Science Fair Project Background Research Plan

Key Info

Background research is necessary so that you know how to design and understand your experiment. To make a **background research plan**—a roadmap of the research questions you need to answer—follow these steps:

1. Identify the keywords in the question for your science fair project. Brainstorm additional keywords and concepts.
2. Use a table with the "question words" (why, how, who, what, when, where) to generate research questions from your keywords. For example:

   What is the difference between a series and parallel circuit?
   When does a plant grow the most, during the day or night?
   Where is the focal point of a lens?
   How does a java applet work?
   Does a truss make a bridge stronger?
   Why are moths attracted to light?
   Which cleaning products kill the most bacteria?

   Throw out irrelevant questions.

3. Add to your background research plan a list of mathematical formulas or equations (if any) that you will need to describe the results of your experiment.
4. You should also plan to do background research on the history of similar experiments or inventions.
5. Network with other people with more experience than yourself: your mentors, parents, and teachers. Ask them: "What science concepts should I study to better understand my science fair project?" and "What area of science covers my project?" Better yet, ask even more specific questions.
6. If you are doing an engineering project, be sure to include questions from the Engineering & Programming Project Tips page of the Project Guide at www.sciencebuddies.org.

Why the Need for Background Research?

So that you can design an experiment, you need to research what techniques and equipment might be best for investigating your topic. Rather than starting from scratch, savvy Investigators want to use their library and Internet research to help them find the best way to do things. You want to learn from the experience of others rather than blunder around and repeat their mistakes. A scientist named Mike Kalish put it humorously like this: "A year in the lab can save you a day in the library."

Background research is also important to help you understand the theory behind your experiment. In other words, science fair judges like to see that you understand why your experiment turns out the way it does. You do library and Internet research so that you can make a prediction of what will occur in your experiment, and then whether that prediction is right or wrong, you will have the knowledge to understand what caused the behavior you observed.

Making a Background Research Plan: How to Know What to Look For

When you are driving a car there are two ways to find your destination: drive around randomly until you finally stumble upon what you're looking for OR look at a map before you start. (Which way do your parents drive?) Finding information for your background research is very similar. But, since libraries and the Internet both contain millions of pages of information and facts, you might never find what you're looking for unless you start with a map! To avoid getting lost, you need a background research plan.

Keywords

The place to start building your background research plan is with the question for your science fair project (see, we did that first for a reason). Let's imagine that you have asked this one:

Question: Does drinking milk help decrease spiciness better than water or Pepsi?

Begin by identifying the keywords and main concepts in your question. In this case keywords would be:

- Milk
- Spiciness
- Pepsi
- Water

That's pretty easy! Now, what might be some of the main concepts that relate to these keywords? Let's think about spiciness first. You're going to do a science experiment, so knowing that a spicy food tastes "hot" is probably not sufficient. Hmmmm, this is a little tougher than finding the keywords.

Question Words Table

The secret is to use the "question words" (why, how, who, what, when, where) with your keywords. Ask why things happen, ask how things happen, ask what causes things to happen, ask what are the properties of key substances. Filling in a little table can help. Let's do it for our keyword spiciness:

Question Word	Fill Your Keywords (or Variations on Your Keywords) into the Blanks *These are just samples to get you thinking; there are always many more questions and the most important ones for your project may not be in the list!*	Possible Questions for Background Research	Relevant?
Why	Why does _____ happen? Why does _____ _____?	Why does spiciness happen? Why do spicy foods taste hot?	No Yes
How	How does _____ happen? How does _____ work? How does _____ detect _____? How does one measure _____? How do we use _____?	How does the tongue detect spiciness? How does one measure spiciness?	Yes Yes
Who	Who needs _____? Who discovered _____? Who invented _____?	Who needs spiciness?	No
What	What causes _____ to increase (or decrease)? What is the composition of _____? What are the properties and characteristics of _____? What is the relationship between _____ and _____? What do we use _____ for?	What causes spiciness to increase (or decrease)? What are the properties and characteristics of spicy substances?	Yes Yes
When	When does _____ cause _____? When was _____ discovered or invented?	When does spiciness cause upset stomachs?	No
Where	Where does _____ occur? Where do we use _____?	Where in the body does spiciness occur?	Yes

Those look like pretty good questions to research because they would enable us to make some predictions about an experiment. But what's that column in the table called "Relevant?"

You can always find more information to research, but some questions just don't have anything to do with the experiment you will define and perform. Questions that **will** help you design and understand your experiment are called *relevant*. Questions that **will not** help you design and understand your experiment are called *irrelevant*. Our table of question words is a great way to generate ideas for your background research, but some of them will be irrelevant and we just throw those out. Some of those irrelevant questions might be very interesting to you; they just don't belong as part of your science fair project. We have to focus our efforts on what we feel is most important, or another way of looking at it, let's not spend time researching anything we don't need to. (I'm sure you have other things you'd like to do, too!)

For a good example of how the question word table can generate irrelevant questions, let's just look at some possible questions if we fill out the table for another one of our sample keywords: milk.

- Why does milk happen?
- How does milk happen?
- Who needs milk?
- What causes milk to increase (or decrease)?
- What is milk composed of?
- What are the properties and characteristics of milk?
- Where does milk occur?

If we research every one of those questions we'll be studying farms, cows, cow udders, baby cows, and what cows eat. Holy flying cows! That information is definitely irrelevant to our science fair project question: Does drinking milk help decrease spiciness better than water or Pepsi?

Even so, in that crazy list of cow science, there are two questions that look relevant for your background research:

- What is milk composed of?
- What are the properties and characteristics of milk?

Sometimes you won't be sure whether a question is relevant or not, and that's always a good time to get the opinion of more experienced people like your mentors, parents, and teachers. In fact, the background research plan is a very important step of your science fair project and two or three heads are always better than one! Even with all that help, you may not be sure whether something is relevant until after you have done your experiment, so don't let it bother you if that's the case.

Talk to People with More Experience: Networking

As you can see with the two above examples, spiciness and milk, the question word table will work better for some keywords than others. You might have a science fair project question where none of the keywords generate relevant questions. Yikes! What do you do then?

One of the most important things you can do is talk to other people with more experience than yourself: your mentors, parents, and teachers. This is called "networking." Some of these people will have had classes or work experience that involved studying the science involved in your project. Ask them, "What science concepts should I study to better understand my project?" Better yet, be as specific as you can when asking your question. Even experts will look puzzled if you ask a question that is so generic it leaves them pondering where to start. Instead of asking, "How do airplanes fly," try asking, "What physical forces are involved in the flight of an airplane," or "What role do propellers play in the flight of a helicopter?" (After all, there's gotta be something that causes that hunk of metal to go up, right?)

For example, let's imagine your science fair project question is: Does the velocity of a roller coaster car affect whether it falls off a loop? If you ask someone who has studied physics in high school or college, they will tell you to ask the research question, "What is centripetal force?"

Sometimes there is even a specialized area of science that studies questions similar to the one for your science fair project. Believe it or not, there are actually people who study "roller coaster physics." (Is that a cool job or what?) Often a good topic for your background research is simply the specialized area of science that covers your project. For the roller coaster example you would research "roller coaster physics."

How do you find the area of science that covers your project? You guessed it, network with your mentors, parents, and teachers. And by the way, networking is something many adults don't expect students to be very good at, so you can probably surprise them by doing a good job at it! The very best networkers, of course, enjoy the spoils of victory. In other words, they get what they want more quickly, efficiently, and smoothly.

The reality is we have all networked at some point in our lives. Remember how you "networked" with your mom to buy you that cool water gun, or "networked" with your grandpa to buy you that video game you always wanted? Well, now you are "networking" for knowledge (which is a very good thing to network for, by the way). Train yourself to become a good networker, and you might just end up with a better science fair project (and don't forget that you'll get a little smarter too in the process). So take our advice: work hard, but network harder.

Are You Doing an Engineering or Programming Project?

If you are doing an engineering or programming project that involves designing or inventing a new device, procedure, computer program, or algorithm, then be sure to check Engineering & Programming Project Tips on the Project Guide page of www.sciencebuddies.org. You should have some special questions in your background research plan.

Sample Background Research Plan

Background research plan for the science fair project question: Does drinking milk help decrease spiciness better than water or Pepsi?

Keywords —

- Milk
- Spiciness
- Pepsi
- Water

Research questions —

- Why do spicy foods taste hot?
- How does the tongue detect spiciness?
- How does one measure spiciness?
- What causes spiciness to increase (or decrease)?
- What are the properties and characteristics of spicy substances?
- Where in the body does spiciness occur?
- What is the composition of milk, Pepsi, and water?
- What are the properties and characteristics of milk, Pepsi, and water?

Science concepts and/or areas of science —

- Taste buds

Background Research Plan Worksheet

You can use the Background Research Plan Worksheet to help you develop your own plan. Your teacher might have passed this out to you, or you can find it on the Project Guide's "Background Research Plan" page under "Related Links" at www.sciencebuddies.org.

Background Research Plan Checklist

What Makes a Good Background Research Plan?	For a Good Background Research Plan, You Should Answer "Yes" to Every Question
Have you identified all the keywords in your science fair project question?	Yes / No
Have you used the question word table to generate research questions?	Yes / No
Have you thrown out irrelevant questions?	Yes / No
Will the answers to your research questions give you the information you need to design an experiment and predict the outcome?	Yes / No
Do one or more of your research questions specifically ask about any equipment or techniques you will need to perform an experiment? (if applicable)	Yes / No
If you are doing an engineering or programming project, have you included questions from Engineering & Programming Project Tips?	Yes / No

Reference List

Engle, Michael. (2003, May 20). *The Seven Steps of the Research Process*. Cornell University Library. Retrieved September 22, 2003, from http://www.library.cornell.edu/okuref/research/skill1.htm