

Connecting high school students to authentic research projects and practicing scientists



Susan Flowers
Assistant Director

Phyllis Balcerzak
Associate Director

WUSTL's signature
effort to strategically
improve teaching and
learning within the K-
12 education
community





Life Sciences for a Global Community

MSP Teacher Leadership Institute

Project Director
Phyllis Balcerzak

SIFT & TERF Programs

Informal Science Education project

Project Director
Susan Flowers



The teachers and the students in our projects were directly connected to research scientists in deep and meaningful ways for extended periods of time.



Science education specialists were critical to facilitating preparation of the participating students, teachers and scientists to cross the cultural boundaries.

Summer 2012

Life Sciences for a Global Community

Leadership Conference

Teachers shared projects they had been working on since completing their MS in biology degree

Scientists and administrators were blown away by the teachers' experiences

SIFT & TERF Programs

National Dissemination

Project team shared program models and former high school participants were available as a panel

Scientists and teachers were blown away by the students' experiences

We would like to show you how the relationships between the participants and the scientists were built.

We are convinced that we must keep this essential component – *engagement in authentic research with scientists* – in our work going forward.



SIFT and TERF programs



The Shaw Institute for Field Training (SIFT) and Tyson Environmental Research Fellowships (TERF) programs are linked programs of field training and field research that teach high school students a variety of field skills and then put those skills to use assisting career environmental and ecological scientists with authentic research projects.



**SHAW
NATURE
RESERVE**

Missouri Botanical Garden
2,500 acres
Educational mission
Accessible to public



Washington University
2,000 acres
Research mission
Accessible to scientists

Shaw Institute for Field Training

Introductory field skills training program designed to engage urban, suburban, and rural teenagers in scientific exploration of the natural world (40-60/year)

- Competitive selection process
- Five-day summer training session with overnight has focus on
 - collaboration
 - field skills acquisition
 - science content
- Lessons in outdoor safety, biotic and abiotic measurement/observation, MO ecosystems, map/compass, GPS



Shaw Institute for Field Training



- Program runs from June through March
- Saturday sessions in fall and spring, winter weekend with overnight
- Exposure to a variety of field projects and career field scientists
- 100 hours of learning and field work
- Teens are paid for their field work (minimum wage)

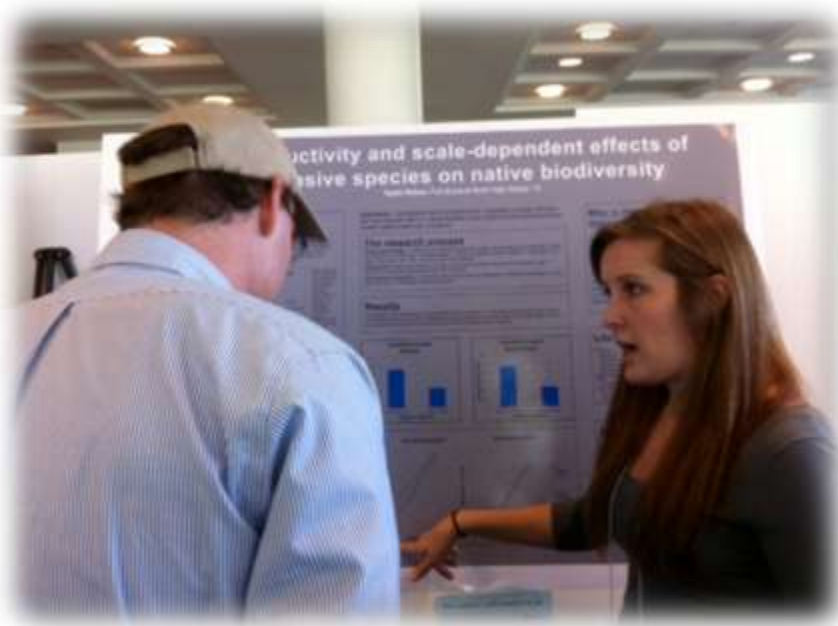
Tyson Environmental Research Fellowships

More advanced field research internship program that provides teens with extended work experience on current research projects and training in scientific communication (18-20/year)

- Competitive selection process, applicants have successfully completed SIFT
- Four-week paid summer internship at Tyson (\$8/hour)
- Cultural apprenticeship in university-based environmental biology research, including training for reading journal articles and attending seminars



Tyson Environmental Research Fellowships



- Poster/presentation work sessions during academic year
- Communication of field research projects to high school biology classes and public audiences
 - WUSTL undergrad research symposium in October
 - TERF symposium in January
- Winter weekend overnight

Evaluation tools include science career survey, climate surveys, interviews, and observations.

SIFT Pre-Program

Informed Consent (IRB/HRPO approval)

SIFT Mid-Program

- Voluntary participants are minors, so also need parental/guardian consent

SIFT Post-Program

TERF Mid-Program

- Possible risks include potential for mild boredom or fatigue

TERF Post-Program

Q: What does it take to attract and sustain the interest of teens who are growing up disengaged from the natural world in households that are disengaged from the natural world?

- Realistic hands-on engagement in science – working on authentic projects with the scientists, as contributing members of a team
- Relationships with scientists that enable personal interaction
- Interaction with other teenagers who have similar interests in science
- Seeing the connection of research projects to broader human problems

Q: How much does belonging to a “special” project and willingness to commit to a special project impact teens’ overcoming barriers to follow-through?

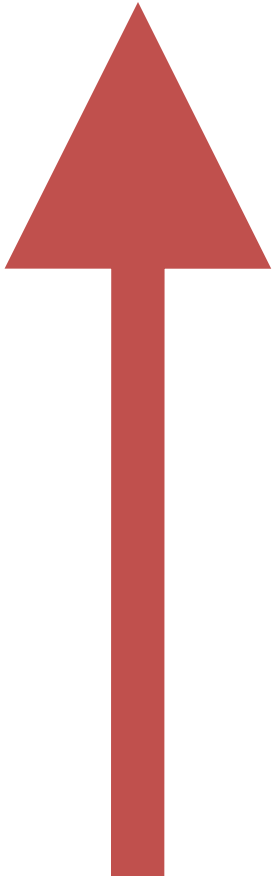
- It allows them to stick with difficult tasks that might otherwise not be pursued.
- It provides a level of “belonging” that guides entrance into the science community.

Q: How does the quality of the team experience support the teens' level of commitment to field research in environmental biology?

We have found critical factors include:

- Mentor styles of working with high school students,
- Mentor emphasis on “teamwork” and inclusion, and
- Increased mentor commitments to intern research posters and ownership of intern success.

Data indicates the combined SIFT & TERF programs



- Develop students' awareness of environmental science careers and seriousness of this career pursuit,
- Increase confidence in completing environmental science activities and college science/math courses,
- Develop the perception of fewer career achievement barriers and increase levels of confidence in overcoming remaining barriers, and
- Provide feeling of greater environmental career supports.

Life Sciences

for a **GLOBAL COMMUNITY**



A NSF Institute for Biology Teachers

 Washington University in St. Louis

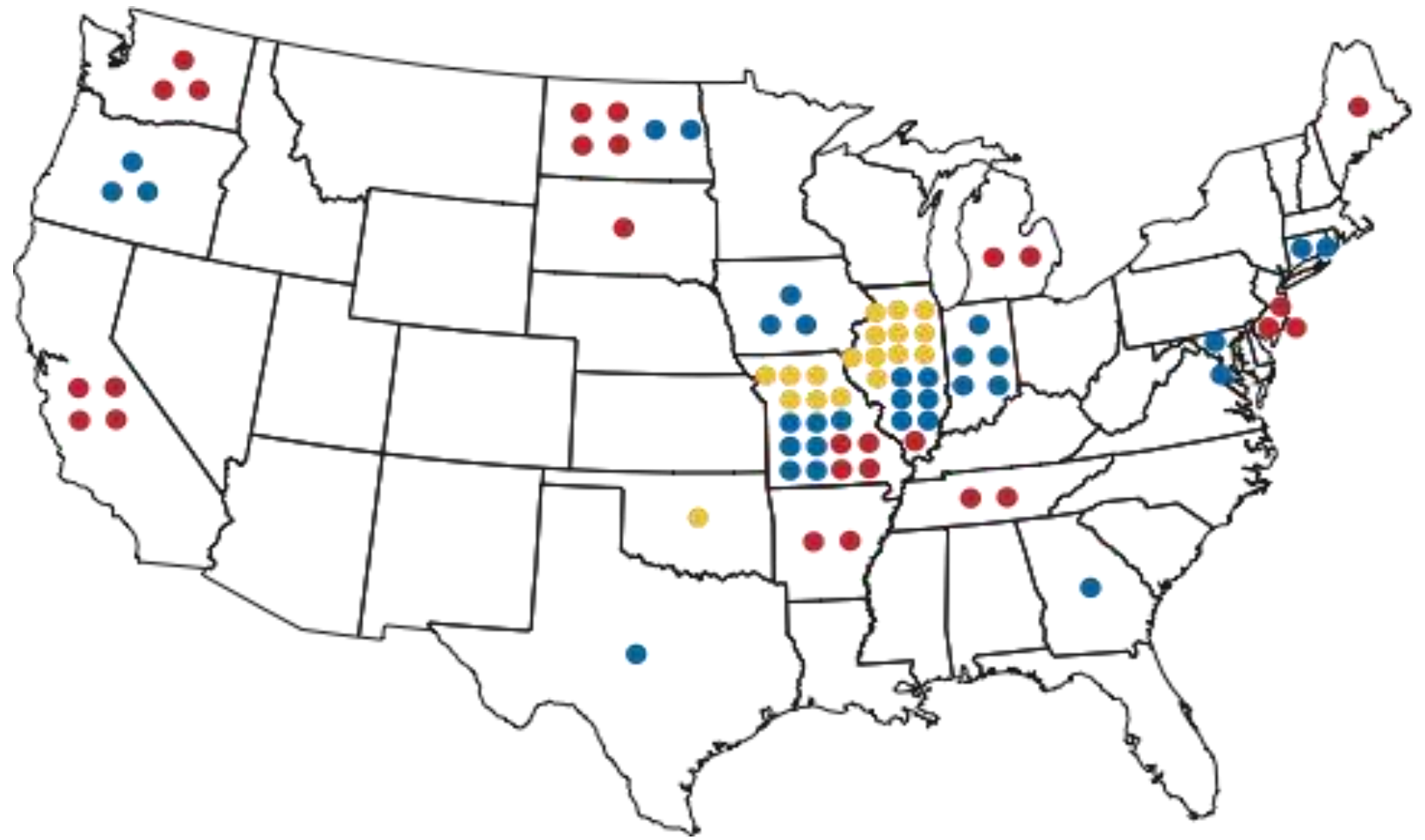
Life Sciences for a Global Community

Goals

- Develop master teachers of high school biology
 - Mastery of global issues
 - Research based pedagogy and content
- Improve interest and achievement of high school students

LSGC Unique Features

- National Cohort (90 teachers, three cohorts, two years)
- Hybrid Model (Summer Residential; Academic Year, Distance)
- Scientists' research to the high school classroom

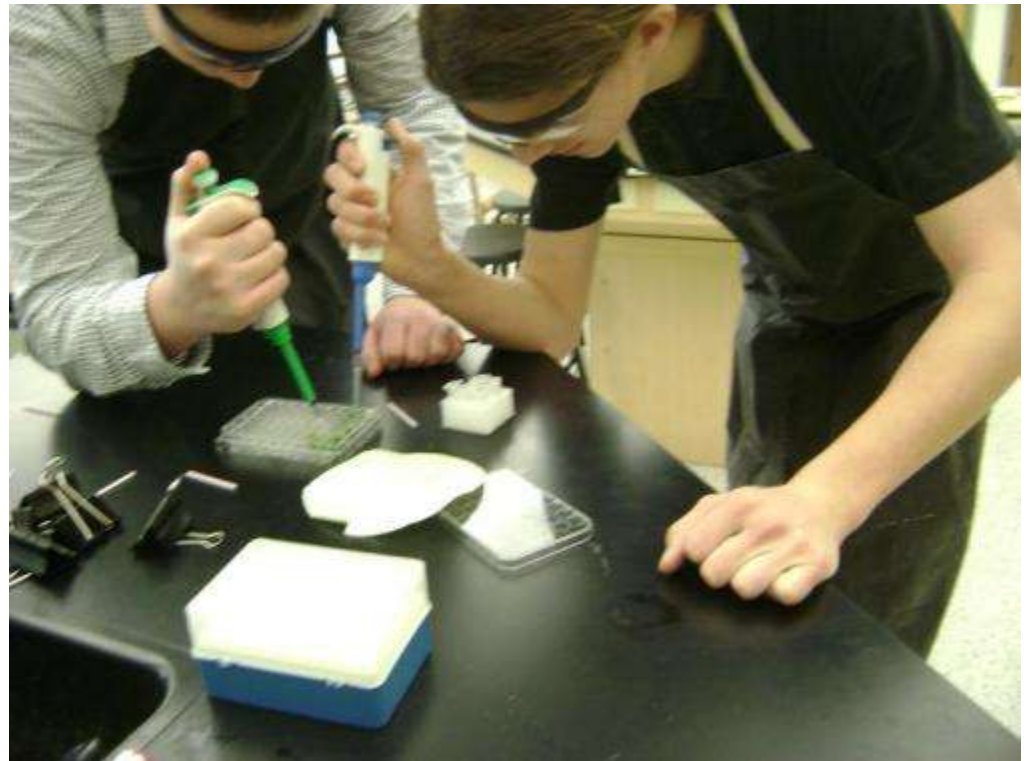


Hybrid Model

| Summer 2007 | AY 2007-08 | Summer 2008 | AY 2008-09 |
|--|--|--|---|
| Bio 523 Plants and People | Bio 509 Chemistry for Biology Teachers | Bio 5924 Molecular Basis of Heredity | Bio 579 Learning Investigations with Model Organisms |
| Bio 524 Ecology & Environmental Sciences | Bio 521 Program Capstone I | Bio 5925 Matter & Energy Transformations | Bio 5771 Program Capstone II |
| Bio 525 Biological Evolution | Bio 529 Case Studies in Biology | Bio 5926 Neuroscience and Behavior | Bio 563 Applications of Biology to Global Health Issues |

Translating scientists' research to the classroom

- Modeling during instruction of summer institute
- Institute projects with teachers



EVOLUTION: Clover Leaf Lab

Cohort 1 Teacher Participant



Students of Cohort 2 Teacher Participant



Ecology and Environmental Sciences

Teacher Authentic Research Experiences Lead to...



Cohort 3 Teacher participants, Summer 2009

...Student Authentic Research Experiences



Students of Cohort 3 Teacher participants field excursion, Fall 2009

Ecology and Environmental Sciences

Cohort 1 Teacher participants Ecology field station- Summer 1...



Cohort 3 Students of Teacher participant after Summer 1 Course: Ecology and Environmental Sciences



Scientist-Teacher Partnerships

- Adapting research to HS curricular investigations
 - Year 1: Domestication of Arabidopsis, Collective Research project, Professor Barbara Schaal
 - Year 2:
Cyanogenesis
in Clover
instructional
module,
Professor
Ken Olsen



Scientist-Teacher Partnerships

- Year 3: Professor Bob Blankenship adaptation of lab on effect of wavelength of light on photosynthetic activity.
- Professor Sarah Elgin adaptation of lab on BLAST, CLUSTL analysis and epigenetics to high school curriculum

Scientist-Teacher Partnership

- Research assistant in scientists' labs

Sheryl Silverberg, Cohort II

Kevin Hall, Cohort II

Chuck McWilliams, Cohort III

Bill Rosser, Cohort I

Anne Puzzo, Cohort II

Measures of Impact

Goals

Metrics

Teacher learning

Pre/post content & retention tests

Teacher transfer

Analysis of projects,
Classroom observations,
Student perceptions

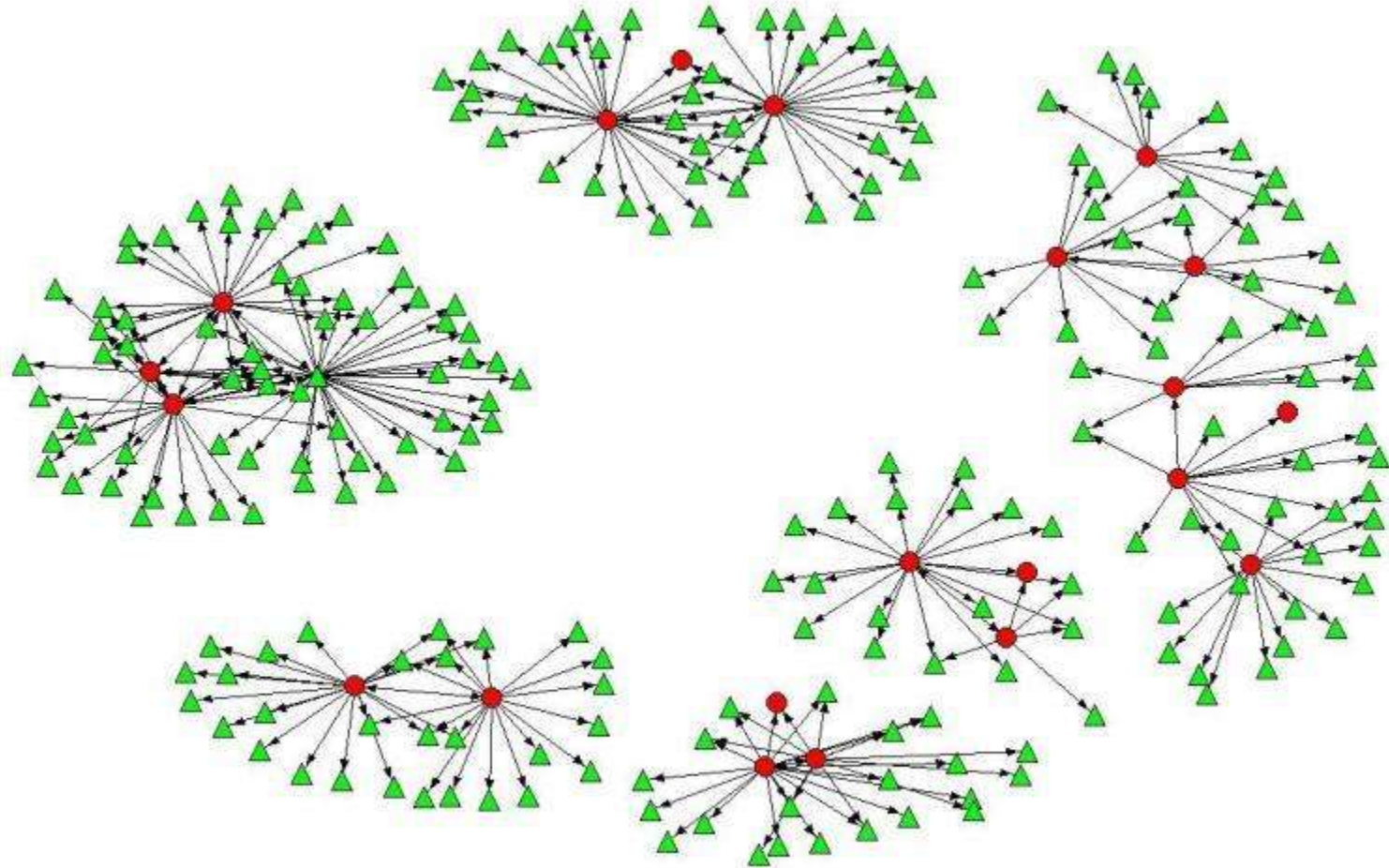
Student learning & Attitude

Pre/post content tests & surveys

Leadership

Dissemination Projects

Cohort 2 2008 (pre-Institute)



Cohort 2 2010 (after 2 years of participation in the Institute)

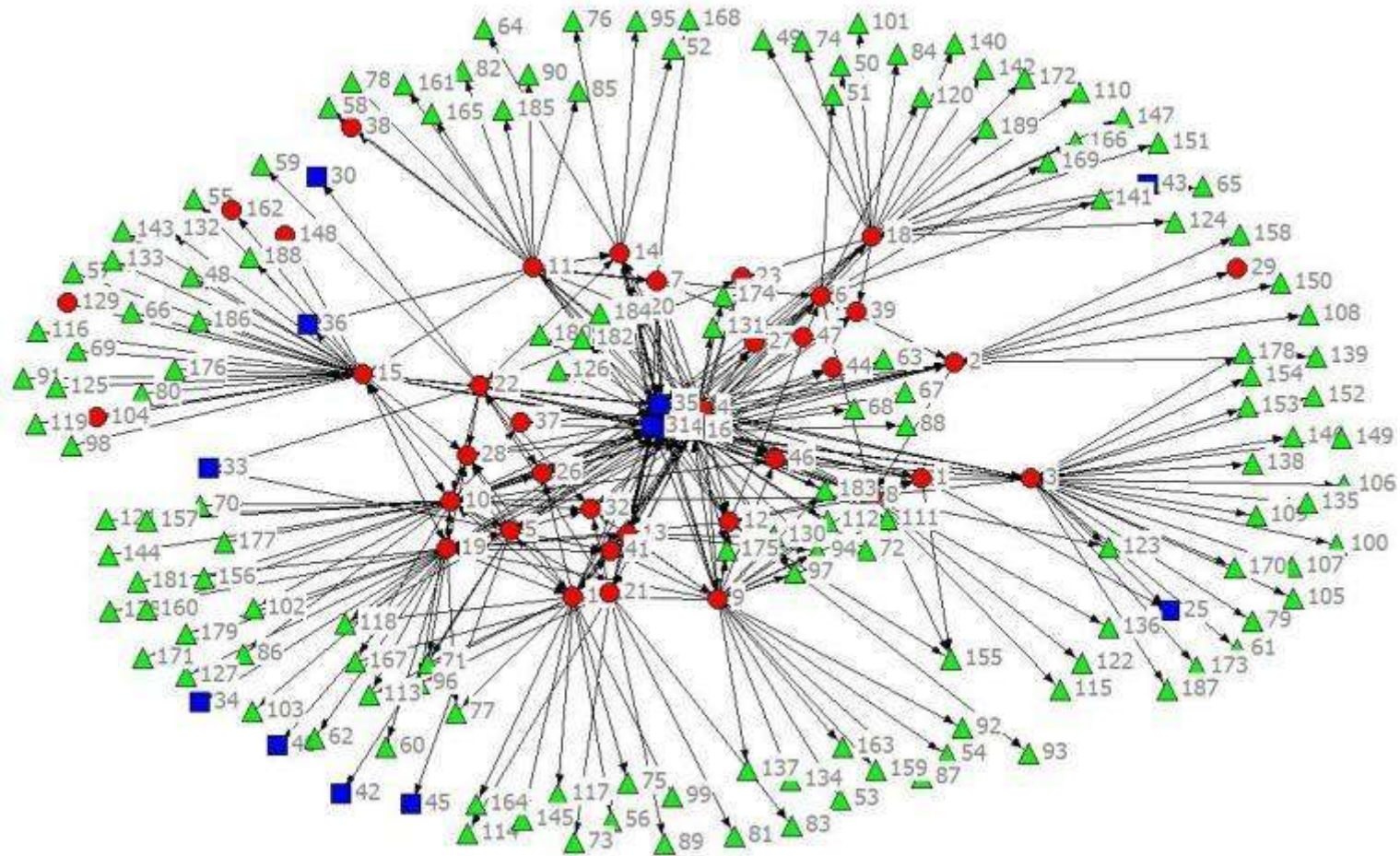
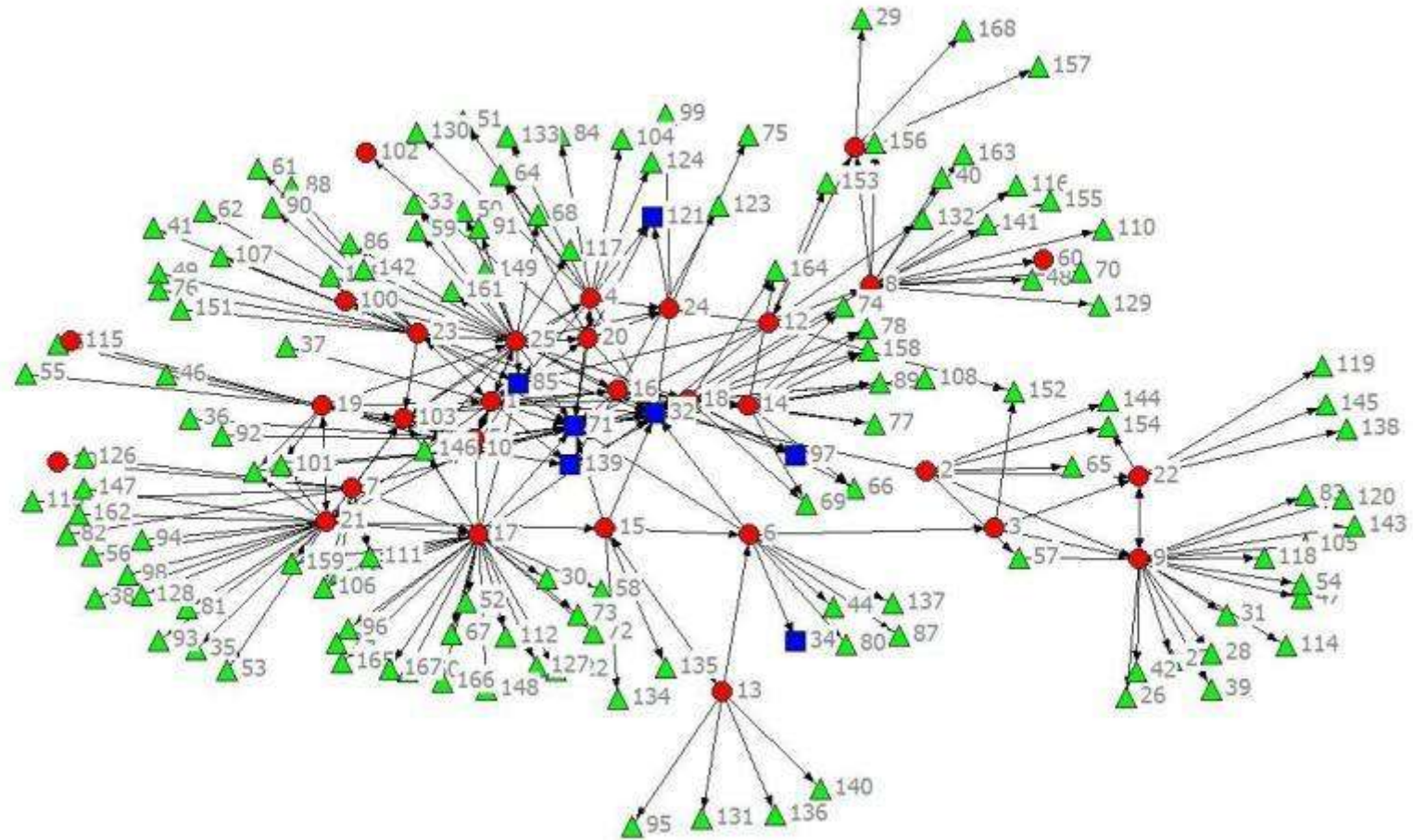
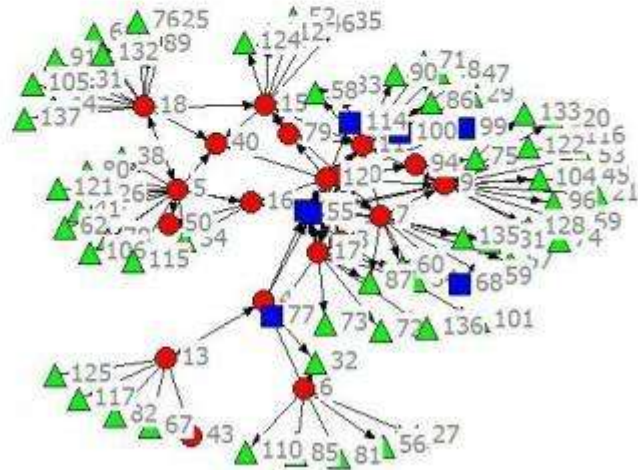
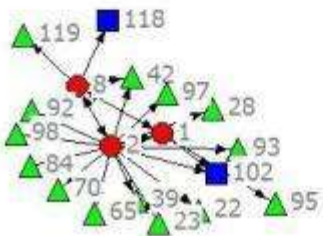
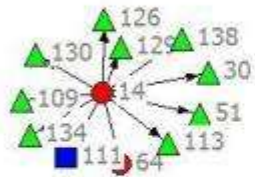
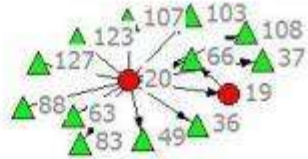


Figure 14: Cohort 2 2011 (1 year post Institute)

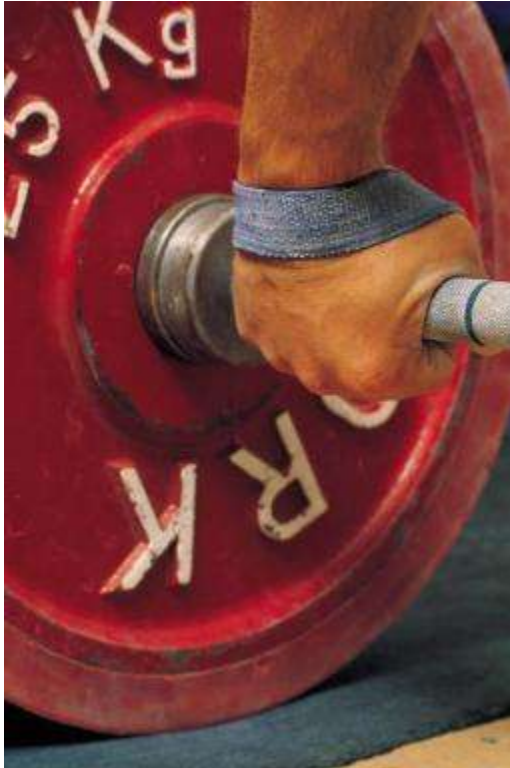


Cohort 2 2012 (2 years post Institute)



Leadership Projects

- Curriculum and Assessment from summer content institute
- Case Studies project
- Teaching in the sustained MS program
- Investigating uses of model organisms for teaching difficult concepts
- *Participation in SIFT & TERF Dissemination Workshops in Summer 2012*



When we started each of these projects, it was hard to get the scientists on board and prepared for the interactions.

- Distracts from their research
- Not in their comfort zone



Back to one of our keys...

Science education specialists were critical to facilitating preparation of the participating students, teachers and scientists to cross the cultural boundaries.

What changed?

- We got students prepared to participate productively in the research and add value to the generation of data.
- We got scientists to see the teachers as communicating and disseminating their research through their curriculum.
- *Now we have scientists looking for ways to continue to interact with teachers and high school students because it has VALUE.*



If you remember one thing...

The teachers and the students in our projects were directly connected to research scientists in deep and meaningful ways for extended periods of time, *with benefit to all.*



Thank you to our colleagues
and partners in this work.

WUSTL Institute for School Partnership

WUSTL Biology Department

WUSTL Tyson Research Center

Missouri Botanical Garden

Shaw Nature Reserve

External evaluators

Kathi Beyer

Carl Hanssen

Our amazing program participants



Susan Flowers
flowers@wustl.edu

Phyllis Balcerzak
pbalcerz@wustl.edu

schoolpartnership.wustl.edu