

Annual Report for Period:09/2007 - 08/2008
Principal Investigator: Hemingway, Claire A.
Organization: Botanical Soc of America
Title:
 Plant IT Careers, Cases, and Collaborations

Submitted on: 05/31/2008
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Project Participants

Senior Personnel

Name: Hemingway, Claire
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Stuessy, Carol
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Stanley, Ethel
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Name: Everse, Amanda
Worked for more than 160 Hours: No
Contribution to Project:

Amanda Everse, consultant, constructed the project website, in consultation with Hemingway, Stanley, and BSA IT Manager Rob Brandt.

Other Participant

Name: Waterman, Margaret
Worked for more than 160 Hours: No
Contribution to Project:

Dr. Margaret Waterman, consultant, has managed the investigation case development and has worked closely with PIs in organizing the summer and academic year professional development for the Fellows. In addition to developing a new investigative case for the summer institutes, Drs. Stanley and Waterman have pilot tested the case with secondary school teachers and students in one of their associated collaborative projects.

Research Experience for Undergraduates

Organizational Partners

Monsanto

Monsanto will contribute experts to interact with teachers and/or students in each of the three project years.

Other Collaborators or Contacts

Nedaro Bellamy of Houston Independent School District has assisted with recruitment of teachers and students from Houston. She will also make Houston facilities available as meeting site for students attending the summer camp.

While researching pollen resources and case writing at the SCOPE workshop, we connected with Ameer Godwin and Cynthia James from the OER Commons Project. Open Educational Resources (OER) aims to engage teachers, learners, and practitioners in resources, ideas and expertise, and collaborative knowledge building. Working with middle school teachers from several countries in a pilot study of online resource use to explore global warming, Ameer proposed a collaboration that would allow us to field test the pollen cases for the upcoming ITEST workshop as well as participate in their pilot study. We agreed to author a pollen case and share resources which were submitted and are planned to be used in June.

Resources shared include:

http://bioquest.org/scope/workshop_forms/project_template.php?project_id=492

<http://www.netvibes.com/ssdonova#Background>

http://cmapspublic2.ihmc.us/servlet/SBReadResourceServlet?rid=1209337920984_529590255_638&partName=htmltext

To provide teachers and students with first-hand exposure to diverse career pathways and plant-related research, a number of experts have been invited to the summer program. Individuals, who have confirmed their involvement, and their contributions are outlined below.

Miguel Gutierrez, Monsanto, will talk with teachers about the genetics behind Bt corn after the teachers have been introduced to the "Corn Under Construction" investigative case, and will work with them as they explore associated resources.

Larry Griffing, TAMU Biology Department, will introduce teachers to Scanning Electron Microscopy and assist teachers as they scan pollen samples they collected from pollen traps set on TAMU research gardens.

Charles Kazilek, Arizona State University, will introduce the teachers and students to the mechanics of podcasting and the art of interviewing and science reporting. He will model this by interviewing Dr. Vaughn Bryant.

Vaughn Bryant, TAMU Dept. of Anthropology, Director of the Palynology Laboratory, will provide teachers and students to an overview of what pollen is and how he uses pollen data to solve forensic cases. He will be interviewed by C. Kazilek and students for podcasts and will lead visits to the palynology lab.

Monique Reed, TAMU Herbarium, will talk with students about technology used in modern herbaria and will lead students through a visit to the herbarium, which will include hands-on activities and informal podcast interviews.

Dr. Joe Novack, TAMU Dept. of Horticulture, will lead a student visit to the Holistic Garden and talk with students about his research in sociohorticulture.

Connie Sabesta will lead a student visit to the TAMU Vegetable and Fruit Improvement Center and age-appropriate activities, including a "Phytochemical Lunch."

We are still in the process of confirming all special speakers and field trips for the summer program. Any additional collaborators or contacts will be mentioned in the interim report, which will be submitted following evaluation of the summer program.

Activities and Findings

Research and Education Activities:

Major research and education activities and deliverables

Project overview: The Plant IT Careers, Cases and Collaborations project aims to increase understanding of and interest in plant science and the technology that supports modern science. During summer institutes and school-year projects, secondary teachers and their students have opportunities to solve contemporary plant-related biology problems and explore career connections featuring the technology and skills that support modern plant science. Over three years, the project will directly serve ~ 60 teachers and ~70 students in summer institutes. Two phases of classroom engagement will be offered to successively build skills and knowledge, and hosted on the project website: Plant IT Cases will offer standards-aligned investigative cases integrating technologies used in the study of plant biology and workplace applications; Plant IT Collaborations will offer capstone opportunities for online classroom collaborations with plant scientists. Workshop observations and classroom case studies will provide insights to student learning.

Major accomplishments in the first year:

- ò negotiated contracts with TAMU, Beloit, D. Dickson
- ò created project website www.myPlantIT.org
- ò identified and began training of TAMU graduate students
- ò site visit by all PIs and M. Waterman to TAMU to plan summer program
- ò organized and hosted Steering Committee meeting
- ò invited experts; secured local logistics for summer program
- ò recruitment of teachers and students for summer program
- ò selection of and communication with teachers and students participating in summer program (including consent forms, school authority approval letters)
- ò advertised and offered position for BSA project assistant

Meeting project goals for the first year:

- ò In project year 1, we aimed to recruit 14 teachers from across the nation to the summer professional development program. We exceeded by one that number, including 2 teachers who had to withdraw due to schedule conflicts following their acceptance.
- ò We aimed to recruit 18 students from rural and urban areas of Texas to the summer camps, and we currently have 20 student applications, primarily from Houston students from underrepresented Hispanic populations.
- ò We aimed to recruit a diversity of scientists and plant professionals to interact with students and teachers during the summer programming, and we currently have 7 confirmed experts, each representing a different specialization and career pathway (science reporting, imaging, forensic palynology, herbarium science, horticulture, genetic engineering, crop improvement).
- ò We have established a relationship with Monsanto to include a Monsanto expert in each year's program.
- ò We aimed to develop a new investigative case and have field-tested the new Pollen Forensic case in advance of the summer program.

What worked and what did not: As the summer program for students and teachers is not

scheduled until July, we do not have measures of the impact of our activities. We do have lessons learned regarding recruitment strategies. Regarding teacher and student recruitment, we found that collaborating closely with a school district representative greatly facilitated the effort, particularly for student recruitment. The other successful tactic for student recruitment was through Stuessy's connections across Texas to rural schools, which are part of the PRISE (Policy Research Initiatives in Science to Improve Science Teaching and Learning NSF ESI-0455679). We learned, however, that the timing of our recruitment deadline was inopportune, as it coincided with Texas state school testing.

Findings:

Major findings

Progress to date, Schedule, Changes or additions, Difficulties and solutions: As the project has only completed the recruitment and selection phases, the majority of our lessons learned relate to project management and participant recruitment. The Botanical Society of America is a new awardee organization and Hemingway a new PI. Negotiating contracts and establishing internal reporting protocols took longer than expected, which delayed disbursement of funds to Co-PIs. Moreover, a change in TAMU policies required that the TAMU subcontract passed through the Research Foundation to adjust TAMU indirect costs from 5% to 15%. This delayed the contracts and disbursement to Stuessy and TAMU graduate students, but has not affected project recruiting or participant costs.

A fortunate burden strained the project's ability to stay on schedule, as last September Hemingway became responsible for both an ITEST and a DRK12 grant. This month, Jennifer Potratz accepted the project coordinator position, which is written into year 2 of the grant.

The major recruiting lesson not mentioned above was that the initially planned 3-week institute was an impediment to teacher participation. We addressed this in mid-recruitment season, by altering the summer program schedule to include overlap between the teacher and student portions and reduce the summer time investment of teachers to 2 weeks. Our recruitment strategies next year will include stronger connections our connections to key school district individuals and will schedule deadlines informed by Texas school calendars to facilitate teacher and student recruitment.

Materials development processes:

The following resources have been developed and/or revised for ITEST. The case materials will be available online at <http://myplantit.org/resources.php> after our first workshop in July 2008.

Resources Event Web Address

Using Investigative Cases for Problem Solving with Strategies, Tools, and Data from Plant Biology.

Citrus Canker Case

Back to the Bay Case BSA Symposium <http://bioquest.org/BSA2007/>
Solve Mini-Mysteries with Plant Investigations

Crime Solving Seeds

Chromatography Caper NABT Conference Workshop
<http://www.nabt.org/sites/atlanta%20program%201b.pdf>
ITEST Plant IT Poster

NABT Poster http://myplantit.org/my_plant_IT_poster.ppt
 ITEST Summer Workshop brochure Plant IT
http://myplantit.org/myPlantIT_brochure_final_v2.pdf
 ITEST Summer Workshop student application Plant IT
http://myplantit.org/myplantit_student_application.pdf
 ITEST Summer Workshop teacher application Plant IT <http://myplantit.org/application.php>
 Pollen Problem Space SCOPE
 Workshop http://bioquest.org/scope/workshop_forms/project_template.php?project_id=492
 Pollen Case

PaulÆs Puzzle OER Commons Pilot Project
<http://www.netvibes.com/ssdonova#Background>

Pollen Concept Map with resources OER Commons Pilot Project
http://cmapspublic2.ihmc.us/servlet/SBReadResourceServlet?rid=1209337920984_529590255_638&partName=htmltext

Impact: Demographic data on teachers and students accepted to the summer program are available to address who will be impacted. Teachers come from seven states (Georgia, New Jersey, Illinois (2), Arizona, Kansas, Missouri (2), and Texas (7)). These teachers are responsible for students in grades 7(1), 6&8 (1), 9&10 (1), 10 (2), 10-12 (4), and 9-12 (4). Teaching experience ranges widely from 2 years to 31 years: 4 teachers have been in the classroom 1-4 years; 4, 5-8 years; 2, 9-15 years; 2, 16-20 years; 3 >20 years. All but three of the 16 student applications received thus far are from urban Houston students. Additional demographic data on participants and impacts on them will be provided following the July program and evaluation of it.

Recruitment processes: Application forms and program brochures were available for download from www.myPlantIT.org and advertised on websites of the Botanical Society of America and BioQUEST Curriculum Consortium. To recruit teachers nationally, we posted information on the National Association of Biology Teachers (NABT) and National Science Teachers Association (NSTA) websites beginning in January. The NSTA Report Vol. 19 No. 7, circulated March 2008, profiled the summer program on page 23. Contacts of project PIs also proved helpful in recruiting teachers from Georgia, Chicago, and Texas. As mentioned above, we worked with Nedaro Bellamy of Houston Independent School District to spread the word to both Houston teachers and students. Student application forms included a teacher recommendation form and parental consent form.

Evaluation activities: Internal and external evaluation plans have been discussed among the project PIs and external evaluator. See the evaluation plan attachment for details. Results of internal and external evaluation of the first summerÆs program will be provided in an interim report submitted this fall.

Training and Development:

During weekly meetings, Stuessy has been providing ongoing training for the graduate students who will participate in the summer programming for teachers and students and the classroom cases studies that will take place during school-year implementation. The students are building a rich library of literature on case-based and inquiry-based learning and assessment tools, which is accessible to the entire project through a Sharepoint internal coordination site, hosted by TAMU.

The summer programming for teachers and students is in the final stages of preparation in anticipation of the July event. The detailed daily calendar of activities involving the teachers, students, science education specialists, and invited experts is provided as an attachment file. The agenda is generally described below.

In the first week, teachers will be introduced to case-based approaches to teaching and learning and will work first with two cases previously published in Waterman and Stanely's *Biological Inquiry: A workbook of investigative cases for Biology 8th edition*. In *Back to the Bay* introduced on day one, teachers will have opportunities to explore how weather variables affect algae growth and work with remote sensing data of chlorophyll levels. They will work with real data sources to examine the impact of particular storms and present group posters of their results. Following this experience working with existing data, the next day the teachers will begin to prepare for collecting their own data on pollen (what is it, what variables affect its dispersal, how is it collected, identified, and applied in various fields of study). Teachers then explore the existing case, *Corn under Construction*, to continue learning how cases present multiple entry points and science questions to answer. Working with an invited Monsanto expert on Bt corn, they will extend their knowledge of how Bt corn is made and resources that are available for student investigations into biotechnology questions. Teachers will then return to their work collecting pollen data (including preparing SEM images with the guidance of an invited expert), which they will use to customize a new Pollen Forensic case during the remainder of the week.

In the second week, teachers will have opportunities to guide student groups through their new cases and to reflect in small groups on the teaching and learning experiences of those cases. Student groups will alternate between engaging in investigative cases with teachers and participating in field trips to labs, gardens, and other facilities where they learn about plant-related careers and have opportunities for informal interviews with professionals and peers. Students will record these interviews and reflections of their time in the summer institute in podcasts.

To prepare students for the interview and podcasting experiences, Charles Kazilek, aka Dr. Biology will model these techniques in interview with Dr. Vaughn Bryant, a reknown forensic palynologist and director of the TAMU Palynology Laboratory. C. Kazikek will provide training to the summer participants and the project team in creating podcasts. He will invite the winner of the Friday podcast competition to co-host a Dr. Biology podcast, hosted through the Arizona State University website, <http://askabiologist.asu.edu/podcasts/>

Outreach Activities:

ITEST Planning, Development and Outreach Activities
Summary of Meetings, Presentations, and Conferences
June 1, 2007 û May 31, 2008

June 9 - 17
2007 BioQUEST Summer Workshop 2007
Beloit College
Beloit, WI
Ethel Stanley
Margaret Waterman

July 7 - 11
2007 Botany and Plant Biology Joint Congress

Chicago, IL
Claire Hemingway
Ethel Stanley
Margaret Waterman

November 28 û

December 1

2007 2007 NABT Conference: Transforming Life Science Education

National Association of Biology Teachers

Atlanta, GA

Hemingway attended the NABT K-12 Outreach Symposium and Poster Session and distributed flyers advertising the summer program.

Stanley and Hemingway presented a Hands-on Workshop ôSolve mini-mysteries with plant investigationsö (Stuessy attending) to ~40 secondary school teachers and distributed flyers advertising the summer programs.

Flyers were also available at booths hosted by our colleagues at the American Institute of Biological Sciences and the American Society of Plant Biologists.

December 14 - 19

2007 ICBL Writing Session

Minneapolis, MN

Ethel Stanley

Margaret Waterman

February 4 û 6,

2008 Annual ITEST Summit

NSF

Arlington, VA

Claire Hemingway

Ethel Stanley

February 28 û

March 1,

2008 ITEST Site Visit and Planning

Texas A&M - College Station

College Station, TX

Claire Hemingway

Ethel Stanley

Margaret Waterman

Carol Stuessy

March 19 - 22,

2008 SCOPE Workshop

National Science Foundation

San Diego Supercomputing Center

La Jolla, CA

Claire Hemingway

Ethel Stanley

Margaret Waterman

Stanley, Waterman, Hemingway, and TAMU graduate student Peterson met at the NSF-funded Phase 1 Course Curriculum, and Laboratory Improvement project, SCOPE. The March The SCOPE Project is a collaborative venture among the BioQUEST Curriculum Consortium, OER Commons, The San Diego Supercomputing Center Educational Program, and the Center for Science Education at Emory University to link existing e-science resources, web-based productivity and communication tools, and open educational

resources in ways that promote communities of inquiry.
http://bioquest.org/scope/march_2008.php

April 14 - 16
 2008 ICBL Writing Session
 Cape Girardeau, MO
 Ethel Stanley
 Margaret Waterman

April 17 - 18,
 2008 Steering Committee
 Botanical Society of America
 BSA Headquarters Missouri Botanical Garden
 St. Louis, MO
 Claire Hemingway
 Ethel Stanley
 Carol Stuessy

May 15 - 16,
 2008 NSF Conversation in Undergraduate Biology / AIBS Biology Education Summit
 American Institute of Biological Sciences
 Washington, DC
 Claire Hemingway

Upcoming scheduled outreach activities:

October 2008. NABT Meeting. Memphis, TN
 Hemingway, Stanley, Waterman, and Stuessy's abstract for a hands-on workshop
 "Plant IT: Careers, Cases, Collaborations" has been accepted. Hemingway has also secured
 a booth to enhance dissemination throughout the meeting.

November 2008. School Science and Mathematics Association Meeting. Durham, NC
 Stuessy, Hemingway, Stanley and TAMU graduate student Peterson workshop

March 2009. National Science Teachers Association (NSTA) Meeting. New Orleans, LA
 Hemingway, Stanley, Stuessy, Waterman "Investigative Plant Cases and Innovative
 Technology in the Classroom" abstract submitted.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements:

Although we have not made major changes to the scope of the project, we are slightly behind our desired schedule and have significant carry-over of funds. The carry-over for funds is partly due to the timing of our summer program and the fact that major financial outlay for the participant costs has yet to be spent.

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Journal

Any Book

Any Web/Internet Site

Any Product

Contributions: To Any within Discipline

Contributions: To Any Other Disciplines

Contributions: To Any Human Resource Development

Contributions: To Any Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Supporting Documents

1. Steering Committee agenda and attendees
2. Summer program daily calendar
3. Internal Evaluation Plan

I. AGENDA FOR APRIL 19, 2008 MEETING OF THE STEERING COMMITTEE

- 8:30 Welcome, Introductions, Amendments to Agenda
8:45 Overview of Relationship between PlantingScience and Plant IT
9:00 Review Annual Report and Progress
10:45 - Break -
11:00 Report on / Discussion of New Inquiries in Development
12:00 - Lunch -
1:30 Partnerships: ASPB, Gear-UP, iPlant Collaborative, GC Early College, and others
2:30 - Break -
2:45 Discussion of Lessons Learned / Major Challenges
3:15 Plans for Summer and Coming Years, including Internal and External Evaluation
4:00 Questions. Recap of Day. Next steps

II. Committee Meeting Attended by

Beverly Brown, Larry Griffing, Claire Hemingway, Sandy Honda, Valdine McLean (Friday), Barbara Schulz, Susan Singer, Ethel Stanley, Carol Stuessy, Marsh Sundberg, Gordon Uno, Paul Williams, Teresa Woods. David Dickson (External Evaluator)

Tony Petrosino invited but did not accept invitation.

III. Decisions Taken on Committee Structure and Meeting Venues

We will restructure the board to include 2-year rotations and an executive advisory board, which is informed and advises on both the PlantingScience and the Plant IT projects. The PlantingScience project and the Plant IT project will have separate steering committees.

We will increase representation of secondary school teachers on the committees and hold some committee meetings in conjunction with the National Association of Biology Teachers meeting. We will maintain appropriate representation of BSA and ASPB on the PlantingScience board.

We will secure additional participation in the Plant IT steering committee of independent experts in technology-enhanced learning.

Week of July 7: Teachers, Science Educators, and Invited Experts							
	Monday 7	Tuesday 8	Wednesday 9	Thursday 10	Friday 11	Saturday 12	Sunday 13
8:30-10:00	Introductions Using Investigative Cases	Finish up posters Poster presentation	<i>Corn under Construction (Part 1)</i> Case study group work What resource would you like to use? Monsanto Agricultural expert on Bt corn Miguel Guitterez (30 min)	<i>Pollen Forensics case</i> Uses different SEM data for each group Group work Write testimony as a pollen expert and include images Is the prime suspect guilty? (Data will be pictures like they generated for themselves the night before. Also description of location.)	Case writing focus on assessment, GLEs, and science standards.	Share case scenarios Brainstorming connections	
10:00-10:15	Break	Break	Break	Break	Break	Break	Break
10:15-11:45	<i>Revised Back to the Bay</i> Case study group work Remote Sensing Data Map activity	<i>Paul's Puzzle (weather and pollen counts)</i> Case study group work Pollen Counter (30 min)	Field trip – two locations Collect pollen Set pollen traps	Pollen Resources: Paleontology Bee Visit – do this Curricular materials – just show	Group work	Pairs work	pair work
11:45-1:00	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
1:00-2:30	NOAA expert NOAA Hurricane data	<i>Bee Movie</i> - Pollen jockeys clip What is pollen? Flower and cones lab: a learning cycle	Pollen Imaging - SEM <i>Larry Griffing (90 min)</i> Preparing samples	Writing a case individually Case template	Present forensic cases including activities, standards and assessments Next steps... Pairs develop cases – looking forward to week 2. Case writing. Can be on anything we have talked about.	Pairs consultation	Micro teaching in small groups Implementation issues
2:30-2:45	Break	Break	Break	Break	Break FREE TIME	Break	Break

2:45-4:15	<i>Intro case: Weather and the Bay</i> Pick a hurricane, go back and see effect on bay. Prepare group posters to support your conclusions Work on posters for homework	Pollen Bots Building a pollen trap Visual identification with online images. Groups building two pollen models to scale Finish second pollen model for homework	Collect pollen traps <i>Larry Griffing (90 min)</i> SEM images from samples Homework: Look up five plants found in own schoolyard. Copy picture and describe pollen .	Group work on a forensic case Homework: continue working on group forensics case and resources. They will be presented tomorrow	Pairs work	Pair work	Micro teaching in small groups Implementati on issues Meet students
4:15-5:00	Summary of the Day <i>Big Ideas</i> – Chlorophyll can be measured. Algae and plants respond to changes in environment	Summary of the Day <i>Big Ideas</i> – Pollen is monitored. It travels. Pollen has distinct characteristics.	Summary of the Day <i>Big Ideas</i> – Pollen carries genetic information. Pollen is similar in closely related plants Brainstorming ways to use pollen traps as a tool for student investigations.	Summary of the Day <i>Big Ideas</i> - Pollen provides information on vegetation both past and present. Investigative cases use real data and tools.	Summary of the Day <i>Big Ideas</i> – Assessment is critical,	Summary of the Day <i>Big Ideas</i> Cases are contextualized.	Summary of the Day <i>Big Ideas</i> - Case implementation
Day Overview	Introduction to cases, remote sensing of chlorophyll, and accessing weather data	Pollen production, monitoring and resources	Pollen collection and identification, genetically engineered crops	Pollen as evidence and case writing Role play of pollen expert Case template,	Case presentation and peer review.	Adopting, adapting, and creating a case for local use	Case implementation strategies
Integration of Invited experts	<i>NOAA expert to use hurricane data</i>	<i>Pollen Counter</i>	<i>Agricultural expert – using Bt corn/ Bt cotton, etc.</i> <i>Visualization expert- Larry Griffing SEM</i>				

6:30-9:30 [9:30 in dorms; doors locked and closed]	Dinner and get-acquainted games, etc. (dorm)	Teachers: 1 hour debriefing of teaching at dorm after dinner. Student Groups 1-4 convene for dinner (dinner cards) then chose from options below	Teachers: 1 hour debriefing of teaching at dorm after dinner. Groups 1-4 convene for dinner then chose from options below	Teachers: 1 hour debriefing of teaching at dorm after dinner. Groups 1-4 convene for dinner then chose from options below	Teachers: 1 hour reflections and plans. Groups 1-4 convene for dinner then chose from options below		
Teachers and students choose from these options (students are required to sign up for an option)	Category	*Options	*Options	*Options	*Options		
	Computers	Computer Lab	Computer Lab	Computer Lab	Computer Lab		
	Plant/ Movie	Little shop of horrors Private Life of Plants	Day of the Triffids The Happening (opening June 2008) Suicide inducing pollen	The thing The Ruins, angry plant that eats people.	Modern Jack in beanstalk		
	Speaker/ Discussion	Charles Kazilek	Charles Kazilek	TBA	TBA		

Internal Evaluation - Research Plan

Research Questions

1. (a) How well do teachers' incoming proficiencies, perceptions, and practices predict their levels of reception of the summer intervention (i.e., BioQuest and PlantingScience)?

(b) Are there differences in the relationships between incoming variables and levels of reception between BioQuest and PlantingScience teacher participants?
2. (a) How well do teachers' incoming proficiencies, perceptions, and practices predict their levels of classroom implementation of the intervention (i.e., BioQuest and PlantingScience)?

(b) Are there differences in the relationships between incoming variables and levels of classroom implementation between BioQuest and PlantingScience teacher participants?
3. (a) What is the relationship between teachers' levels of classroom implementation and student involvement and learning in the intervention? (BioQuest and PlantingScience)

(b) Are there differences between teachers' levels of classroom implementation and student involvement and learning between BioQuest and PlantingScience teacher participants?
4. (a) What is the relationship between the level of classroom intervention and high school students' interests in plant- or science-related careers? (BioQuest and PlantingScience)

(b) Are there differences between the relationships between level of classroom intervention and high school students' career orientations between classrooms of BioQuest and PlantingScience teacher participants?
5. What are the effects of the summer intervention on high school students' interests in plant- or science-related careers? (BioQuest only)

Constructs, Variables, and Instruments

Incoming Proficiencies, Perceptions, and Practices

Proficiencies – content knowledge: concept maps of underlying prior knowledge regarding concepts required for full understanding of the intervention; “ideal” concept maps will be drawn by workshop presenters; a short excursion on conventions of concept mapping will be presented to teachers, and then teachers will be asked to draw a concept map of their understanding of basic concepts and principles underlying the workshop; an electronic program will “grade” teachers' incoming conceptual understanding of the

concepts required for full understanding of the content associated with the implementation

Concept Map Analysis of Teachers' Incoming Conceptual Understanding

Perceptions – teachers' beliefs: instruments designed to measure teachers' beliefs about teaching, about their abilities to teach science, and about their ideas about the role of technology in teaching science

Context Beliefs about Teaching Science (CBATS)
Science Teaching Efficacy Belief Instrument (STEBI)
Role of Technology in Teaching Science

Practices – classroom teaching strategies: instruments designed to measure teachers' preferred teaching strategies and the frequencies with which they use constructivist-mediated teaching strategies

Modified Best Practices Survey (M-BPS-BSCS)
Constructivist Learning Environment Survey – Teachers (Time 1) - CLES-T1

Levels of Reception of the Intervention

Daily evaluation forms – completed every day by teacher-participants to assess teachers' levels of satisfaction and concerns about the intervention

Open-ended Concerns Form

Pre- and post-interviews of teacher-participants – completed at the beginning and end of the summer intervention by graduate student mentors, aimed specifically at perceived barriers to full implementation, what the teachers did and did not like about the intervention, and the adaptations that they will make to the recommended intervention in order to meet expected levels of performance in the classroom

Interview Protocol

Levels of Implementation

All teachers: an instrument to measure the frequencies with which they use constructivist-mediated teaching strategies; analyses of teacher-written products associated with their implementations

Constructivist Learning Environment Survey – Teachers (Time 2) - CLES-T2
Qualitative analysis of teachers' electronic responses to questions regarding their implementations

Subset of Co-researcher/teachers: classroom observations using two instruments: (1) the MSCOPS (Mathematics and Science Classroom Observation Protocol System,

Stuessy 2003), that (a) records the frequencies of complexity levels with which students are receiving and using information in the classroom, (b) records the frequency with which student-centered strategies are used in the classroom, and (c) visualizes via a colored profile the flow of the teacher's orchestration of the activities chosen by the teacher to create the learning environment; and (2) the RTOP (Reformed Teaching Observation Protocol, Piburn & Sawada, 2000), which allow classroom observers to characterize an observed classroom on a quantitative scale of reform.

Mathematics and Science Classroom Observation Protocol System
Reformed Teaching Observation Protocol

Student Involvement and Learning

Students of all teachers -- teachers' reports of involvement and learning – segmentation, coding, and analysis of electronic reports to reveal trends in student involvement; analysis of student products offered by teachers as evidence of learning to assess students' levels of scientific activity and accuracy – these data will be used in the first year to develop a teacher ranking scale for Year 2 of the project

Qualitative Analysis of Teachers' Reports
Qualitative Analysis of Student Products

PlantingScience students – assessment via rubric of students' electronic journals to measure levels of scientific activity and accuracy; assessment via segmentation, coding and analysis of electronic dialogues with scientists to measure levels of scientific communication among students

Laboratory Journal Rubric
Qualitative Analysis of Electronic Dialogue

Student Career Orientation

BioQuest summer students' career orientations – pre- and post interviews of summer students' interests in science and/or plant-related careers, conducted by graduate student mentors

Student Career Orientation Interview

All students -- school-year pre- and post questionnaires administered by the teacher regarding their students' interests in science- and/or plant-related careers

Student Career Orientation Questionnaire

Administration Schedules

To Whom and When	Instrument
Teachers	
<u>All Teachers</u>	
Pre-Summer Workshop	CBATS – electronic STEBI – electronic Role of Technology – electronic
Day 1 Summer Workshop	Concept Map Pre-Interview Barriers, Adaptations
Evening 1 Summer Workshop	M-BPS-BSCS CLES-T1
Daily during Workshops	Open-ended Concerns Formative Evaluations
Post-Summer Workshop	Post-Interview Barriers, Adaptations
Post-Classroom Intervention	CLES-T2 Electronic implementation surveys
<u>Subset of Co-Researcher/Teachers</u>	
During Classroom Intervention	Classroom Observations – MSCOPS Classroom Observations – RTOP
Students	
<u>All Students</u>	
Teachers' Reports of Involvement and Learning	Segmentation, coding, analysis to reveal trends of involvement and learning in both environments
Teachers' Submissions of Student Work	Analysis to reveal trends in student work submitted by teachers
Pre-Classroom Intervention	Student Career Orientation Questionnaire administered and collected by teacher
Post-Classroom Intervention	Student Career Orientation Questionnaire administered and collected by teacher
<u>Bioquest Summer Students</u>	
Pre-Summer Intervention	Student Career Orientation Interview
Post-Summer Intervention	Student Career Orientation Interview