should prepare detailed lists of the materials that they will use and the detailed steps that they will follow while conducting the experiment.

- Do a second safety review of projects when you receive the experimental procedures. Do this *before* experimentation begins. As before, refer to the included Safety Guidelines.

- Contact parents if you have any concerns. Some teachers ask parents to submit in writing that they will personally supervise projects with special safety considerations.
- Make sure that students have plans to create well-organized data tables, so that they take the right measurements and record all data.

Step 11: Part II: Do an experiment.

If students have prepared clear experimental procedures, their experiments should start smoothly.

- Encourage students to do preliminary runs to identify any possible mistakes or corrections that they need to make to their experimental procedures.
- Set a requirement that each student do at least three runs of the experiment.
- Remind students to keep laboratory notebooks, single repositories of experiment data, observations, and reflections.

Step 12: Analyze the data and draw a conclusion.

Let students know that the unexpected can be part of the scientific method. A failed experiment is not necessarily a failure. There is still a great deal of learning that can come from understanding what went wrong.

Step 13: Communicate the results.

Option A: Display Board

Students need to make a display board only if you are providing a way for them to use them, such as a science expo or oral presentations.

Option B: Final Report

The Final Report, apart from the abstract, is simply a compilation of everything that the students have done. It should not take long for them to prepare and for you to grade.

Ease the process of writing an abstract, the only new item that is part of the final report. Ask students to write it first without sticking to a word limit. Then ask them to cut words to 250.

Option C: Class Presentation

Class presentations are a great way for students to share their work. Students don't necessarily have to do display boards to do presentations, but they can be a beneficial tool.

Optional: Avoid a restless crowd. Ask the student audience to assess each presentation by writing a few positive comments and a few suggestions.

Option D: Science Expo

The Science Expo Planner (located in the Appendix) will guide you through the expo event. Students will appreciate the chance to see that their work matters to the larger school community.

Science Expo Planner

If you are having an optional science expo, do these steps at the following times:

Before you kick off your science project program	Expo Step 1
One month before the expo	Expo Steps 2-6
The day of the expo	Expo Steps 7-10

Expo Step 1: Set expo date and place.

If you are doing an expo, set the date and location. You will need to find a location for the expo that can accommodate the display boards of your students.

- Calculate how much table space that you will need.

  Note: Each display board will be around 36" wide, when open with sides angled, and you can usually get four boards, back-to-back, on a six-foot table.

- Determine which locations will accommodate the appropriate number of tables. Here are some possibilities:
  - Library: The easiest location due to the lack of disruption to other school activities
  - Your classroom: If you have only one or two classes doing projects
  - Multi-purpose room
  - Cafeteria: Easiest if your expo takes place only after school
- If you need to use a location that affects the school, involve your principal in the decision-making and planning at this point.

Now set the date considering the planning you did in the step above and the availability of the location. If you are having all of your classes participate, probably you will need the location for at least one whole day. Again discuss this with your principal. Closer to the date of the expo, you will determine the specifics of the schedule.

Do Expo Steps 2-6 one month before the expo.

Expo Step 2: Determine a schedule for the expo.

Think through a rough schedule of how you wish the expo to go. The flow of how projects get set up and viewed will depend on your location and the specifics of your school. Here are some questions that you need to answer for your own situation:

- When will you need to prepare the room for the expo, or can custodians handle this?
- When will you have each class set up?
- Will you invite parents?
- Will you invite other science classes?

For example, each class could set up projects during regular science class time. The students in each class could then review the display boards from their own class and any other classes that set up earlier. The expo could then remain open for an hour or two after school for parent visits.

If the expo remained open the next day, science classes taught by other teachers could visit. Your classes could return so that your students could speak with members of the other classes.

Expo Step 3: Invite visitors to the expo.

Use the following table to brainstorm ways to contact potential visitors.

Inviting Visitors

Possible Visitors	How to Invite Them	When
Students and teachers who are not participating in the expo	• Mention the expo at a teacher's meeting. • Send teachers the text below by email or in a memo. • To generate enthusiasm, have your classes create posters for the school. • Make sure that the date and description of the expo appear on the school calendar, website, and/or newsletter.	One month before the expo
School administrators	• Send administrators the text below by email or in a memo.	One month before
School district officials (e.g., science fair coordinator)	• Send officials the text below by email or in a memo.	One month before
Parents of participants	• Send **the Final Expo Participation Reminder for Parents** included in this guide. Send it as a flyer or as an email.	Two weeks before

Sample Text for Inviting Visitors

"The students of <CLASSROOM name> are pleased to invite you to our <NAME OF EXPO>, to be held on <DATE> from <TIME> to <TIME>. Come see <NUMBER OF PARTICIPANTS> exciting experiment display boards. We are scheduling visits from other classrooms in thirty-minute shifts from <TIME> to <TIME>. We welcome administrators and district officials at any time. Parents are welcome any time during the whole day, as well as after school."

Expo Step 4: Plan expo room details.

First, determine if there are enough tables in the expo room. Given the width of each display board, figure out if you need to get extra tables from other locations in the school.

Second, write a description or sketch a map of where the tables will go in the room.

Third, meet with custodial staff and administration to go over the details. Your agenda could include (depending upon your school specifics):

- Unlocking and locking procedures: Who handles this task if the expo takes place partly outside school hours?
- Room set-up or take-down: Do custodians want to be involved?
- School disruptions caused by the room being used for a day: How can administration help?
- Additional tables needed: Could these come from other classrooms?

Expo Step 5: Identify and schedule expo volunteers.

Can students themselves, depending upon their ages, help re-arrange the room the morning of the expo? Even with student help, it is convenient to have parent support also. Schedule volunteers as needed using the template below.

Worksheet for Assigning Volunteer Shifts

Activity	Volunteer Assignments	Backup Assignments
Set up the room.	1) Name: Phone: Assigned time: 2) Name: Phone: Assigned time:	1) Name: Phone: Assigned time:
Assist science expo: • Help students set up projects. • Assist in checking safety. • Monitor event. • Direct visitors.	1) Name: Phone: Assigned time: 2) Name: Phone: Assigned time: 3) Name: Phone: Assigned time: 4) Name: Phone: Assigned time:	1) Name: Phone: Assigned time: 2) Name: Phone: Assigned time:
Return the classroom to normal.	1) Name: Phone: Assigned time: 2) Name: Phone: Assigned time:	1) Name: Phone: Assigned time:

Expo Step 6: Send a reminder to parents and students.

Send home the Final Expo Participation Reminder, included in the Appendix, for parents and students.

Do Expo Steps 7-10 on the day of the expo.

The expo, the culminating event of your program, has arrived. Excited students are arriving carrying display boards. When they experience their work and that of all of their peers on display, they will feel like, and they are, real scientists.

Expo Step 7: Set up the room.

Ask the parent volunteer(s), any custodians involved, and perhaps the first students arriving to set up projects to help set up the room. Move and clear tables to make room for display boards. Get the extra tables, if you need them. Use your layout map or description to help direct those involved.

Expo Step 8: Set up display boards.

- Help students to display their projects. Direct each student to his or her display table or desk.
- Ask parent volunteer(s) to circulate through the room and help where needed.
- Critical Safety Check: Check and re-check the safety of each project display board. Even when the project proposals have passed a safety review, it is still critical to ensure that students have not brought anything unsafe to the fair. As students set up and BEFORE visitors arrive, look for and remove the following hazards (Fredericks & Asimov, 2001, p. 64-65):
  - Display boards that are flimsy and could fall over
  - Animals: Absolutely no animals should be on display. Only photographs are allowed.
  - Chemicals and liquids in open containers
  - Wiring hazards, such as frayed insulation, exposed wires, or loose connections
  - Foul-smelling or allergy-provoking substances such as molds in open containers

Expo Step 9: Monitor the event.

Monitor the room routinely to make sure that no valuables go missing.

Expo Step 10: Return the room to normal.

Students should remove their projects as the expo ends. Ask parents who are present to help re-arrange the room, or rely on one of your volunteers.

Program Evaluation

After your program is complete, answer these questions to evaluate results and collect ideas for next year.

Evaluate your program.

Review the goals of the program, and assess how well you achieved them.

Goal Assessment

Goal	**Assessment**:	**Ideas for Next Year**: What would you do again? What would you avoid?
Help all participating students to become enthusiastic scientists.	Did any students fail to complete a project? ❑ yes ❑ no How many? _____	
Challenge students to learn the scientific method and scientific principles through experience.	What percentage of projects were experiments? ____ What was the reaction of students? How did you evolve as a teacher?	
Give students a chance to communicate what they have learned to others.	How many visitors came? ___ Other students? ___ Parents? ___	

Let Science Buddies know about your experience.

If you have used this guide in any way, let us know about your experiences. Teachers are wonderfully creative in how they organize their programs. We would appreciate the opportunity to feature your ideas in an upcoming revision of the guide. You can find a feedback form on the Teacher Resources Page.

Appendix: Printable Worksheets & Resources

See the following pages for printable worksheets, the Student Science Project Schedule, and resources to distribute to parents.

Student Science Project Schedule

Assignment	To Do or Read Readings are in the Project Guide at www.sciencebuddies.org	Hand In	Due Date
Ask a question. Part I: Find a project idea.	• Complete the Topic Selection Wizard (www.sciencebuddies.org). • Read "The Scientific Method."	Print Topic Selection Wizard results or write down your project question.	
Part II: Do project proposal.	• Read "Your Question."	Do the **Science Project Proposal Form**.	
Do background research. Part I: Collect information.	• Read "Background Research Plan." • Read "Finding Information." • Read "Bibliography." • Read "MLA Format Examples" or "APA Format Examples" as directed by your teacher.	1. Complete the **Background Research Plan Worksheet**. 2. Complete the **Bibliography Worksheet**.	
Part II: Write your research paper.	• Read "Research Paper."	1. Write your research paper. 2. Complete the **Research Paper Checklist**.	
Construct a hypothesis.	• Read "Variables" or "Variables for Beginners" as directed by your teacher. • Read "Hypothesis."	Complete the **Variables & Hypothesis Worksheet**.	
Test your hypothesis by doing an experiment. Part I: Design an experimental procedure.	• Read "Experimental Procedure." • Read "Materials List."	1. Write a materials list, including measurements. 2. Write experimental procedure steps.	
Part II: Do an experiment.	• Read "Laboratory Notebook." • Read "Conducting an Experiment." • Repeat your experiment at least three times.	1. Write one paragraph describing your observations. 2. Bring in the data that you collected in a data table.	
Analyze your data and draw a conclusion.	Read "Data Analysis & Graphs." Read "Conclusions."	1. Make at least one graph. 2. Write your conclusion.	
Communicate your results: Do only the assignments that your teacher has checked off below.			
❑ Display Board	Read "Display Board."	Create and assemble your display board.	
❑ Final Report	Read "Final Report." Read "Abstract."	1. Write your abstract. 2. Compile your final report. 3. Complete the Final Report Checklist.	
❑ Class Presentation	No reading assignment.	Write note cards to guide your presentation.	
❑ Science Expo	No reading assignment.	Bring your display board, laboratory notebook, and any other display items to school!	

Note: Bold=a worksheet that your teacher will provide to you.

Introducing Science Projects

Date: _____

Dear Parents:

Your child will have the chance to solve his or her own science mystery by doing a science project, a mandatory assignment for your child's class.

Since your child has the chance to pick his or her own science project question, from the physics of making music to the biology of tide pool animals, he or she will have the chance to experience the joy of discovery.

When starting a science project, a student chooses a question he or she would like to answer. Then, he or she does targeted library and Web research to gain the background information needed to formulate a hypothesis and design an experimental procedure. After writing a report to summarize this background research, the student performs the experiment, draws conclusions, and communicates the results to teachers and classmates.

Through time management and project planning, your child will take on the responsibility of completing a project over at least a ten-week period. Your child will discover his or her creativity by brainstorming science project questions and figuring out how to display the process and results. A science project, through its challenge to ask questions and discover, is truly a real-world experience in innovation, similar to what scientists do in their careers.

We will provide your child with sufficient support to succeed, so that he or she develops enthusiasm for scientific discovery. First, your child will accomplish each step of the project by doing homework assignments. We will review the assignments at key checkpoints along the way, so that you won't face helping your child do a project the last night before the fair. Second, we have included a basic guide (enclosed) of how to help without getting over-involved.

To get started, read through this packet: Student Science Project Schedule and Guide to Science Projects.

You will have the opportunity to approve the project your student selects by signing a Science Project Proposal Form, one of the early assignments on the attached schedule.

If you have any questions, please email me at _____ or phone at _____ .

Sincerely,

Included:

- A Parent's Guide to Science Projects
- Student Science Project Schedule

Parent's Guide to Science Projects

Information on the Scientific Method

Science projects should follow the six-step scientific method. These steps are shown on the chart below. A comprehensive Science Buddies Project Guide (www.sciencebuddies.org) provides direction on all of the steps.

Time Management

See your child's Student Science Project Schedule for all of the key due dates. Help your child meet these dates by getting out your family calendar and marking the interim due dates. Block out times for trips to the library and other work time. Look for any scheduling conflicts, such as vacations, and discuss issues with the teacher.

How to Help

As your child works on his or her project, he or she will likely face stumbling blocks. To help, ask questions to help your child figure things out; don't just provide the answers. Open-ended questions, such as, "What else could you try to solve this?" or "What is stopping you from going on to the next step?" are best (Fredericks & Asimov, 2001, p.xiii). Sometimes just talking it out can help children get unstuck. If not, ask the teacher for help. Respect your child's independence in learning by helping at the right level.

Helping at the Right Level at Every Step

Project Step	Helping at the right level:	Going too far:
Ask a question.	• Discussing with your child whether a project idea seems practical	• Picking an idea and project for your child: A topic not of interest will turn into a boring project.
Do background research.	• Taking your child to the library • Helping your child think of keywords for Internet searches	• Doing an Internet search and printing out articles
Construct a hypothesis.	• Asking how the hypothesis relates to an experiment the child can do	• Writing the hypothesis yourself
Test the hypothesis by doing an experiment.	• Assisting in finding materials • Monitoring safety (you should always observe any steps involving heat or electricity)	• Writing the experimental procedure • Doing the experiment, except for potentially unsafe steps • Telling your child step-by-step what to do
Analyze data and draw a conclusion.	• Asking how your child will record the data in a data table • Reminding your child to tie the data back to the hypothesis and draw a conclusion	• Creating a spreadsheet and making the graphs yourself, even if your child helps type in values • Announcing the conclusion yourself
Communicate your results.	• If a presentation is assigned, acting as the audience • If a display board is assigned, helping to bring it to school	• Writing any of the text on the display board • Determining the color scheme and other graphic elements

Science Project Proposal Form

Student Name:

The question I plan to investigate in my experiment (*please phrase as a question*):

Science Project Question Checklist	
1. Your teacher may put some restrictions on projects. Have you met your teacher's requirements?	Yes / No
2. Is the topic interesting enough to read about, then work on for the next couple months?	Yes / No
3. Can you find at least 3 sources of written information on the subject?	Yes / No
4. Can you measure changes to the important factors (variables) using a number that represents a quantity such as a count, percentage, length, width, weight, voltage, velocity, energy, time, etc.? Or, just as good, are you measuring a factor (variable) that is simply present or not present? For example, • Lights **ON** in one trial, then lights **OFF** in another trial • **USE** fertilizer in one trial, then **DON'T USE** fertilizer in another trial	Yes / No
5. Can you design a "fair test" to answer your question? In other words, can you change only one factor (variable) at a time, and control other factors that might influence your experiment, so that they do not interfere?	Yes / No
6. Is your experiment safe to perform?	Yes / No
7. Do you have all the materials and equipment you need for your project, or will you be able to obtain them quickly and at a very low cost?	Yes / No
8. Do you have enough time to do your experiment more than once before the due date?	Yes / No
9. If you are planning to enter a science fair outside of your school: • Does your project meet all the rules and requirements for the science fair? • Have you checked to see if your science fair project will require approval from the fair before you begin experimentation?	Yes / No Yes / No

I have discussed the project idea and the checklist with my parent(s) and I am willing to commit to following through on this project.

_____

Student Signature **Date**

I have discussed the project idea and the checklist with my student and I believe he or she can follow through with this project. I agree to supervise the safety of the project steps that my student performs at home.

_____

Parent Signature **Date**

Background Research Plan Worksheet

Name: _____

1. What is the **question** you are going try to answer with an experiment? _____

_____

2. List the **keywords** and phrases from your question and the topic in general. (Hint: Use an encyclopedia to help you)

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

3. Now use your keywords to build some **questions to guide your background research**. Develop at least two or three from each "question word." Don't worry about whether you already know the answer to the question—you'll find the answers when you do your background research. And don't forget to "network" with knowledgeable adults who can help guide you toward good materials!

Question Word	Possible Questions (you can think of others)	Substitute your keywords (or variations of your keywords) for the blanks in the previous column. Write down the relevant questions and use them to guide your background research.
Why	Why does ____ happen? Why does ____ ____? Why _____?	
How	How does ____happen? How does ____ work? How does ____ detect ____? How does one measure ____? How do we use _____? How _____?	

Question Word	Possible Questions (you can think of others)	Substitute your keywords (or variations of your keywords) for the blanks in the previous column. Write down the relevant questions and use them to guide your background research.
Who	Who needs _____? Who discovered _____? Who invented _____? Who _____?	
What	What causes _____ to increase/decrease? What is _____ made of? What are the characteristics of ____? What is the relationship between ____ and ____? What do we use _____ for? What _____?	
When	When does _____ cause _____? When was _____ discovered? When _____?	
Where	Where does _____ occur? Where does _____ get used? Where _____?	

4. To analyze the results from experiments you might need to know some **key formulas or equations**. Think about your own experiment and write down any step or task that requires a formula or equation. Don't worry about whether you already know what the formula or equation is—you'll find the actual equation when you do your background research.

   List steps or tasks that may require a formula or equation:

_____ _____ _____ _____

_____ _____ _____ _____

Bibliography Worksheet

Note: You won't fill in every item depending on the type of source. **Name:** ____________________

This source is a: ☐ Book ☐ Magazine ☐ Newspaper ☐ Website ☐ Other_______________		
Author's Last Name	First Name	Middle Initial
Date Published	Publication/Website Title	
Title of Article (periodicals, encyclopedias, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals or encyclopedias)	Page Number(s)
Website is a ☐ Company ☐ Organization ☐ Government ☐ Newspaper/Magazine ☐ Other_________		
The URL is http:// (websites only)		Last Date of Access (websites only)

This source is a: ☐ Book ☐ Magazine ☐ Newspaper ☐ Website ☐ Other_______________		
Author's Last Name	First Name	Middle Initial
Date Published	Publication/Website Title	
Title of Article (periodicals, encyclopedias, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals or encyclopedias)	Page Number(s)
Website is a ☐ Company ☐ Organization ☐ Government ☐ Newspaper/Magazine ☐ Other_________		
The URL is http:// (websites only)		Last Date of Access (websites only)

This source is a: ☐ Book ☐ Magazine ☐ Newspaper ☐ Website ☐ Other_______________		
Author's Last Name	First Name	Middle Initial
Date Published	Publication/Website Title	
Title of Article (periodicals, encyclopedias, websites)		
Place Published (books only)	Publisher (books only)	Editor (if applicable)
Edition (if applicable)	Volume Number (periodicals or encyclopedias)	Page Number(s)
Website is a ☐ Company ☐ Organization ☐ Government ☐ Newspaper/Magazine ☐ Other_________		
The URL is http:// (websites only)		Last Date of Access (websites only)

Research Paper Checklist

Name: _____

☐	Have you defined all important terms?
☐	Have you clearly answered all your research questions?
☐	Does your background research enable you to make a prediction of what will occur in your experiment?
☐	Will you have the knowledge to understand what causes the behavior you observe?
	Does your research include the following:
☐	- Currently accepted theories, facts, and data
☐	- Relevant mathematics/equations (if applicable)
☐	- Key discoveries and early researchers
☐	Have you referenced all information copied from another source and put any phrases, sentences, or paragraphs you copied in quotation marks?
☐	Is every fact or picture in your research paper followed by a citation telling the reader where you found the information?
	Does your research paper include:
☐	- A title page
☐	- Your report
☐	- Bibliography
☐	Have you used the proper capitalization and punctuation?
☐	Have you checked your grammar and spelling?

Variables & Hypothesis Worksheet

Name: _____

Variables *(Fill in the table with the appropriate information from your own experiment)*		
Independent Variable **(***What will you be changing in the experiment. Note: There should only be one item listed here***)**	**Dependent Variables** (*What will you be measuring or observing*)	**Controlled Variables** (*What will you be keeping the same during the experiment*)

Your Hypothesis (*Fill in the blanks with the appropriate information from your own experiment.*)
If [*I do this*] _____ _____, **then** [*this*]_____ _____ **will happen.**

Final Report Checklist

Name: _____

☐	Does your abstract include a short summary of the hypothesis, materials & procedures, results, and conclusion?
☐	Have you used the proper capitalization and punctuation?
☐	Have you checked your grammar and spelling?
	Does your final report include the following key sections:
☐	- Title page
☐	- Abstract
☐	- Table of contents
☐	- Question, variables, and hypothesis
☐	- Background research (your Research Paper)
☐	- Materials list
☐	- Experimental procedure
☐	- Data analysis and discussion (including data tables and graphs)
☐	- Conclusions
☐	- Acknowledgements
☐	- Bibliography

Final Expo Participation Reminder

To Students and Parents of Students in _____ Science Expo

Here are the rules and information that you need to have a successful science expo experience.

Rules

1. The expo will not provide access to electricity, gas, or water.
2. Your display board should not exceed:
   Width: 4 ft, 122 cm Depth: 2.5 ft, 76 cm Height: 5 ft, 152 cm
3. Make a sturdy display board. Two days before the expo, test it by setting it up to make sure it stands alone.
4. Do not bring animals to the expo. Bring photos instead.
5. The expo cannot be responsible for any loss of items. We advise that students should not display laptops or other items of value.
6. You must remove your project at the end of the expo. We do not have storage space for unclaimed projects.

Dropping off Projects

Drop off projects in the _____ between _____ and _____ on _____.
You may park in the _____ .

Make sure to bring the following, if your child completed them:

1. Display board
2. Any items that go in front of the display board
3. Laboratory notebook
4. Pen, tape, glue, and other quick-fix items in case the display board gets damaged in transit
5. Final report (if assigned)

Visiting the Expo

Parents and other family members are welcome to visit the expo between _____ and _____ on _____. We highly recommend that you visit the expo to give students the chance to feel proud of showing their work.

Removing Projects

You must remove projects by _____ on _____. The school does not have space for the storage of projects.

Works Cited

Fredericks, Anthony D. and Isaac Asimov. Science Fair Handbook: The Complete Guide for Teachers and Parents. Tucson: Good Year Books, 2001.

National Research Council (NRC). National Science Education Standards. Washington: D.C.: National Academy Press, 1996.