Diversifying Science

Is it as Simple as Replicating 'Programs that Work'?

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Background and History


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THE PIPELINE PROBLEM

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EDITORIAL

Minorities in Science

A special news report in this issue of *Science*, coordinated by Ellis Rubinstein, Ann Gibbons

programs, many of which are begun at the college level or beyond, are needed because we cannot afford to lose students—whether majority or minority—once they are embarked on the arduous but highly rewarding path of a scientific career. We also know that some minority students who lack privileged parents can be late bloomers. Programs that encourage those most likely to succeed therefore might be a useful addition to those in existence.

The low percentages of minorities in science probably reflect two aspects of past history: (i) that prejudice did exist and (ii) that the pool sizes at the college and graduate school level of that ethnic group were small. The world fortunately has changed. The pool sizes are increasing, and the number of scientists who want to increase the representation of minorities through affirmative action vastly outnumber those who wish to exclude individuals on the basis of race or gender. Under these circumstances the opportunities for able young minority scientists or women should be good in future years. Also for a newcomer without connections a career in science has the great advantages that one can advance on the basis of ability and

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of majority scientists are helpful, especially in mentoring, which is crucial even in the case of the most successful scientists. National Science Foundation Director Walter Massey, for example, points to his mentors as keys to his success (see page 1177). So those who discuss the glass ceiling and the existence of prejudice should do so in order to abolish these unfair barriers, but they should not overdo it because they can do a disservice by discouraging the young minority students who might elect a career in science.

As our earlier issue on Careers (18 September 1992) showed, the disappointment and feelings of betrayal can be great even for majority scientists who entered a long and arduous training only to discover that the "room at the top" is small. Those who are less privileged and entering a new world need early encouragement and optimism, but there is then the danger of loss of faith and pessimism if expectations are not achieved. The encouragement should not be withheld, but realism in achieving the goal should be part of the mentoring in the hope of minimizing the disappointment factor. Identifying individuals in early years who have the potential of being scientists, providing them with mentors, helping them, and not losing them as a result of poor teaching, poor funding, or racial prejudice are important ways to augment the many fine programs already in existence. Improvement in elementary school science and math will be helpful to all students, but it will be particularly helpful for those who are likely to have the least help from parents and environment.

The Biology Scholars Program (BSP)

Matsui et al, Cell Biology Education, vol. 2 Summer 2003

Funding HHMI, Moore Foundation, & NIH

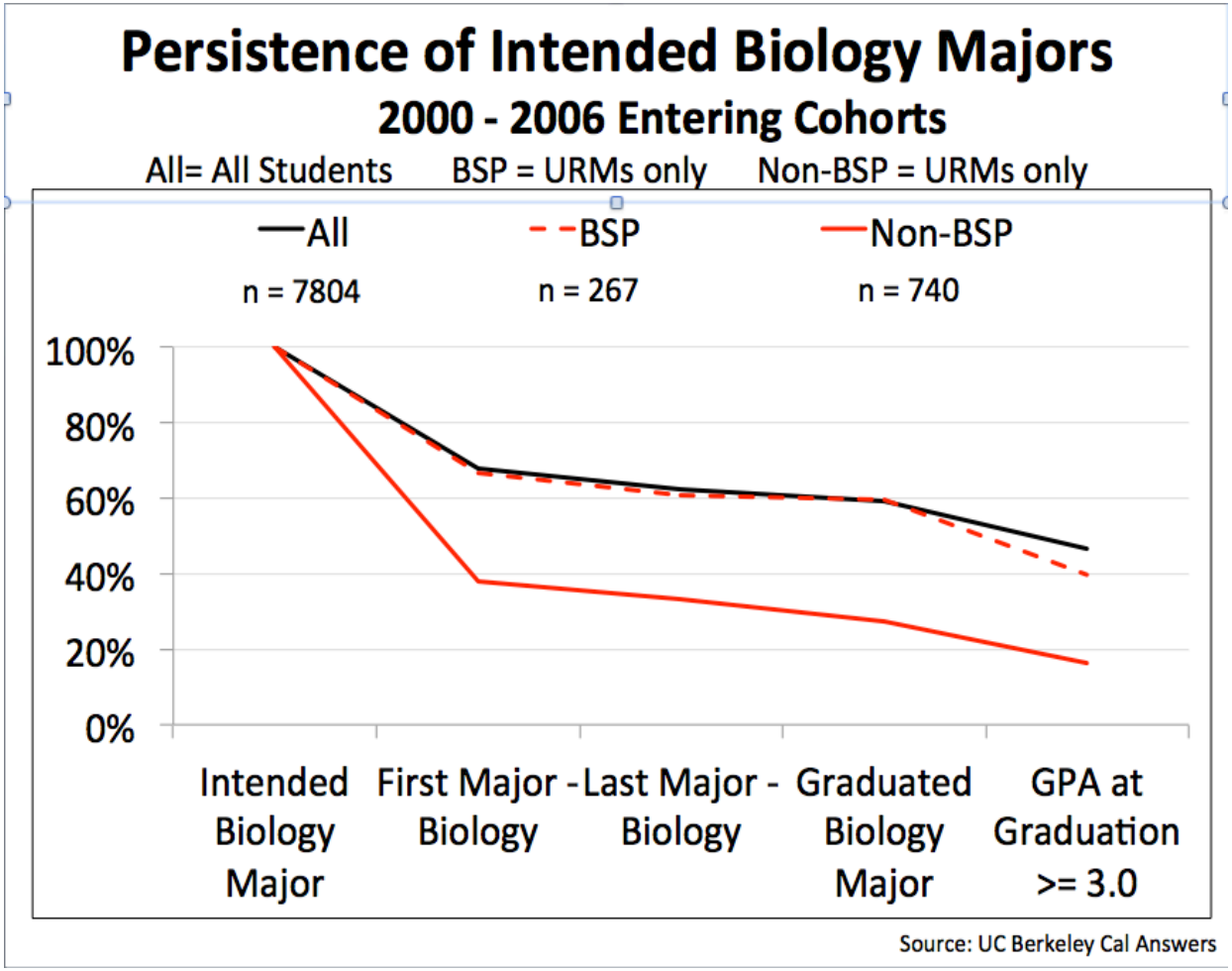
Goal To *enlarge* and *diversify* the pool of students who succeed in biology majors and careers

Members 2950 UCB undergraduates (1992-present)
2550 graduates; 60% minority 70% women
80% low income/1st generation; mostly health careers, growing research career interest

Success **BSP Minority vs. Non-BSP Majority**

- Enter UCB with lower SATs and GPAs
- Graduate in biology majors in same % and with equivalent GPAs

More recent study



Program Components

Features of BSP & Other Diversity Programs

1. Academically Centered, Discipline Based 'Programs'
2. Address 'Life Beyond Academics'
3. 'Front-Loading' of Resources
4. Continuum of Resources to Address Critical Transitions
5. Diverse Criteria for Participation
6. High Academic Expectations
7. Student Networking in an Academic Context
8. Mentoring by Culturally Sensitive Faculty & Staff
9. Students Do Work of the Discipline/Career Connections

‘The List’

Undergraduates

- Mentoring
- Research experiences
- Financial support
- Tutoring/Academic Support
- Academic/Personal Counseling/Advising
- Career Development/‘Next Steps’ Preparation
- Community

‘The List’

Graduate Students

- Mentoring
- Research Mentor Training
- Fellowships/Financial Support
- Professional Development
  - ✓ Grant Writing/Scientific Writing
  - ✓ Pedagogical/Presentation Training
  - ✓ Preparation for Post-doc
- Community

The Problem

Over the last 40 years we've spent billions of dollars …

- to do the same traditional list of interventions with our under-represented students.
- The result?
- A perpetually small pool of competitively eligible minority students.
- And, it is this small pool of students for which our graduate and professional programs, and our faculty search committees continue to compete.

Question

How do we break this cycle and realize our common goal?

NIH/HHMI

Advisory Committee Meeting

on

URM STEM Persistence

August 29-31, 2012

Charge to the Committee

1. Examine barriers to URM persistence in STEM and develop workable strategies to address the achievement gap.
2. Develop ideas for future initiatives at NIH, HHMI, and NSF aimed to increase the numbers of well-prepared students from UR backgrounds that go on to graduate work in the natural sciences.
3. After the meeting, continue working with NIH, HHMI, and NSF to improve the persistence and success of UR undergraduates in STEM fields.

Three of Our Recommendations

1. Academic institutions should be held accountable for creating, sustaining, and institutionalizing a culture of success in STEM for *all* students, with a special emphasis on those from UR backgrounds.

2. Diversity work should be data driven.

3. With forty years of intervention data, we should identify, scale, and disseminate the practices that work well.

Review of What We Know About What ‘Works’

Ingredients for Improving the Culture of STEM Degree Attainment with Co-Curricular Supports of URM Students

- National Academy of Sciences White Paper (2014)
  Mica Estrada, PhD Social Psychologist, UCSF
- Literature review re: what we know about program features => increase STEM persistence & retention of URM students
- 3 critical program components
  1. Quality Research Experiences
  2. Quality Mentorship
  3. 'Engaging' Environment

Ingredients for Improving the Culture of STEM Degree Attainment with Co-Curricular Supports of URM Students

1. Quality Research Experiences

- 'Quality' – authentic research, opportunities for mastery and ownership
- Combined with Mentorship and an 'Engaging' Environment
- Increased likelihood => sustained interest in STEM

Ingredients for Improving the Culture of STEM Degree Attainment with Co-Curricular Supports of URM Students

2. Quality Mentorship

- Research on mentoring = 'emerging,' not fully developed, more questions than answers
- What is known suggests 3 aspects of mentoring => positive outcomes
- 3 critical qualities
  a. Instrumental Support - info, opportunities, advice
  b. Psychosocial Support - competency, identity, efficacy
  c. Relationship Quality - trust, respect, empathy, connection

Ingredients for Improving the Culture of STEM Degree Attainment with Co-Curricular Supports of URM Students

3. 'Engaging' Environment

- Raises expectation can succeed
- Affirms personal values, connects relevance of material to lives and personal experiences
- Promotes belonging/integration into STEM community
- Done so by increasing self efficacy, science identity, resilience, resistance to stereotype threat
- Result = increased STEM persistence

Question

Knowing this, can we replicate programs that 'work'?

Meyerhoff Adaptation Project

Funded by the Howard Hughes Medical Institute (HHMI)
2014 - 2019

Meyerhoff Scholars Program (MSP)

- University of Maryland, Baltimore County (UMBC) since 1989: 900 alums, 300 in grad/ professional programs
- Goal is to promote the success of 'highly able UR students who aspire to become leading research scientists and engineers'
- Project goal is to establish MSPs at
  - *University of North Carolina, Chapel Hill
  - *Pennsylvania State University
- Assistance of External Advisory Group

Questions

What are the challenges?
And where do we look for help?

How to Adapt Effective Programs for Use In New Contexts

Card, J. et al, Health Promotion Practice, 2011 (January) vol. 12 (1), 25-35

Challenge/Tension – *when building on success*

- Maintain *fidelity* to the original/proven model while at the same time
- Demonstrating *sensitivity* to both the
  - **New population*
  - **New implementation context*

How to Adapt Effective Programs for Use In New Contexts

Card, J. et al, Health Promotion Practice, 2011 (January) vol. 12 (1), 25-35

Replication

- Implement the established, tested model in a new context
- Maintain - core goals, activities, delivery techniques, etc.
- Ideally - replicate 'As-Is' in new setting with no changes
- However– often Mismatches/Discrepancies in
  - **Population*
  - **Implementers*
  - **Conditions, available resources, etc.*

How to Adapt Effective Programs for Use In New Contexts

Card, J. et al, Health Promotion Practice, 2011 (January) vol. 12 (1), 25-35

Adaptation

- Process of altering the program model to reduce mismatches between its characteristics and those of new context and population
- Goal is to adapt a proven program to a new context while reproducing successful outcomes of original program
- Requires careful planning and execution that result in
  - **Cultural appropriateness*
  - **Local acceptance*
  - **Feasibility*

Adaptation Process

Card, J. et al, Health Promotion Practice, 2011 (January) vol. 12 (1), 25-35

A pragmatic 7-step process to adapt an existing, successful program to a new context, while preserving what made it effective in the first place

1. Select a suitable effective program
2. Gather original program materials
3. Develop a program model/logic model
4. Identify the program's core components & best practices
5. Identify mismatches between the original program model/materials and the new context
6. Adapt the original program model
7. Adapt the original program materials

What's a logic model?

Picture or 'Roadmap'

- *What want to achieve and how plan do it*

Diagram/Table that depicts the relationship among

- *Available resources (Inputs)*
- *Approaches plan to use (Strategies)*
- *Changes or results hope to achieve (Outputs, Outcomes, Impacts)*
- *How will define and measure success (Evaluation)*

Logic Model

INSTITUTION: UC Berkeley

2008 Professors/Program Directors Meeting

LOGIC MODEL TEMPLATE - BSP Pre-Graduate Pathway (PGP)

Inputs	Strategies	Outputs	Outcomes		Impacts
			(Short Term-Learning)	(Medium Term-Action)	(Long Term-Conditions)
BSP Staff – Pre-Graduate Pathway (PGP) Coordinator, Academic Advisors, Tutors, Assistant Director, and Director Cadre of pre-screened biology faculty at Berkeley Pre-screened pool of BSP undergraduates interested in research HHMI funds Laboratory facilities of faculty	Exposure of pre- or novice researchers to more experienced undergraduate researchers Setting clear roles and expectations for both students and faculty Pay students to do research so they can do science while meeting their financial need Pre-screening of both undergraduates and faculty Matching students and faculty based on experience, expectations, scientific interest, personalities, etc. Comprehensive and developmental support for students (tutoring, career workshops, application workshops, academic advising) Communication/feedback loops from application, selection, match, doing research, end of the program Student and faculty evaluations Use information and evaluations to improve the program	Create the PGP Hire one graduate student or post-doc to mentor Pathway undergrads Increase the number of program students that participate in the PGP each year Increase the number of students from the larger campus that participate in the Biology Fellows Program (BFP)	Increase the participation of low-income and first generation students that participate in research on and off campus Increase the number of students applying to graduate science programs Increase the number of students graduating with a biomedical undergraduate degree Increase retention in “gateway” courses Increase students’ identification with science	Understand how “program” interacts with the undergraduate research experience Increase students’ career options awareness Increase faculty awareness of diversity issues in science	Enlarge and diversify the pool of undergraduates conducting bio-medical research Increase the number of students admitted to PhD science programs Increase the number of first generation and low income students entering biomedical careers Diversify the professoriate Institutionalize science diversity programs at our universities and colleges Eliminate the need for science diversity programs with universities and colleges employing the “best practices” of BSP to broaden access to science for students from all backgrounds

Building Your Logic Model

Outcome/Impact - *identify first, then work backwards*

- Results you expect/would like to achieve
- e.g., parity of URM and non-URM STEM research professionals

Strategy – *how to*

- How you'll focus resources/actions to effectively and efficiently achieve outcome
- e.g., maximize students' introductory research experiences with a methods pre-course, ongoing mentor training, 'brokered' matches, etc.

Output – *activity data*

- e.g., increase the persistence of students in research beyond the initial exposure, % enrolling in STEM MS or PhD programs, etc.

Assessment and Evaluation

Measuring Change – meaningful metrics of 'success'

- Baseline
- Comparison Group

Broader Impact

- Beyond program participants
- Institutional change

Questions and Considerations

- Correlation v. Causation?
- Selection v. Treatment?
- Skimming v. Expanding the Pool?
- Longitudinal Effect – over what timeframe?

After 23 years of work with BSP
What have I learned, what do I recommend?

We need:

1) Rigorous social science research to help us understand diversity work.

and, using this research

2) Expert training and resources to help us go from theory to practice re: what works, what doesn't, for whom, and under what conditions.

and, finally

3) The will -personal, political, and professional- to hold ourselves accountable through rigorous assessment/evaluation and to tie funding and other 'rewards' to student outcomes.

Now, let's talk…