And Cultivating Mentoring

*Plant Biology & Botany 2007*

Claire Hemingway, Education Director, Botanical Society of America
A Discussion Plan

- What is PlantingScience?
- What is mentoring?
- What can we learn from other mentors?
- What is your approach to mentoring?
- What are the qualities of effective mentoring?
- What are the reasons to mentor?
- What is the process of mentoring in PlantingScience?
Poll Question

My interest in plant science was influenced by interactions with a key individual (mentor)?

- YES
  What did you learn about growing, observing, identifying plants from your mentor?

- NO
  What experiences drew you to study plants? What were the key features of those experiences?
Plant scientists, teachers, and students

Together enhance understanding of the nature and process of science and plant biology
Helping Teachers Meet National Standards

Fundamental Abilities of Inquiry  Grades 9-12

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise scientific explanations and models using logic and evidence.
- Communicate and defend a scientific argument.

Online Collaboration and Mentoring

Teachers → Students → Team

Students

Team

Team

Students → Teachers

Students

Online Collaboration and Mentoring

Student research webpage
Posting research journal and data, Discussing, Explaining, Analyzing

Co-mentoring, scaffolding inquiry

Teachers

Scientists

Project provides inquiry guides, pre/post-tests, materials
Matches mentors-teams
Supports participants

Classroom hands-on plant investigations
2+ weeks long

plantingscience.org
Standards-Aligned Open-ended, Student-Directed Inquiry Modules

<table>
<thead>
<tr>
<th>Inquiry Unit</th>
<th>Inquiry Co-Authors (scientists-K-12 teachers)</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed germination</td>
<td>Beverly Brown, Peggy Skinner et al.</td>
<td>Spring 2005</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Marsh Sundberg and Valdine McLean</td>
<td>Spring 2007</td>
</tr>
</tbody>
</table>

Thanks to Monsanto Fund for grant to develop and field test new inquiries 2007-2008.
Resources on the Scientist Mentor Page

Welcome to the scientist mentor page for PlantingScience

Here you will find out just how easy it is to lend a few hours to improve science literacy. We ask that all scientist mentors register in advance. To register, click on Volunteer as a Scientist Mentor. On this page are resources for getting the most out of this mentoring experience.

Once you are a registered participant and access the site with your login and password, the scientist mentor page will contain all the information you’ll need to communicate with your teams and their teachers. When your student teams begin their research projects, their Team Name will appear under My Mentor Teams. Just click on the hyperlinked team name. The header and team name will appear only when your are logged in.

Interested in Becoming a Mentor?
- Volunteer as a Scientist Mentor
- Join the Master Plant Science Team
- View all scientist mentors

Getting Started as a Scientist Mentor
- Locate Your PlantingScience Teams and Other Quick Tips
- PlantingScience Mentor Guide
- Good Science—Good Science Mentoring PowerPoint

Forum Discussions
1 Recent Topics:
- Fall Forage Claire - Jan 17, 2007

PlantingScience Forums
- Mentor-to-Mentor
- Teacher and Mentor Discussions

My Mentor Teams
the seed investigators
Apr 17, 2007 4:35 am

Live Help
Offline

http://www.plantingscience.org
Example of Student Team Webpage

Online journal and dialog make student thinking visible

Encourages higher-level thinking

Enhances student ownership

Research Information
Research Question
How does different surface areas effect the rate of photosynthesis?

Research Predictions
We think that if we put a piece of black paper under the leaves, the rate of photosynthesis will be the fastest compared to white paper and a mirror because black paper will attract the most heat.

Experimental Design
First we will make the sodium bicarbonate solution by adding 1/8 teaspoon of baking soda and 2 drops of liquid dish soap to 200 ml of water. Then we will make 10 leaf disks and put them in a surenge. We will then suck up some of the solution with the surenge. After the solution and the leaves are in the surenge, we will get all the oxygen out of the leaves by covering the top of the surenge with our thumb and pulling back on the surenge, then releasing. We will continue this until all the leaves are no longer floating. Then we will put the leaves and about 3 cm of solution into a petri dish. We will set the petri dish on a black paper, white paper, or a mirror to test the different surface areas. After we are all set up we will turn the light on and record how long it takes for each leaf to float again.

Research Conclusions
In conclusion, the petri dish that had black paper as a surface had all the leaf disks floating faster than the mirror and white paper surface areas. The black paper’s disks were all floating at about 3 to 4 min. while the mirror and white paper’s disks were all floating at about 6 min. We were right at making our predictions when we said that the black paper would make the rate of photosynthesis faster.

Comments
November 16, 2006 | 7:12 AM | Dr. Andrew F. Schnabel

Thanks for the answers
Dear MiRaCIE GrOw,
Just one quick comment: The control for your experiment is not the number of disks in solution. That would be considered a CONTROLLED VARIABLE, which is different from the control treatment. Controlled variables are those aspects of the experiment that you make constant across all treatments, such as amount of light, number of disks, amount of bicarbonate solution, period of time that the experiment runs, and
Just doing science is not enough!

Hands-on projects and apprenticeships in research labs DO NOT ALWAYS lead to improved understanding of nature and process of science.

(Bell et al. 2003, Sandoval and Morrison 2003)

Reflection is essential for deep understanding.

Argumentation is necessary to solve problems and advance knowledge.
Planting Science

Scientific Community

- Learning in collaborative, student-centered, interactive environment
- Creating common sense of purpose
- Hands-on Plant Investigations
- Online Community
- Mentoring in a science culture of reflection and discourse

Doing Science

Writing and Talking about it

Learning Environment

Collaboration

Teaching through social/constructivist context and inquiry approach

Creating knowledge

Making meaning
What mentoring is NOT

Playing the role of:

Classroom Teacher

Ask the Expert Q & A
Brainstorm Activity 1: Personal Reflection

What is mentoring?
Experts helping novices make connections. Experts...

- Notice features and meaningful patterns
- Have acquired a great deal of content knowledge that is organized in ways that reflect deep understanding
- Are able to flexibly retrieve important aspects of their knowledge with little attentional effort
- Have knowledge that cannot be reduced to sets of isolated facts

From NRC. (2000) *How People Learn: Brain, Mind, Experience, and School*
Brainstorm Activity II
Reflect & Discuss

What are some of the ways you have been mentored?

Effective ways
Ineffective ways
A perspective on mentoring

“Effective mentoring can be learned, but not taught. Good mentors discover their own objectives, methods, and styles by mentoring. And mentoring. And mentoring some more. Most faculty learn to mentor by experimenting and analyzing success and failure, and many say the process of developing effective methods of mentoring takes years.”

Handelsman, J. et al. 2005 Entering Mentoring
Brainstorm Activity III
Personal Reflection

Do you have a written statement on your teaching philosophy?

Your mentoring philosophy?

Jot down 3 key aspects of your mentoring philosophy. Why are they central to your approach?

How has your view of mentoring changed over time?
Online Advantages and Challenges

"On the Internet, nobody knows you're a blog"
*apologies to Peter Steiner*
Like Any Conversation, Each Online Exchange is Unique

Following an introduction, the focus of and participation in a discussion can go in many directions.

Consultant  Collaborator  Cheerleader

Dr. Claire Hemingway

March 8, 2007 | 10:11 AM

Welcome
Hello Plant your seed,

You are now a member of the plant research community. Welcome! It is my pleasure to introduce you to your scientist mentor, Dr. Jenny Archibald. She will be in touch soon to tell you a little about herself and give you a bit of feedback on your research. We are all looking forward to exchanging ideas with you. Don’t hesitate to ask questions.

Good luck and have fun. Regards, Claire Hemingway
Team Plant Your Seed

Research Information

Research Question
Will the change in lighting allow plants to grow faster. We will use conventional sunlight as the control and two experimentat groups 1 60 watt light bulb and the other a black light.

Research Predictions
We believe that the control group will grow the best because if growing plants under blacklight resulted in bigger heathier plants then florists would use blacklight instead of sunlight.

March 14, 2007 | 12:14 PM | Dr. Jenny K. Archibald

Hi!
I'm a researcher and teacher at the University of Kansas. Much of my research focuses on how or why new species have formed and how plant traits (such as flower shape) change through evolution, especially in some groups in South Africa and the Canary Islands.

Interesting experiment! There a lot of different types of sunlight exposure in nature, depending on where a plant is and what other plants are around. Plants hidden on the forest floor not only get less light than the leaves in the tree–tops, but also a different kind of light because some light wavelengths are preferentially absorbed by the trees. There are differences at home as well, such as houseplants at north– vs. south–facing windows (etc.). How do you plan to set up your sunlight control?

Jenny Archibald

http://www.plantingscience.org/Team Plant Your Seed
the sunlight plant will be in a box also. the box that the sunlight plant will be in will be lifted off so that it may get sunlight. all the plants will receive the same time in light

Boxes
Your plan to use boxes to control the light sounds good, although I'm not sure how your sunlight control will be set up. Will it be in an open box?

Experimental Design
~Materials~:
- Gallon of water
- Potting Soil
- 2 60 watt soft light bulb
- Blacklight Bulb
- 3 Boxes
- Automatic Light timer
- Black Paint
- 3 Planting Pots

light control
we plan to use painted black cardboard boxes with the three different types of light. the lights will then be plugged into a power coard on a time relay switch.
stomata
we have learned about the stomata. We are unable to think of a way to make it so we dont bumb the plants. What would you suggest to help solve this problem. We were thinking of making the top of the box removeable?

Experimental controls
One thing to keep in mind with experiments is that we want everything in each treatment to be identical except the thing that is being tested (light in this case). So, it's good that you have a box for your sunlight control as well – but even smaller things can sometimes be worth considering. For example, when plants are bumped it can cause them to close their stomata for a period of time (have you learned about stomata?), which slows photosynthesis. You might not be able to avoid bumping your sunlight plant when moving the box on and off. Is there a way to set up your protocol so that all plants are jostled the same amount?
idea
so what you are saying is to remove all the boxes and put them back on so that all the plants will be bumped?

stomata
A removeable top could be good, if enough sunlight gets in. That would also make the microenvironment around the plant a little more similar for each treatment, since removing the entire box might let out more humidity or let in more carbon dioxide. Another possibility would be to still remove the sunlight box when starting the light treatments – but to also remove (and then return) the boxes for the other treatments. Hopefully, that way all treatments would get similar amounts of movement. Many experiments have things like that built in – similar to placebos in medical experiments. There might be other ways to deal with it as well, but that's what that comes to mind right now.
Ok, that should help. I'd suggest moving them all as little as possible, but equally (so if you bump one a little, do the same for the others). I'm interested to hear how it turns out.

March 28, 2007 | 8:41 AM | Stuart

we tried the remove-able top and it didn't work so well so we are just going to bump the boxes

March 24, 2007 | 10:48 AM | Dr. Jenny K. Archibald

box movement
Yes – that is one possibility that you could try. If you can work out a removable lid on the sunlight box, that would possibly be even better.
April 23, 2007 | 7:26 AM | Stuart

end
Also thank you for helping us begin our project by telling us about bumbing our plants can close the stomata. Thank you for your interest in our project
Team Plant Your Seed

April 19, 2007 | 12:22 PM | Dr. Jenny K. Archibald

Your comments on heat are good points – with light boxes you can get differences in lighting AND heat at the same time, which makes it hard to determine which is causing a given effect. You mentioned that a larger testing area might be useful, that's a good idea. A larger, ventilated testing area could help with the heat problem – plus you could have more test plants to compare. You could also otherwise heat or cool the boxes to try to keep them to same temperature, if you were doing other experiments along this line. Regardless, it looks like you produced a good experiment, thanks for sharing your results!

JA

Growthofplant.xls (16.50k)

Our Uploaded Journals:

010101.doc (21.00k)  Images

TEAM PLANT YOUR SEED

plantingscience.org
Tell me what you are seeing/thinking

May 30, 2006 | 7:13 PM | Dr. Patricia G. Gensel

your seedlings
Hi again, look at the sprouted seedlings again and see if the "mold" actually consists of aligned threads or if they are all mixed up. If aligned, they may not be mold. Try to find an image of a new seedling—radish is commonly shown, perhaps in your text or by googling on it (and select images). Let me know what you find!

We just germinated radish seeds for my botany summer school class, and we will examine them tomorrow.

Dr. Pat Gensel

May 26, 2006 | 12:06 PM | stacva

In response to Dr. patricia G. Gensel
Thank you for commenting. Your questions are very interesting. In response to the first one, the seed pod is pale, and the sprout itself is being described as 'somewhat' moist. In response to your second question, most of the mold is focused around the root tips, and not the seed pod. We will be sure to research root fungi and soil fungus.

Thanks
Probing questions

- What do you see? What else do you see?
- What do you want to find out?
- Is this the most important question, or is there an underlying question that is the real issue?
- You seem to be inferring ... Why do think the inference holds up?
- What other information do you need?
- What effect would xxx have on your results?

Adapted from Richard Paul 1993. Critical thinking: How to prepare students for a rapidly changing world.
Tell me what you are seeing/thinking

March 13, 2007 | 9:43 AM | Sydney

Dr. Claire Hemingway
We think that the seeds with sugar water will grow faster because one of us did a project in 5th grade about plants and it involved sugar water and plain water and the flower with the sugar water ended up to grow faster.
Yes we thought that the seeds would germinate faster in sugar-water. We no longer believe that because the seeds are already growing and the seeds in plain water have started to grow faster.
Yes we are seeing signs of germination.
Our group thinks that our seeds are swelling just a little bit.

– The Pink Firefighters

March 12, 2007 | 2:34 PM | Dr. Claire Hemingway

sugar and seeds
Hi Pink Firefighters,

Thanks for posting your research question, prediction, and plan. And your journals too. Great details there. Tell us a bit about why you think sugar-water will be better for the seeds than water? Do you think the seeds will germinate faster with the sugar-water? Are you seeing signs of germination yet? Are the seeds swelling? Looking forward to hearing what is happening. –CH
Tell Me Why You Think That

March 14, 2007 | 10:15 AM | Sydney

Flowers and seeds
I think that the flower worked because it already had it's roots. The seeds probably didn't work because it is working on building it's roots.

–The Pink Firefighters

March 13, 2007 | 1:08 PM | Dr. Claire Hemingway

Hi Sydney and the Pink Firefighters
Thanks so much for your comments. It really helps to know what you are thinking and why.

Great that you are building on your previous experiences--just like a practicing scientists. So the flower benefited from sugar-water, but the seeds didn't. What is different about flowers and seeds that could explain this observation? Keep up the great work. --CH
Uncovering Alternate Conceptions

- Food for a plant is either fertilizer or other plants
- Plants get food from soil and water
- Plants (like people) get food from many sources
- Food is anything that helps an organism live or is taken into the body
- Sunlight is helpful to plant growth, but not critical
- Oxygen and carbon dioxide help plants breathe
- Trees and grass are not plants

From Barman et al. 2006 American Biology Teacher 68(2): 73
See also Hershey 2004, 2005
When talking with student teams, scientist mentors...

- encourage and confirm
- respond to inquiry teams’ questions
- provide advice about experiments
- suggest that students get more information
- encourage scientific thinking
- provide information about their science
- embed factual information
- embed information about the ways scientists work
- reveal facets of the history of scientific discovery
What Feedback Would You Give?

Scenarios of Student Projects
Think / Pair / Share

- Building rapport
- Being authentic, candid, and constructive
- Setting clear expectations for feedback, recognizing limits
- Providing feedback regularly
- Asking for feedback on your own feedback

Adapted from Zachary 2000. *The Mentor’s Guide*
Scenario 1: Establishing the relationship in an e-introduction

Consider the examples / Write your own introduction to a student team / Share to discuss what features set a positive tone online

“Mentors who involve mentees in the very first conversation set a positive tone and expectation for active engagement for the entire relationship.”

Zachary, The Mentor’s Guide
Scenario 2: Guiding students to a testable question and sound experiment

Consider the examples / Write your own feedback to the team / Share to discuss what you observe about student thinking and strategies for promoting scientific habits of mind

“The art and science of asking questions is the source of all knowledge.”

Thomas Berger
Scenario 3: Probing for understanding, balancing challenge with compassion

Consider the examples / Write your own feedback to the team / Share to discuss phrasings that sound helpful and those that don’t

“If I have seen further than others, it is by standing upon the shoulders of giants.”

Issac Newton
What significant mentoring tip have you learned?

-- ”Respond quickly to your teams and don’t overload them with questions and/or information. A little feedback, but often, is much more effective.”

-- ”It takes lots of effort to get some groups to communicate, but when they do, it can be very rewarding.”

-- ”Poorly motivated students can be difficult to distinguish from poorly prepared students. Next time I’ll be more observant.”

-- ”It is all new to the students and having a positive experience opens doors. Enjoy the students.”
More Mentor Survey Results: Realistic Expectations

• 48% of mentors spent 1 hr per week mentoring (40% spent 1-2 hrs) --less time than they expected

• 68% will definitely mentor again (20% will probably, depending on their time commitments)

• 62% felt that students’ abilities to conduct science were less than expected for students of their age

N=25 Mentors in Spring 2007 session
This is not INTEL Science/Engineering Fair

1,500 young scientists
51 countries
20% held patents
3 top winners:
$50,000 college scholarship

http://www.sciserv.org/isef/finaldir.pdf
The students reflect our nation’s schools
What are the reasons to mentor?

- American students lack strong understanding of and interest in science (National Assessment of Educational Progress, Timms, 2006 Science and Engineering Indicators)

- High school science courses not providing skills and knowledge (NRC 2006 America’s Lab Report)

- Scientists directly engaging in education can have positive impact (NRC 1996 The role of scientists in the professional development of sci teachers; Loucks-Horsley et al. 2003)
More Survey Results: Impacts on Mentors, Teachers, Students

• 71% of mentors said volunteering elevated their interest in and ability to support K-12 education
• 61% said they will be more effective teachers

“...this is one of the [best] projects I have ever done with my students. They are really taking to the experience and have gained valuable insights into germination.” —T. Johnson, Chicago, IL

“The project can make it easy to teach because student are motivated.” —C. Packard, Sisters, OR

“Having scientists comment on our project was cool.” —Sean
Ways to volunteer

Scientist Mentor
• Mentor ~2 teams per session

Master Plant Science Team
• Mentor ~4 teams each in fall and spring session (~2 hrs per week)
• Receive free membership for the year, 50% off meeting registration, training in online mentoring

Integrate activities into NSF broader impacts

Inquiry Author
Workshop Leader
### What is the process of mentoring?

**Mentor as your schedule permits, skip a session, skip a year.**

*(Teams active 2-4 weeks during 2 mo. window of opportunity)*

<table>
<thead>
<tr>
<th>Pre-Project</th>
<th>During Project</th>
<th>Post-Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contact teams regularly (≥3 times per week)</td>
<td>• Provide feedback to help us evaluate and improve the project for all</td>
</tr>
<tr>
<td></td>
<td>• Contact project staff &amp;/or teacher when appropriate</td>
<td></td>
</tr>
</tbody>
</table>

#### Year-round communication with project staff

- Mentor as your schedule permits, skip a session, skip a year.

*(Teams active 2-4 weeks during 2 mo. window of opportunity)*
Resources, see also Good Science.ppt


Hershey, D. Avoid misconceptions when teaching about plants Action-Bioscience Aug2004 www.actionbioscience.org/education/hershey.html


Want to know more?

Please contact:
Claire Hemingway,
Education Director, BSA
chemingway@botany.org
562-433-4057

www.plantingscience.org