planting science DIGGING DEEPER

A Model for Collaborative Teacher/Scientist Professional Development

Catrina Adams, Botanical Society of America, PI
Jodi Creasap Gee, Botanical Society of America
psteam@plantingscience.org
@PlantingScience

Joseph Taylor, BSCS, co-PI
Winnie Nham, American Society of Plant Biologists, co-PI
Horizon Research Inc., External Evaluator








PlantingScience works!

planting science + planting science DIGGING DEEPER =

An effective way for scientists to get involved in middle and high school classrooms

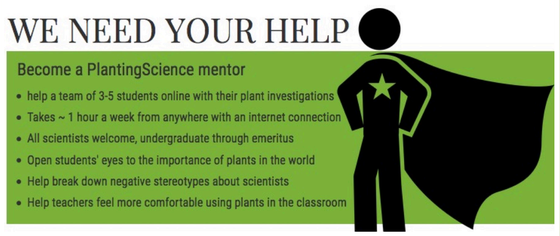
- significantly increases high school students' understanding of key photosynthesis concepts

and

- significantly improves high school students' attitudes about scientists

The model of online student mentoring and collaborative teacher/scientist professional development can be used by other scientific disciplines to help bridge the gap between K-12 and higher education and serve the next generation of scientists and citizens.

Join us!



Digging Deeper Collaborative PD

Participants

4 5-day Summer Workshops
65 High School Teachers
45 Early-Career Scientists

Goals

- Increase Plant Science Content Knowledge
- Increase Pedagogical Content Knowledge
- Familiarize with Power of Sunlight Investigation Theme
- Familiarize with PlantingScience Website
- Develop understanding of roles of teachers, scientists, students

Location

BSCS Headquarters, Colorado Springs, CO

Activities

- Discuss common misconceptions
- Practice questioning strategies for eliciting student thinking
- Hands-on experience with plant photosynthesis and respiration activities
- Experience investigation theme lessons as students will
- Practice interacting with website in role of student, teacher, scientist
- Discuss and reflect on best practices for roles of student, teacher, scientist
- Connect with other participants

Quotes

"Meeting [the scientists] face-to-face was extraordinary."

"The informal not-prompted conversations I had with teachers about how their classroom dynamics work and what their schedules are like helped me get a better sense of how to best communicate."

PlantingScience Awards

Science Education Prizes

THE POWER OF (A) STRONGER BY ASSOCIATION

planting science

STUDENTS

projects last 2-8 weeks

IN THE CLASSROOM

- students work together in teams to plan and carry out investigations
- students and teachers correspond with scientists online and get to know the scientists as real people
- teachers cover other content alongside investigations

9 Plant Biology Themes

From seed germination to genetics to agronomy...basic materials provided

STUDENT TEAMS DOING
REAL SCIENCE
COLLABORATING ONLINE WITH
SCIENTIST MENTORS
FROM AROUND THE WORLD

Student projects
Each team of 3-5 students designs and carries out an investigation with online advice and support from a volunteer scientist

I liked that we didn't know what was going to happen before we did the experiment. Instead of being taught something and then just doing an experiment to prove it, we made an attempt to find out what would happen ourselves.

Scientists are:

- from 32+ countries
- from 18+ scientific societies
- excited to share their passion for plants and science with the next generation

AROUND THE WORLD

TEACHERS

Videoconferences with scientists are an option if classrooms have a high speed internet connection

teacher/mentor group
Teachers communicate online with their teams' scientist mentors about what is going on in the classroom and about student projects

SCIENTISTS

Selected early career scientists work closely with teachers and help keep conversations going strong

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Research Methods

Experimental Design:

- Pre-test/post-test control group design
- Cluster randomized assignment of participating teachers to treatment/control groups
- Students are clustered by teacher

Outcome Measures:

Science achievement

- 2 forms of 26 item multiple choice achievement test covering photosynthesis and cellular respiration. Rasch analysis common item equated outcome measure has 37 total items

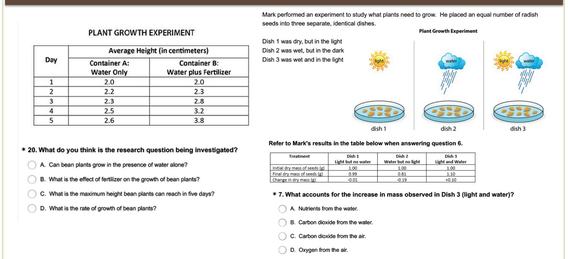
Student attitudes toward scientists

- 2 forms of attitude scale including 10 Likert scale items. Rasch analysis common item equated outcome measure has 15 total items.

Analytic sample:

64 teachers (27 treatment; 37 comparison); 1535 students (514 treatment; 1021 comparison).

Sample Achievement Questions



PLANT GROWTH EXPERIMENT

Day	Average Height (in centimeters)	
	Container A: Water Only	Container B: Water plus Fertilizer
1	2.0	2.0
2	2.2	2.3
3	2.3	2.8
4	2.5	3.2
5	2.6	3.8

Mark performed an experiment to study what plants need to grow. He placed an equal number of radish seeds into three separate, identical dishes.

Dish 1 was dry, but in the light
Dish 2 was wet, but in the dark
Dish 3 was wet and in the light

Plant Growth Experiment

dish 1 dish 2 dish 3

* 20. What do you think is the research question being investigated?

A. Can bean plants grow in the presence of water alone?
B. What is the effect of fertilizer on the growth of bean plants?
C. What is the maximum height bean plants can reach in five days?
D. What is the rate of growth of bean plants?

Refer to Mark's results in the table below when answering question 6.

Treatment	Dish 1 Light but no water	Dish 2 Water but no light	Dish 3 Light and Water
Initial dry mass of seeds (g)	1.00	1.00	1.00
Final dry mass of seeds (g)	0.90	0.91	1.10
Change in dry mass (g)	-0.01	+0.19	+0.10

* 7. What accounts for the increase in mass observed in Dish 3 (light and water)?

A. Nutrients from the water.
B. Carbon dioxide from the water.
C. Carbon dioxide from the air.
D. Oxygen from the air.

Results

	Achievement		Attitudes	
	Treatment	Comparison	Treatment	Comparison
Sample Size	514	1021	514	1021
Standard Deviation	10.030	11.448	6.881	9.055
Unadjusted Mean	48.441	47.002	50.903	50.268
Adjusted Mean*	48.359	45.237	51.312	48.960
Unadjusted Effect Size	0.131		0.076	
Adjusted Effect Size	0.284		0.280	

***Effect sizes for impacts.** Effect sizes corresponding to the treatment effects estimated using the multilevel models were computed using guidance from the What Works Clearinghouse (WWC) Procedures and Standards Handbook 3.0 (see IES, 2017). The WWC recommendation is to use in the numerator the treatment effect estimate from the multilevel model (i.e, the covariate-adjusted mean difference) and in the denominator the pooled student-level standard deviation. WWC define effect sizes of .25 or larger as substantively important.

Controlling for the effects of student and teacher-level characteristics, Digging Deeper demonstrates a statistically significant impact on student achievement (p=.017) and attitudes about scientists (p=.003).

Partners

are you taking part in the evolution?
planting science join us, make a difference