

THE SCIENCE FAIR PROJECT

A Step-by-Step Guide

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A-Step by-Step Guide

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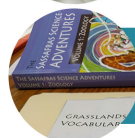
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I.

INTRODUCTION: YOU CAN DO THIS!

The science fair project is that dragon in the corner of our basement - back where we keep the science-teaching tools we don't want to use.

We know it's down there. We know we should do something about it. But we really, really don't want to face the idea of having to do a science fair project with our students.

We have no idea where to begin.

And right now, you just want me to tell you that it's okay - you can ignore the dragon and stick to his easier to manage cousin, the hands-on scientific test. Right?

But we are not going to do that. Instead, Brad and I (Paige) going to spend the next ten chapters laying out exactly how to do a science fair project with your students, step by step.

Why are we doing this, you ask?

Because we understand where you are and we both know how critical it is to have someone walk you through the process. My (Paige) first science fair project was a complete disaster. The only direction I got was to come up with a question, design a project to answer it, and then report what I found.

I was confused about how to really go about doing a science fair project and I ended up choosing a terrible topic - Is there a pattern to clouds? In my sixth-grade mind, I was convinced that over a month I would see the same clouds appear again and again in the same repeatable pattern.

Had someone told me to do a bit of research, I would have thrown my question out the window and started over. But, alas, they did not. And I was left with an utter frustration for the science fair project.

So, when it come up the following year, I had a different teacher. Her last name was really hard to pronounce, so we just called her Mrs. I.

Mrs. I walked us through a science fair project step by step. And that year the seed for my passion for science was planted.

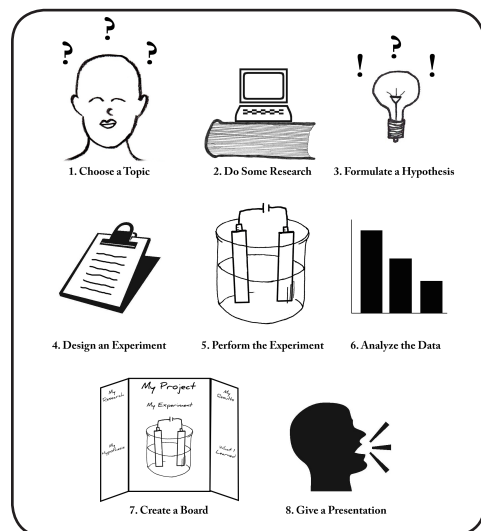
When it came time to do a science fair project with our homeschooled students, we developed the following eight steps based on what I remembered from my seventh-grade experience along with Brad's experience in the research lab. And this book is our opportunity to share what we have learned and developed with you.

Take a deep breath.

Head towards the basement.

And let's go down and face that dreaded science fair project dragon together!

1. WHY YOU NEED TO DO A SCIENCE FAIR PROJECT



You are at the basement door, but you are not convinced that you should go in. You are not sure that it is really worth the time and effort it takes to do a science fair project.

It's okay. We understand.

Let's chat a bit about what the purpose is behind doing a science fair project. We say that:

The purpose of the science fair project is to give the students hands-on experience with the scientific method.

We know from our research and experience that to truly understand science, one must be familiar with the scientific method. And because of this need, we believe that all students need to have the scientific method demonstrated repeatedly for them. Plus, they need to have used the process over and over again in experiments until it has become a natural habit.

It can take year for the students to fully etch the concept of the scientific method into their mind in such a way that it becomes second nature. The science fair project is an important tool that we, the teacher, can use with our students to increase their understanding and familiarity with the scientific method.

WHAT IS THE SCIENTIFIC METHOD?

If the main purpose of the science fair project is to give our students the opportunity to practice using the scientific method from start to finish, we need to know what the scientific method is in the first place.

Just to make sure we are all on the same page - in a nutshell, the scientific method teaches the brain to logically examine and process all the information it receives.

This method requires that one observes and tests before making a statement of fact. It is the main process that scientists use when asking and answering questions.

The key steps of the scientific method are:

1. Ask a Question
2. Research the Topic
3. Formulate a Hypothesis
4. Test with Experimentation
5. Record and Analyze Observations and Results
6. Draw a Conclusion

When one uses the scientific method, it causes one to look at all the evidence before making a statement of fact.

It can sound like a lofty idea, but in reality, it is an integral part of science education. And if we want our students to be prepared for higher education science, they must be comfortable with this fundamental process.

Are you feeling a bit intimidated?

Please don't!

You are simply teaching your students to take the time to discover the answer to a given problem by using the knowledge they have as well as the things they observe and measure during an experiment.

The scientific method is a simple, yet logical process that follows the same steps every time, and it forms the foundation for the science fair project.

WHAT SHOULD A SCIENCE FAIR PROJECT LOOK LIKE?

In essence the science fair project is an in-depth experiment which will take several weeks to complete. It follows the steps of the scientific method from start to finish, but adds to more steps to help the students share what they have learned.

Our eight steps to complete the science fair project are as follows:

- **Step 1** - Choose a Topic
- **Step 2** - Do Some Research
- **Step 3** - Formulate a Hypothesis
- **Step 4** - Design an Experiment
- **Step 5** - Perform Experiment
- **Step 6** - Analyze Data
- **Step 7** - Create a Board
- **Step 8** - Give Presentation

CHAPTER 1: THE SCIENCE FAIR PROJECT

We'll break each of these steps into manageable chunks in the coming chapters. But, basically, once a school year, your older students should follow these steps to complete a science fair project.

Their projects should work through the scientific method from beginning to end. The first time the students do this, you will need to be certain to thoroughly explain each step and coach them through the entire process. They will need you to work alongside of them as an advisor from the time they formulate their question until they polish up their presentation. This is so that they learn the process correctly from the beginning. But, as the students become more familiar with the process, they will be able to do more of the work on their own.

It is also important to have the students present their project to a group and answer related questions from them. This will serve to reinforce what they have learned as well as help them to discern how to communicate what they know.

The best way to achieve this is to have the students participate in a Science Fair where their project will be judged, but if that's not possible for your student, don't skip this component. The students can still present his project to his family or a group of his peers.

WHEN SHOULD A STUDENT DO A SCIENCE FAIR PROJECT?

The students doing a science fair project should be able to read fairly well on their own. They should also be able to summarize what they have learned from reading several paragraphs of non-fiction material. And, they should be starting to learn how to apply what they have learned to a new situation that is before them.

For these reasons, we recommend beginning to do a science fair project with your students once they are in fifth grade and continuing to do so through middle school. Your goal is to do at least three science fair projects with your students.

As the students progress into high school, the science fair project is still a beneficial tool, especially for the student who wants to continue on in the sciences. However, it is not as critical to do a science fair project with your students past the middle school years. (*Please see chapter 10 for a more thorough explanation of how to use the science fair project with the high school student.*)

CONCLUSION

The science fair project is a key tool in our science-teaching kit.

It is an essential component of an excellent science education for middle school students. These students need to experience the scientific method from start to finish in a real and practical way.

In the next eight chapters, we will explain each step in detail so that you will be prepared to guide your students through this much maligned and often misunderstood process.

2.

STEP 1: CHOOSE A TOPIC



STEP 1 KEYS TO COMPLETE:

1. Decide on an area of science.
2. Develop several questions about the area of science.
3. Choose a question to be the topic.

The first step of the science fair project is to choose a topic for the project. What you will do in this step is patterned after the first step of the scientific method, which is “Ask a Question”.

The first step of the scientific method begins when the scientist observes an occurrence that makes him wonder what is happening. Then, he creates a question which relates to what originally peaked his interest. When crafting this inquiry, the scientist will make sure that the question is worded in such a way that he will be able to measure whether or not he has obtained the answer.

For this step, your students should:

- Begin with deciding on an area of science that interests them.
- Develop several questions about this area of science which they want to answer.
- And, finally, choose one of those questions to be the topic for their project.

Let's take a closer look at how this process works!

DECIDE ON AN AREA OF SCIENCE

The first part of completing step one of the science fair project is to decide on an area of science that interests the students.

The students should choose an area that fascinates them, something in science that they want to know more about. Because if they are interested in the area, it will be much easier for them to complete the project and they will be more likely to engage with the material.

Here is what you need to do:

- ✓ Begin by leading the students to brainstorm about things in science that interest them.

CHAPTER 2: STEP 1 CHOOSE A TOPIC

- ✓ Next, have them rank these areas by degree of interest.
- ✓ Then, have them choose one area on which to focus.

If their area is too broad, you will want them to narrow their area down a bit. You can do this by asking them what they find interesting about the particular field.

For example, let's say a student has written the following for his brainstorm list:

- > plants
- > animals
- > light bulbs
- > magnets

He decides that he is most fascinated with plants. Plants are quite a broad topic, so to narrow it down a bit you ask him:

What is it about plants that you find interesting?

He says that he is most interested in the way that plants grow. So, he writes down the following for the area of science he would like to explore with his science fair project:

- > the growth of plants

And you are ready to move onto the next part of this step.

DEVELOP SEVERAL QUESTIONS ABOUT THE AREA OF SCIENCE

Once the students have determined their area of science, they need to develop several questions about the subject that they can answer with their project.

Remember that good questions begin with how, what, when, who, which, why or where.

Here is what you need to do:

- ✓ Say to the students, "Now that we have determined the area of science we want to learn about, let's think of some question that we want to answer about the subject."

At this point, you are getting them to think of possible questions they could answer, you will narrow down these questions in the next section.

So, let's rejoin our sample student who chose the growth of the plants as his area of science. For this section, he could come up with questions like:

- > Why do plants grow?
- > How fast do plants grow?
- > When do plants grow?

CHAPTER 2: STEP 1 CHOOSE A TOPIC

> Which plants grow faster?

Once, the students have several options for questions, you are ready to move onto the final section of this step.

CHOOSE A QUESTION TO BE THE TOPIC

Now that the students have several options of questions they can answer with their science fair project, you will need to have them choose one of those questions for their project.

Some of their questions will be easy to develop an experiment for their science fair project that will determine the answer; some will not. If their question is too broad, you will need to help them narrow it down to something more specific.

Let's analyze one of the questions our sample student came up with:

> Why do plants grow?

This question is too broad because sunlight, water and nutrients all affect plant growth, not to mention the weather and a whole host of other factors. It will be far too time-consuming to do an experiment that will measure the answer to this question.

So, you will want to help the student narrow down the question. Some options would be:

- How does the lack of sunlight affect the growth of house plants?
- Which soil is best for house plants to be grown in?

Each of these questions is more specific, making them far easier for the student to measure.

It is important to note that the student may need to tweak and adjust their topical question as they proceed through the next several steps.

They may find through their research that they need to be more specific. Or, they may discover as they design their experiment that their question needs to be a little less specific. Their topic remains a fluid question until they begin their experiment.

CONCLUSION

The keys for choosing a topic are to start with deciding on an area of science, then to develop several questions about that area, and finally to choose a question to be the topic of the project.

Once the students have their topic chosen, they will move onto Step 2: Do Some Research.

But before we move on, we wanted to mention to you that we have developed worksheets you can use with your students as you complete each step.

3.

STEP 2: DO SOME RESEARCH



STEP 2 KEYS TO COMPLETE:

1. Brainstorm for research categories.
2. Research these categories.
3. Organize the information.
4. Write a brief report.

Remember that fruitless cloud science fair project from the introduction? All that hassle could have been avoided if Paige would have just done this step before beginning her project.

The second step of the science fair project is to do some research. This process is based on the second step of the scientific method.

In this step of the method, the scientist researches about the topic from the question so that he will have some background knowledge about the subject, which will give him a basis for formulating his hypothesis. You see, it is very hard for someone to predict what is going to happen in an experiment without knowing something about the principles at work. The scientist also does research to prevent him from repeating mistakes that have been made in the past.

For the science fair project, the students also need to do some research so that they can make an educated guess on the answer to their question. This research will also be useful to them when they design their experiment.

For this step, your students should:

- Begin by brainstorming for categories that are relevant to their topical question.
- Research these categories at home through their personal library, through the Internet and their local library.
- And, finally, organize the information into a brief report.

Let's take a closer look at how this process works!

BRAINSTORM FOR RESEARCH CATEGORIES

The first part of this step of the science fair project begins with the student brainstorming for categories to research. They need to develop relevant research categories before they begin to search for information

CHAPTER 3: STEP 2 DO SOME RESEARCH

as this will help the student to maintain a more focused approach to their research.

This key will help the student to know where to begin their research and to know what information is important to their project and what is not. It's an important organizational tool that you should not skip.

You will need to guide your student through the brainstorming process, just like you did in step 1. However, if your student is younger, you may need to hold his hand through this process even more, since the younger student may have a harder time coming up with categories that relate to their topic.

The students should have at least three categories and no more than five. This will help them obtain relevant information as well as make it easier for them to write their report.

Once the students have chosen their research categories, have them assign each category a number.

Let go back to our sample student, who chose the topical question, "Which soil is best for house plants to be grown in?" He could then come up with the follow topics to research:

- > What is found in soil
- > Plant growth
- > General information about plant structure
- > Types of soil

Once the students have their research categories, they are ready to move onto the next part of this step.

RESEARCH THE CATEGORIES

Now, the students are ready to begin their research!

Have the students begin by looking at reference material that they have close at hand, such as encyclopedias that they own or that are in the classroom. Then, they can look to their local library or the Internet for additional information. Depending upon their experience with research, you may or may not have to walk them through this entire process.

We recommend that the students use a pack of index cards on which to write their information.

As they uncover bit of relevant data, have them write each fact in their own words on a separate index card. Have them number each card at the top left with the category in which it fits, which will make them easier to organize.

We also recommend that they assign a letter for each reference they use, which they can write in the right-hand top corner of each card. This way, after they organize and sort their cards, they will know which reference they need to include in their bibliography!

CHAPTER 3: STEP 2 DO SOME RESEARCH

So, their index cards would look like the one below:

Category Number	Reference Letter
One piece of Information	

The students will gather a lot of information from their research and it may seem like a waste of index cards, but it is important that they follow this procedure as it will help them organize their research. In the next key, you are going to help them to sort through what they have found and to determine what is relevant for their project and what is not.

Back to our sample student who is interested in how plants grow. He is researching four different categories and has found a book all about soil, which he labels as reference B.

He finds out that there are several different types of soil, such as sand, silt, clay, loam, peat and chalk.

From another reference, which he labeled reference G, he discovered that a good portion of the world's sandy soil is found in the Great Sahara Desert.

So, he would add two cards to his stack that would look like the following cards:

4	B
There are several different types	
of soil, such as sand, silt, clay, loam,	
peat and chalk.	

4	G
A good portion of the world's	
sandy soil is found in the Great	
Sahara Desert.	

And once he has a stack of index cards, you are ready to move onto the next part of the second step of the science fair project.

ORGANIZE THE INFORMATION

Once the students have finished their research, you need to have them organize and sort through the information that they have found.

CHAPTER 3: STEP 2 DO SOME RESEARCH

Here is what you need to do:

- ✓ Begin by having the students sort their cards into piles using their research categories, which are in the top left hand of their index card.
- ✓ Then, have the student read through each fact and determine five to seven of the most relevant facts from each pile. You may need to help them determine which facts are relevant to their project (i.e. useful for answering their topical question) and which ones are not. These facts will form the basis of their report for the next key.

So, our example student has sorted his cards into four piles according to his research categories. He has chosen six relevant facts from each pile except the fourth one.

He has been able to choose six facts for his fourth category so far, but he can't decide which of the facts we shared above about soil that he should include. Remember that his topical question was: Which soil is best for house plants to be grown in?

In this case, he should discard the fact about sand and the Great Sahara Desert because the information about the different types of soil is far more relevant to his particular question.

Now that the students are organized, you are ready to move onto the final part of this step.

WRITE A BRIEF REPORT

The final key to the second step of the science fair project is to have the students write a brief report sharing what they have learned.

This report should be one to two pages in length and should contain three to five paragraphs. This will be an easy task for the students because the previous sections have prepared them for this task.

Here is what you need to do:

- ✓ Begin by having the students determine the order they want to share their research categories. Normally they would go from broad information about their subject to more specific information for their project.
- ✓ After they do this they need to take the five to seven facts from the first category and write a three to four sentence paragraph by combining the facts into a coherent passage.
- ✓ Have the students repeat this process until they have a three to five paragraph paper.
- ✓ Then, the students will need to edit and revise their paper so that it becomes a cohesive report.
- ✓ Finally, they will need to add in a bibliography with their sources after their report.

Our sample student chose to organize his research categories like this:

- > General information about plant structure (#3)
- > Plant growth (#2)

CHAPTER 3: STEP 2 DO SOME RESEARCH

- > What is found in soil (#1)
- > Types of soil (#4)

Then he writes his first paragraph from his stack of cards, which looks like this:

The group of plants that I am looking at in my project is called vascular plants. This means that they use a system of tubes to transport nutrients and water throughout the plant. Vascular plants all conduct photosynthesis, which happens at the cellular level. These plants also all have roots for drawing up water and nutrients, stems for transporting those nutrients, leaves for photosynthesis and flowers for reproduction.

His final report could look something like this:

The type of plant that I am looking at in my project is called a vascular plant. This means that they use a system of tubes to transport nutrients and water throughout the plant. Vascular plants all conduct photosynthesis, which happens at the cellular level. These plants also all have roots, stems, leaves and flowers.

Vascular plants grow by drawing up nutrients from the soil and using them to make energy from the sun. The roots of a vascular plant draw water and nutrients from the surrounding soil. The stem of the vascular plant takes the food up to the leaves. In the leaves, a process, called photosynthesis, uses sunlight to turn the food into energy. The plant uses this energy to grow.

Since vascular plants get their food from the soil, they need it to grow. They also need soil because it gives them a place to anchor themselves. Soil traps the water and air that plants need for growth. Finally, soil gives a place for nutrients and minerals to attach to and the roots of the plant can extract this food.

Soil is made up of rocks, minerals and decaying plants or animals. Most types of soil are a combination of these materials, which allows for variety in how the soils hold water and nutrients. There are several types of soil, such as sand, silt, clay, loam, peat and chalk. Generally, sand is very porous, with lots of space for water and nutrients, while clay is very dense. In my experiment, I am going to see what type of soil is best for growing grass.

CONCLUSION

The keys for researching the science fair project are to brainstorm for research categories, to research the categories, to organize the information and to write a brief report.

Once the students have finished their report, they are ready to move onto Step 3: Formulating a Hypothesis.

THE SCIENCE FAIR PROJECT

Student Sheets



STEP 1: CHOOSE A TOPIC

KEY 1: DECIDE ON AN AREA OF SCIENCE.

What areas of science are you interested in learning about?

Rank your interest in the different areas you listed and then circle the one area that you would like to use for your topic.

KEY 2: DEVELOP SEVERAL QUESTIONS ABOUT THE AREA OF SCIENCE.

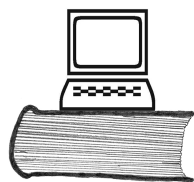
What questions would you like to answer about your area of science?

Note: Remember that good questions begin with how, what, when, who, which, why, or where.

THE SCIENCE FAIR PROJECT: STUDENT SHEETS

KEY 3: CHOOSE A QUESTION TO BE THE TOPIC.

Write down the question that you will be using for your project.



STEP 2: DO SOME RESEARCH

KEY 1: BRAINSTORM FOR RESEARCH CATEGORIES.

What categories are you going to research for your project?

1. _____
2. _____
3. _____
4. _____
5. _____

KEY 2: RESEARCH THE CATEGORIES.

Use the following template for your research cards:

Category Number	Reference Letter
One piece of Information	

Record your sources below.

A. _____

THE SCIENCE FAIR PROJECT: STUDENT SHEETS

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

KEY 3: ORGANIZE THE INFORMATION.

- ☐ Organize the information for your report.

KEY 4: WRITE A BRIEF REPORT.

Write down what the order of your categories will be for your report.

1. _____

2. _____

[illegible]

[illegible]

THE SCIENCE FAIR PROJECT: STUDENT SHEETS

FINAL REPORT

[illegible]

[illegible]