Background Research Plan and Bibliography

Outline

Overview

As you know, a bibliography is a listing of the books, magazines, and Internet sources that you use in designing, carrying out, and understanding your science fair project. But, you develop a bibliography only after first preparing a research plan—a roadmap of the research questions you need to answer.

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.

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 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 plan.

Keywords

The place to start building your 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!*	My Possible Questions to 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 does the tongue detect spiciness? How does one measure spiciness?	Yes Yes
Who	Who needs _____?	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 relation between _____ and _____?	What causes spiciness to increase (or decrease)? What are the properties and characteristics of spicy substances?	Yes Yes
When	When does _____ cause _____?	When does spiciness cause upset stomachs?	No
Where	Where does _____ occur?	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 to 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 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 research questions that look relevant:

- 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 research plan is a very important step of your project and the experience of your Science Buddies Mentor and Advisor can be super valuable. 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 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 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 to 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! One of the nicest features of the Science Buddies program (in our opinion) is that for every Investigator, we provide 2 mentors, both of whom can become your "networking" targets. 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. You should have some special questions in your research plan.

Sample Research Plan

Research Plan for the 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

Summary

Background research is necessary so that you know how to design and understand your experiment. To make a list of questions and concepts to research:

1. Identify the keywords in the question for your science fair project.
2. Use a table with the "question words" (why, how, who, what, when, where) to generate research questions from your keywords.
3. Throw out irrelevant questions.
4. 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 project?" and "What area of science covers my project?" Better yet, ask even more specific questions.
5. If you are doing an engineering project, be sure to include questions from Engineering & Programming Project Tips.

How to Find Information

No matter how you do your research, record your sources and take good notes as you go. Your teacher may be able to offer you some tips.

Library Research

Often the best place to start your research is by looking up your keywords in an encyclopedia, dictionary, or textbook. Your library may have specialized dictionaries for different topics like science, sports, music, and so on, which offer more complete information than a regular dictionary. Ask your reference librarian to help you.

"Read the background information and note any useful sources (books, journals, magazines, etc.) listed in the bibliography at the end of the encyclopedia article or dictionary entry. The sources cited in the bibliography are good starting points for further research. . . . By using this technique of routinely following up on sources cited in bibliographies, you can generate a surprisingly large number of books and articles on your topic in a relatively short time" (Engle 2003).

You can also check the subject headings of books and articles as you look them up in the library catalog. Check to see if other books in the same subject area contain relevant information.

Periodicals are printed material like magazines and newspapers. Depending on your topic, they may also contain useful information. You can look up your keywords in a printed index such as the *Reader's Guide to Periodical Literature*, which covers popular magazines. Your library may have a number of periodical indexes in both printed and online forms. Check with your reference librarian.

Internet Research

There are two primary ways to search for information on the Internet. The first is to use a search engine such as Google:

http://www.google.com

Search engines try to index everything on the Internet. The second way to search is using a subject portal. Subject portals list just a small portion of the information on the Internet, but the sites listed have been checked for relevance. Two popular subject portals are:

Librarians' Index to the Internet

WWW Virtual Library

Enter your keywords one at a time to search for information in search engines and subject portals.

If you want some advanced tips on using the Internet to find information, the Teaching Library at the University of California at Berkeley offers this tutorial:

http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/FindInfo.html

Finding Too Much or Too Little Information

If you are finding too much information, for example pages and pages of irrelevant hits on Google or a periodical index, you need to narrow your search. You can narrow your search by borrowing some of the terms in your research questions. For example, let's imagine that searching on "milk" brings up too much irrelevant information about cows. Here are the research questions we listed having to do with milk:

- What is the composition of milk, Pepsi, and water?
- What are the properties and characteristics of milk, Pepsi, and water?

Try searching on:

- milk composition
- milk properties characteristics

This will narrow your search, and hopefully give your more relevant results.

If you aren't finding enough information, you need to simplify your search. Let's imagine that searching on "measuring spiciness" isn't finding what you want. Try searching on:

- measure spiciness
- spiciness
- spice

Most online search engines and periodical guides have instructions about how to narrow and broaden searches. Read the instructions! (Sorry, do we sound like your teacher?) For example, here's where Google talks about how to improve your searches:

http://www.google.com/help/refinesearch.html

Too Complicated or Too "Babyish" Information

Sometimes the information you find will be relevant, but either too complicated given your science background or too babyish. This is a problem that we all experience. Just keep looking and ask for advice if you're really stuck.

Your Goal

Never forget, the goal of your searching is to find information to answer the research questions you asked about your topic. Don't stop looking until you have sources that will answer your questions! Be sure to ask for help from mentors, parents, and teachers if you're having trouble.

Summary

How to find information:

1. Find and read the general information contained in an encyclopedia, dictionary, or textbook for each of your keywords.
2. Use the bibliographies and sources in everything you read to find additional sources of information.
3. Search periodical indexes.
4. Search the Internet.
5. Broaden your search by adding words to your search terms. Narrow your search by subtracting words from or simplifying your search terms.

Your Bibliography

You should have a minimum of three written sources of information about your topic from books, encyclopedias, and periodicals. You may have additional information from the Web if appropriate.

Your Assignment

Type your bibliography in a word processor.

Examples

There are standards for documenting sources of information in research papers. Following are standard formats and examples for basic bibliographic information.

Books

Format:
Author. *Title: Subtitle*. Place of publication: Publisher, Date.

Examples:
Allen, Thomas B. *Vanishing Wildlife of North America.* Washington, D.C.: National Geographic Society, 1974.

Searles, Baird and Martin Last. *A Reader's guide to Science Fiction.* New York: Facts on File, Inc., 1979.

Magazine & Newspaper Articles

Format:
Author. "Title of Article." *Title of Periodical* Volume # (Date): Pages.

Examples:
Kanfer, Stefan. "Heard Any Good Books Lately?" *Time* 113 (21 July 1986): 71-72.

Kalette, Denise. "California Town counts Down to Big Quake." *USA Today* 9 (21 July 1986): sec. A:1.

Website or Webpage

Format:
Author (if available). "Title of page." Editor (if available). Date (if available). Institution. [cited Access Date]. URL.
(simply omit any information that you do not have)

Examples:
Devitt, Terry. "Lightning injures four at music festival." August 2, 2001. The Why? Files. [cited 23 January 2002]. http://whyfiles.org/137lightning/index.html.

Article from an Encyclopedia

Format:
Author. "Title of Article." *Title of Encyclopedia*. Date.

Examples:
Pettingill, Olin Sewall, Jr. "Falcon and Falconry." *World Book Encyclopedia.* 1980.

Grading Yourself

What Makes a Good Research Plan?	For a Good 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

What Makes a Good Bibliography?	For a Good Bibliography, You Should Answer "Yes" to Every Question
Have you included at least 3 sources of written information on your subject? (If you include Web pages, they should be in addition to the written sources.)	Yes / No
Have you used the proper format for each of your sources?	Yes / No
Do you have sources of information to answer all of your research questions?	Yes / No

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Reference List

Engle, Michael. The Seven Steps of the Research Process. 20 May 2003. Cornell University Library [cited 22 September 2003]. http://www.library.cornell.edu/okuref/research/skill1.htm