Using PlantingScience Effectively to Mentor K-16 Students Online

In your career as a scientist, you probably find that your role as a mentor comes easily. Advising undergraduates, leading journal clubs, training graduate students make mentoring second nature. Telementoring offers some unique challenges, as does communicating with young learners. The purpose of this page is to provide some advice about using your existing mentoring skills in a new setting, and perhaps learning a few new tricks of the trade.

This page provides scientist mentors with information about the PlantingScience program and some tips on how to contribute your science expertise to K-16 students via the web interface. You'll find information about:

- The role of PlantingScience mentors, with hints for mentoring online
- The PlantingScience program and website
- Working with middle school and high school students

If you don't find what you are looking for here, e-mail us at sip3@botany.org or chemingway@botany.org. Please let us know if you have any questions, concerns, or comments about the program. We look forward to working with you to make this program as successful as possible.

Most importantly, have fun. Enjoy the experience, and remember that mentoring can have a lasting impact!

The Role of PlantingScience Mentors

In designing the program, we have tried to make the program as convenient as possible for the scientist mentors. This online outreach program allows you to volunteer your time and expertise—without having to leave your office or lab. Volunteering does, however, require a commitment of your time and energy.

Time commitment: We ask that mentors be willing to spend up to one hour per week when student projects are active online. We hope, but do not require, that you will be available to mentor at least 2 months (2 inquiry blocks) per year.
**Hints for scientific mentoring online:** For many students, these hands-on inquiry projects will be their first exposure to conducting plant investigations, and interacting with a scientist. Mentors provide far more than science knowledge; they share their passion for doing science and studying plants. Students are also interested in learning about scientists as people, and knowing how scientists think and work.

Communicating in an asynchronous online forum presents some challenges. As you and your mentee will not be online simultaneously, building a productive dialogue will happen more slowly than in face-to-face communication.

- Do not wait for a question from your mentees; start the conversation.
- Send messages regularly to your mentees, even if they do not always respond.
- Respond promptly to your mentees' messages.

Be a positive role model. Prompt your mentees to think and work like scientists. Try to avoid technical jargon. Making your thinking clear to the students is important. Thinking scientifically will likely be new to many of your mentees, so help build their confidence and understanding.

**General suggestions for communicating with student teams:**
- When first communicating with a team, please introduce yourself. Share a bit about what you do and how you became interested in plants.
- Ask only 1 or 2 questions at a time. Students are not likely to follow up on longer strings of questions.
- Encourage critical thinking, problems solving, and reflection.
- Suggest resources students might use to answer questions they pose.
- Offer insight to the scientific process, encourage scientific reasoning, careful research.
- Share your plant expertise to supplement information students will likely receive in class.

**Examples of some of the ways scientist mentors have interacted with student teams in earlier projects.**

1. **Encourage and confirm**
   —"Excellent! You know what you are looking for. As far as seeds and UV go, you may be the pioneers in this area. Choose some species and go for it."

2. **Respond to student questions, either directly or with a request for more information regarding their data methods, and science content knowledge.**
   —"Great question about why some are sprouting and others aren't. Sometimes small differences can have consequences in germination. We could consider each bottle as having its own 'microclimate'."
"...at this point it would be useful to be able to see some of your data. For instance, you mention that only 5 seeds germinated hydroponically, but I can’t make a very good comparison with your soil treatment without knowing how many seeds you planted in each as well as the number that have germinated."

3. **Provide advice about experiments or methods or equipment that the student teams might consider.**

"My advice would be to try growing oats under different moisture levels. This auxiliary experiment would help you find out if moisture levels contributed to your oat problem and what the optimum conditions for oats are. Your 'failed' experiment could actually lead you to some interesting new experiments."

4. **Encourage scientific thinking by prompting students to make their thinking explicit to others.**

"I'm curious—do you have any idea how you will tell whether the white tissue you see is a root or a shoot? What will you look for?"

5. **Embed factual content information, information about the general ways scientists work, and the history of scientific discovery.**

"Seedlings turn green after they have been exposed to light. Chlorophyll, which is necessary for photosynthesis, takes a lot of energy to make. Until a seedling is exposed to sun it would be wasteful to produce chlorophyll..."

"We're often interested in general questions, such as "What is important for seed germination?" However, the only way to answer those kinds of questions is to break them down into small pieces that can be tested experimentally."

**Response Time:** Time seems to be in short supply for everyone these days. Many of the student teams spend only 2 weeks on an inquiry project. Ten class days does not allow much time for doing science and communicating about it. Make the most of every opportunity.

Please respond to your mentee’s webposting within 48 hours. If you do not have the time to write a full response, please send a your mentee a quick note. Indicate that you've seen the latest posting and will respond as soon as you can. Your mentee will appreciate that you are taking time out of your busy schedule to share your knowledge and insight. Otherwise, your mentee might take your lack of response as rejection or lack of interest.

If an unavoidable change in your schedule will prevent you from communicating with your mentees for more than a couple of days, please let your mentees know. The PlantingScience staff will help fill in short gaps.

Additional hints for good communication, unfortunately, relate to the practicalities of living in today's technological age. Stay alert to notes from a student that may need attention by a teacher or the PlantingScience staff. Reinforce the importance of safety on the Internet. Screen websites before recommending them to your mentees. Do not provide your personal e-mail contact information to students who would like you to continue providing
feedback. The program does not sponsor or authorize any unsupervised contact between mentors and mentees.

The **PlantingScience** Program and Website

As you might suspect, a program with scientific inquiry in its name has an inquiry approach as its underpinning. The National Science Education Standards (1996) called for greater emphasis on teaching science content through inquiry. Plant biology offers numerous profitable opportunities for students to engage in hands-on/minds-on inquiry projects.

Inquiry is an approach to teaching and learning that closely mirrors the inquiry process scientists use to study the world. It has been shown to deepen understanding of science content and process. Inquiries can take many forms, with various levels of structure to support novice learners.

**The National Research Council (2005) defines inquiry as:**
"...a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in the light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations and predictions; and communicating the results."

**The PlantingScience program is designed to support students and teachers in inquiries using plants.**

The PlantingScience website is designed to facilitate your communication with students throughout the inquiry process. Each student team will have a research web page where they will post their observations, research journals, and other supporting data. On this page, there will also be a comment box for communicating with the research team.

**The basic website communication tools:** We will connect you with 1-3 student teams. We will provide you with a login and password to access the website. When the research teams you are mentoring are active, you will receive a daily e-mail summary of activity on their web page. The e-mail will contain a link, clicking the link should open up your team’s research web page. Links, however, sometimes fail. The fail-safe way to access their team page is by logging on to the website. Please let us know immediately if you experience problems reaching your teams’ web pages.

**Try the teacher-scientist forum:** You might want to communicate with your mentees’ teacher about what is happening in the class, or what background knowledge students have. The teacher-scientist forum allows you to do just that.

**Try the scientist forum:** If you would like to share your mentoring experience with other scientists, consider using the scientist forum. You’ll find links to these forums on your scientist mentor page.
Working with Young Learners

Many scientists would like to contribute to improved K-12 science education. Uncertainty about what is taught in schools, and how to interact with young learners, can cause scientists to think twice about volunteering to work with K-12 students. Becoming familiar with the characteristics of young learners can make your role as a scientist mentor to young learners much easier.

**Middle school students** are making many important transitions. They have likely moved from a smaller, self-contained elementary school classroom, where science is not always taught as a separate subject, to a larger school, where they change classes and teachers throughout the day. By grade 7, students experience a faster pace of learning and are expected to take on more challenging tasks. The transition to middle school is also a time of great change in their personal and social lives.

By middle school years, students are familiar with some basic aspects of conducting science, and should have an idea about what a "fair test" (an investigation in which everything is kept constant except one variable) is. Vocabularies are rapidly expanding for these students, as they learn general science, health science, earth science, and environmental science. And they are becoming familiar with science tools and equipment.

**High school students** are also making many important transitions, toward more independent projects and individual intellectual expression. High school students are more likely to test limits, but like middle school students, they value their peer group. Many high school students will have exposure to chemistry, physics, and biology.

We encourage you to communicate with the teachers of your mentee teams via the teacher-scientist forum if you would like specific information about the background knowledge and skill levels of your mentees. We will expand this section of the mentor’s guide as we obtain information from K-12 educators participating in the program.

**Credits:** Examples of the dialogues between students and scientist mentors were adapted from an analysis Dr. Carol Stuessy performed on the pilot project. Notes on characteristic of young learners adapted from www.aacap.org/publications/factsfam/develop.htm.

**Additional resources on science mentoring:**
Handelsman, J. et al. (2005) Entering Mentoring

www.cur.org

www.nap.edu/readingroom/books/mentor

**Questions?** E-mail PlantingScience staff at sip3@botany.org