Science Buddies: How to Find a Mentor

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by Amber Hess

Special thanks to Terik Daly, Benjamin Pollack, and Mary Lou O'Donnell, who contributed to this article.

The vast majority of winners at top fairs have a mentor, AND the vast majority of students have to find their own mentors (85% of the 2005 Intel Science Talent Search (STS) finalists had to do this).

Why is a mentor important?

Mentors can:

- Give you access to a lab for your research.
- Explain difficult concepts, which can save you a great deal of time and frustration.
- Help you with trouble-shooting your experiment or providing instruction on techniques and equipment.
- Help you learn more about the cutting-edge research in your field, i.e. the research that has not yet been published but is still important to know for your own project. This new research could be essential to doing your experiment or knowledge of the new area might be considered necessary when discussing your work with others.
- Make sure you are interpreting your results and the results of others correctly (such as from a research paper).
- Coach you about how to present your findings in a way that will be favorably received by other scientists who will be your judges.
- Provide you with access to scientific journals. It is easy to find abstracts through a variety of online sources, but getting the full-length article for free can be challenging.
- Show you what it is like to be a scientist. If you want to see what a career as a scientist is like, this is a great opportunity to learn more.

Where can you find a mentor?

- Participate in a research summer program where you are in contact with professors who could help you complete a research project. Many science/engineering programs are available and can be browsed at this website: http://sciserv.org/stp/. You can easily search for programs that offer scholarships and financial aid. Most programs do offer assistance in this regard, so if you are afraid a program might be too costly, look around and you should be able to find a program that fits your needs.
- Participate in a summer program (see link above), not necessarily for research, or take a class at a nearby college, university, or research institute. Either of these choices will give you access to professors while you are there, and with some persistence you might be able to set up a research opportunity.
- Talk to the faculty at a nearby college, university, or research institute. Make sure to ask around! Oftentimes there is research going on in your area that you do not know about. Search on the Internet, ask your teachers, look through the phone book, etc. I spoke with Mary Lou O'Donnell from Plainview-Old Bethpage John F. Kennedy High School in New York, whose students are frequent participants at Intel ISEF and the Siemens Competition. Her students found researchers at nearby institutes to help them complete their projects (see her comments below).
- Contact judges from a previous science competition. This is what I did, and it worked out wonderfully.

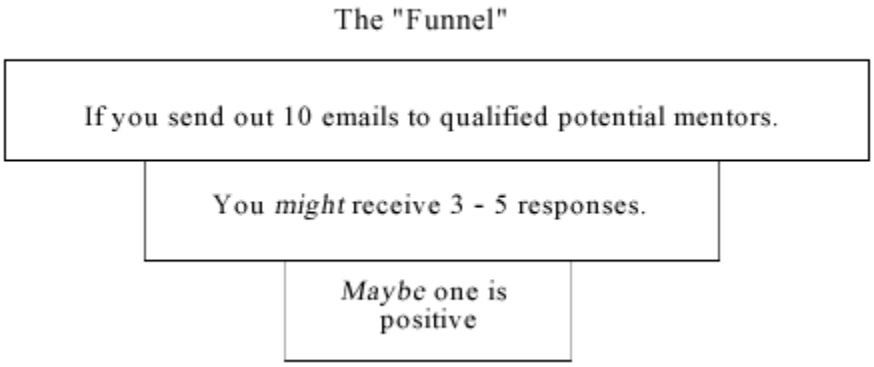
I always email my judges after each science competition to ask how I can improve my project. The college professor who became my mentor wrote a very long email back to me about my project because she was so interested in it. We exchanged emails for a while. A conflict in my high school schedule prompted me to ask if I could complete one of her research courses online (and asked her to be my "sponsor" for it, so that my teachers in my high school knew I was doing something useful), and she indirectly became my mentor. Even though she and I were 350 miles apart, I used the phone and email to stay in contact with her.

- Contact a person who wrote a science article in your field.
- The Science Buddies Ask an Expert is a great resource to obtain help on your project, even if you might not be able to find your own personal mentor there. The volunteer scientists can give you advice about many of the same aspects of your project that a mentor would.
- Note that a mentor does not have to be local, unless you need to work in his or her lab to do your project. Email is great for getting feedback on papers that you write (for the Siemens Competition or Intel STS, for example), display boards that you are putting together (for the Intel International Science and Engineering Fair (ISEF), for example), and pre-labs you write up in preparation for the experiment.

So, how do you find a mentor?

These are the steps Mary Lou O'Donnell's students take in order to find a mentor (these are also the same steps that some of my friends from Intel STS took). With a little modification, these steps can also be used to contact a mentor who is not nearby (do a phone interview instead of a meeting, and so forth). And, Ms. O'Donnell adds, "Advice for teachers: Students must find their own mentors! It's the only way they'll appreciate the mentor. This advice comes from many times when I've mentored kids and they come back complaining about my choice, the lab, etc. Mentors respond when contacted by motivated students, not by motivated teachers."

1. Determine your general areas of interest: physics, chemistry, biology, psychology, astronomy, etc.
2. Search nearby research university websites for scientists in the departments of these schools. Ms. O'Donnell states: "We steer our students to university professors. We have had private psychologists, doctors, and engineers work with students, but find that the level of research is usually not high enough." You want someone who is actively publishing research in his or her field, or in engineering, someone working directly on cutting-edge products or techniques in the area.
3. At the department webpage for the university, bring up the faculty biographies. Read through them all, noting the email addresses or contact information for those you are interested in.
4. Once you've gathered 20-30 professors' biographies, research them one by one. Prior to contact, you must find recent articles written by the potential mentor. This is extremely important. You don't want to look like an idiot when you contact him or her, and it will also help you determine if the person is involved in research that is similar to your project.
5. Draft a personalized email in which you identify yourself, your school, and identify specifically what interested you about the scientist's research. In the email, you should *never* directly ask "to be my mentor." Instead, you might want to mention that you are interested in doing research, in general. Request a meeting so you can speak more about his or her research. You might also ask him or her to distribute your request throughout the department if he or she cannot help you. One of his or her colleagues might be looking for a student with whom to do research. (This is actually how one of my friends from Intel STS got a mentor. The person she emailed was nice enough to send her request to others in the department, and someone else replied.)
6. Have someone proofread and edit the letter.
7. Mail it out and hope for the best. Note that you might go through numerous rejections until you find someone who wants to help you. Some of the people you contact might not even respond. When I emailed judges, there were always a few who never replied. Keep meeting and calling people! Eventually, you should be able to find a potential mentor. Often, the response to the email alone is only 33%-50%, so don't lose hope if only a few potential mentors reply. Positive responses range from less than 10% to as much as 33% (determined by asking a few fellow students involved in research).



Possible objections from potential mentor:

- Don't have the time.
- Don't have the resources. For example, there might not be space in the lab.
- Just not interested in working with high school students.
- Potential mentor might not be familiar with high school competitions and/or might think that a high school student should not do or is incapable of doing research in his or her area of expertise.

For most of these, there's nothing that can be done; however, if the last one is known to be the problem, you can send the potential mentor to the Mentoring & Coaching Advanced High School Student Research page on the Science Buddies website.

8. If you receive a positive response, set up a meeting date. Be sure to bring everything that you've found on the scientist's research and a couple of thoughtful questions about it to the meeting. Treat the meeting as you would a job interview. For more suggestions, see the FAQ section "How should I prepare for my first meeting with a potential mentor?" below.

   If you are lucky enough to have multiple researchers offering to be your mentor, take advantage of the situation! Choose a mentor with a personality that fits yours. You want to make sure you and your mentor "click," otherwise you might have a miserable time. Think about what kind of person you want to work with: fierce and competitive, outgoing, shy, nurturing and supportive, etc. Keep in mind that having a mentor who knows what a science competition is like would be helpful (although this is rare and certainly not necessary).

9. Finally, if the rapport seems good and the science is interesting, you should ask "Do you need any help in your lab this summer?" I would add not to be afraid to ask about helping during the school year, too.
10. In Ms. O'Donnell's case, most of the time the mentors say "sure," but sometimes they give the student "an assignment" to test his or her commitment and work habits. She states, "Our success rate is pretty high. If the students are motivated to contact enough people, they are all usually placed for the summer."
11. Always send a thank you note after any meeting.
12. Sometimes you get a mentor with whom you do not get along for one reason or another. If this is the case, Ms. O'Donnell has this advice: "If there is a bad mentor situation, you just 'suck it up' and be respectful and conscientious and count down the days until the project is over! Never abandon a research project, because the mentor is counting on you."

Keep in mind that you can use Ask an Expert during all of the steps of your project. The Experts love working with dedicated, hardworking, advanced students and are a valuable resource for anyone working on a project, even if the student has another mentor.

FAQs:

How important is prior experience when mentoring high school students?

BENJAMIN: Professors who have experience with high school students generally understand their capabilities and are more willing to allow higher-level research projects. Also, they are more willing to hire high school students and be supportive throughout the competition process. Many students feel as though in order to win a competition they need to work with a mentor who consistently hires students each year and/or produces winners on a consistent basis. In some cases, professors can even become celebrities in the high school research competition world. However, just as a reminder, the professor isn't what wins the award—it's the student and his or her work and passion that wins the award. If you are passionate about a lab and your mentor doesn't have a history of taking students, it doesn't matter—you should still follow your dreams and goals.

TERIK: If the choice is between having a mentor and not having a mentor, take the mentor! Even if the mentor has no prior experience working with HS students, he or she can still provide support, guidance, and advice to you. You might have to train your mentor a bit about how to fill out paperwork and explain to him or her the significance of the various competitions, but the professional perspective that someone actively doing research in your field can offer is priceless.

How should I prepare for my first meeting with a potential mentor?

BENJAMIN: Students should realize that when they meet with the professor for the first time, it is very much like a job interview. They should conduct themselves as they would in a professional setting. They should dress appropriately, be prepared by reading publications, understand the professor's work, and have a set of questions ready. Professors expect high school students to act like undergraduates, if not graduates, and there is no "slack" given just because the students happen to be younger. I have heard from many professors who have experience with high school researchers that the quality of work produced is often equal, if not better, than that of undergraduates or even graduate students. Although the mentor is interviewing the student, it is important for the student to interview the mentor, too. They should make sure it's a good fit and that it will be a good working atmosphere.

Some tips for interviewing:

- Always bring a notebook and a pen.
- Have a copy of your latest resume readily available (even if you emailed it to them previously).
- Maintain good posture.
- Dress appropriately.
- Bring a copy of background research.
- Be honest, don't just say what you think the professor wants to hear.
- Learn about the expectations of the position (time, workload, who you will be working with, forms that need to be filled out ahead of time).
- Knock on the door (even if it is open). Do not just barge in because it's 4 p.m. and that's when you were supposed to meet.
- Write down the office number and time you are supposed to meet. Laboratories can be confusing. Trying to remember if your meeting was in L506 or L650 is not something you want to happen at 3:55 p.m. when you are meeting at 4 p.m.
- Arrive at the building early. You may want to do a quick walk-by to make sure you know where the office is.
- Always be courteous to everyone you come across. You never know when that same person you didn't hold the door for will re-appear.
- *Tip:* If your hands get sweaty during the interview, gently slide them down your knee as you stand up. If you have sweaty hands for some reason, don't mention it...yes, I have heard a student introduce himself as "Hi, my name is XYZ. Sorry my hands are sweaty."

TERIK: It is definitely very important to be professional when working with a mentor, but it is of the utmost importance to be so during your first contact with him or her. You need to be well versed, not only in the work that your prospective mentor is doing, but also in the vocabulary and relevant theories in his or her particular field of science. You need to be able to have a conversation with your mentor at the level he or she might expect of his or her graduate students. This is especially important when working with a mentor

who has not worked with high school students before. You have one shot to convince your prospective mentor that working with you is worth his or her very limited time. It also helps to have an idea of what you want to do. It doesn't work to walk in and say "So, I want to do research in your lab," but not have any clue what the researcher is doing or what aspect of his or her work you would like to be most involved in; you need to prepared!

Should you accept an offer to work in any lab that will have you?

BENJAMIN: It is important to note that students should pursue labs in which they are truly interested, rather than a random one that does not interest them. Some students settle because they are satisfied with just finding a lab that is willing to accept them. If a student is not interested in the work, it will become quite evident when he or she presents the research. Each year, there are dozens of students who appear at local competitions simply because it's part of the process. 9 times out of 10, those students don't get too far with their research. It is very difficult to pretend when it comes to your research. Motivated students will work harder at overcoming hurdles. Some researchers may be eager to hire you because there is a lack of funding and it's more efficient to hire a high school student who will work for no pay than a college student who might need compensation. Make sure it is a good fit for you.

If working in a professor's lab, how important is direct contact with the professor?

BENJAMIN: Graduate students, post-doctorate students, and other lab members usually have a good understanding of the procedures and the background research. It is important that the mentor is available some of the time though. If the mentor is going to be traveling for an entire summer, it might not be in the student's best interest to work in that lab. When the student presents his or her research later on, or is showing his or her resume to a college, potential lab, employer, etc., the student doesn't want to be asked "Oh I know Dr. XYZ, what did you think of her?" and have nothing to answer.

TERIK: From my experience working in a lab this past year as an undergraduate, I would add that you should probably expect to work more with undergraduates (depending what institution your are at, some of them may or may not have undergraduates working in the lab), grad students, and technicians more so than with the professor. He or she is often working on teaching assignments, writing papers, writing grant proposals, writing book chapters, working on other university assignments, etc., and is only available for maybe a few hours a week to actually be working in the lab alongside his or her student researchers. Be sure to make wise use of the time that the professor does have!

What are the pros and cons of doing research without a mentor?

TERIK: Not having a mentor limited my success. A high school student needs the perspective that only a professional in the particular field of work can give so that he or she can present his or her work in such a way that it appeals to and meets the expectations of other scientists in his or her field. After all, at the top science competitions you are presenting professional quality work to a professional audience. The fact of the matter is that you are a high school student. It's a bit of a disadvantage to work at a professional level without having a professional to guide you. BUT, I would not want a mentor who either decided what I was going to do or micro-managed me.

Not having a mentor was a huge disadvantage, not so much in the sense that it hampered the quality of my research itself, but because it hampered me in other ways. To be honest, I think it was great that I had control over my work; it was truly my own in ways that I think a lot of people's projects are not. I wouldn't want someone to micro-manage my research process, and I wouldn't wish that on anyone else. However, not having consistent access to journals was a big problem for me. I wasn't able to get back into some of the fundamental articles that were foundational for my work until much too late in the process. Years too late. And now that I'm working in a lab and have access to journals, I sometimes come across articles and find myself saying, "If I had only had this ___ years ago, I could have _____". I would have been thrilled if there had been somebody I could go to when working on figures, tables, charts, citations, and syntax so that I could put them in the format that was the standard in the field, someone to go to when I was writing my paper for Siemens and Intel STS, when I was finalizing my display board for Intel ISEF, when I was preparing for judging. If I had that resource, I would have been better able to tailor the way I presented things to my audience, and I think that doing so is a key part of winning. I think the word "coach" describes what I would have liked, just as well as the word "mentor." I think that I could have done much better than I did if I'd had a mentor/coach to help me with these things.

What if a student can't find a mentor, what's a possible strategy for conducting a research project?

TERIK: One word: tenacity. If you don't have success finding a mentor to work with, then you have to work harder and longer to be successful at the top competitions than most people who have mentors. You will be competing against people who have mentors, and that is a huge advantage for them. But if you work hard enough and long enough, you can hold your ground against the best of them. You need to:

1. Register on the Ask an Expert Forums on the Science Buddies website and get the Experts involved in helping you with your project. Visit our Ask an Expert Guidelines webpage for instructions.
2. Identify a topic that you are interested in researching.
3. Do everything in your power to become as literate as possible in your chosen subject area. This includes using the Internet to find information, going to your local library (yes, you need to actually physically go to the library. If you live near a college or university, their library might be a better resource than the public library), finding and reading textbooks, talking with people, watching the news...the list goes on and on! Do everything that you can, consult every source that you can think of, to learn as much as you can about your chosen subject.
4. As you do research, start to identify questions that you have and look for the answers to them. Are there questions you have that you can't seem to find the answers to? If not, then you haven't done enough research; you haven't dug deep enough into the literature. If you have begun to find questions you can't find answers to, start thinking about which ones you might be interested in trying to answer yourself.
5. Once you have identified a specific question you are going to try to answer, do some more research to become as certain as you can be that this question is something that needs to be answered or whose answer needs to be augmented.
6. Develop a procedure to answer your question.
7. Conduct experiments to answer your question.
8. Analyze your data.
9. Draw conclusions and then identify questions that your conclusion/experiments raise and start the process all over again!

What would you suggest for students who can't find a mentor and need help finding someone who can run an analysis on some samples from an experiment, hopefully at no charge?

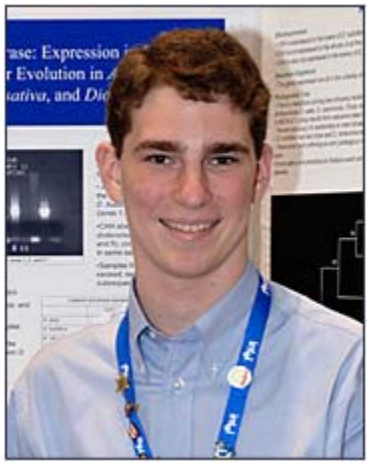
TERIK: If you are unable to find a mentor, or you do not think you need one, there are a few options for analyzing your materials.

- University labs that accept some "imported work" are a good place to start. Be sure to tell them specifically what you are doing and why you need their help.
- You can also look at commercial labs or even equipment manufacturers, although your chances might not be as good as at a university. For companies' labs, if you don't know anyone who works there, ask to speak with someone in the public relations department who might view helping a student to be a neighborly thing to do. A second choice might be to talk with someone in applications or customer engineering (different companies call it different things).

And keep in mind that you might not need to be there in person. You might be able to get your work done at a university thousands of miles from your home.

Amber Hess was a Mentor in the Science Buddies Online Mentoring Program for three years. A passionate science student, she has won awards at many prestigious science competitions. In 2005 she was an Intel Science Talent Search Finalist (one of only 40 students in the entire country), a semi-finalist for the Siemens Westinghouse competition, and she won a First Place Grand Award in Chemistry at the Intel International Science and Engineering Fair (ISEF), which

she also attended in 2003. She has qualified to compete at the California State Science Fair five times, winning 4th, 3rd, and two 1st place awards. Amber graduated from MIT in 2009 with a BS in Chemical Engineering.



Benjamin Pollack was a Mentor in the Science Buddies Online Mentoring Program for two years. In addition to being named 2nd Place National Finalist for teams in the 2005-2006 Siemens Competition, he has also won Third Place and Fourth Place Grand Awards at the Intel International Science and Engineering Fair (ISEF), as well as a special award from the Society of Technical Communication. Benjamin is now attending the University of Rochester.

Terik Daly competed at Intel ISEF three different times and won numerous awards each year, including a "Best of Category" at ISEF 2006. He was a semifinalist in both the Intel STS and Siemens Competition and competed at the California State Science Fair for several consecutive years, winning awards including "Best of Fair" in 2005. Terik is currently an undergraduate at Brigham Young University majoring in Geology. His research interests include the study of residual lunar volcanism, transient lunar phenomena, and chemical speciation in meteorite and micrometeorite impacts.