Increasing Diversity in STEM Education

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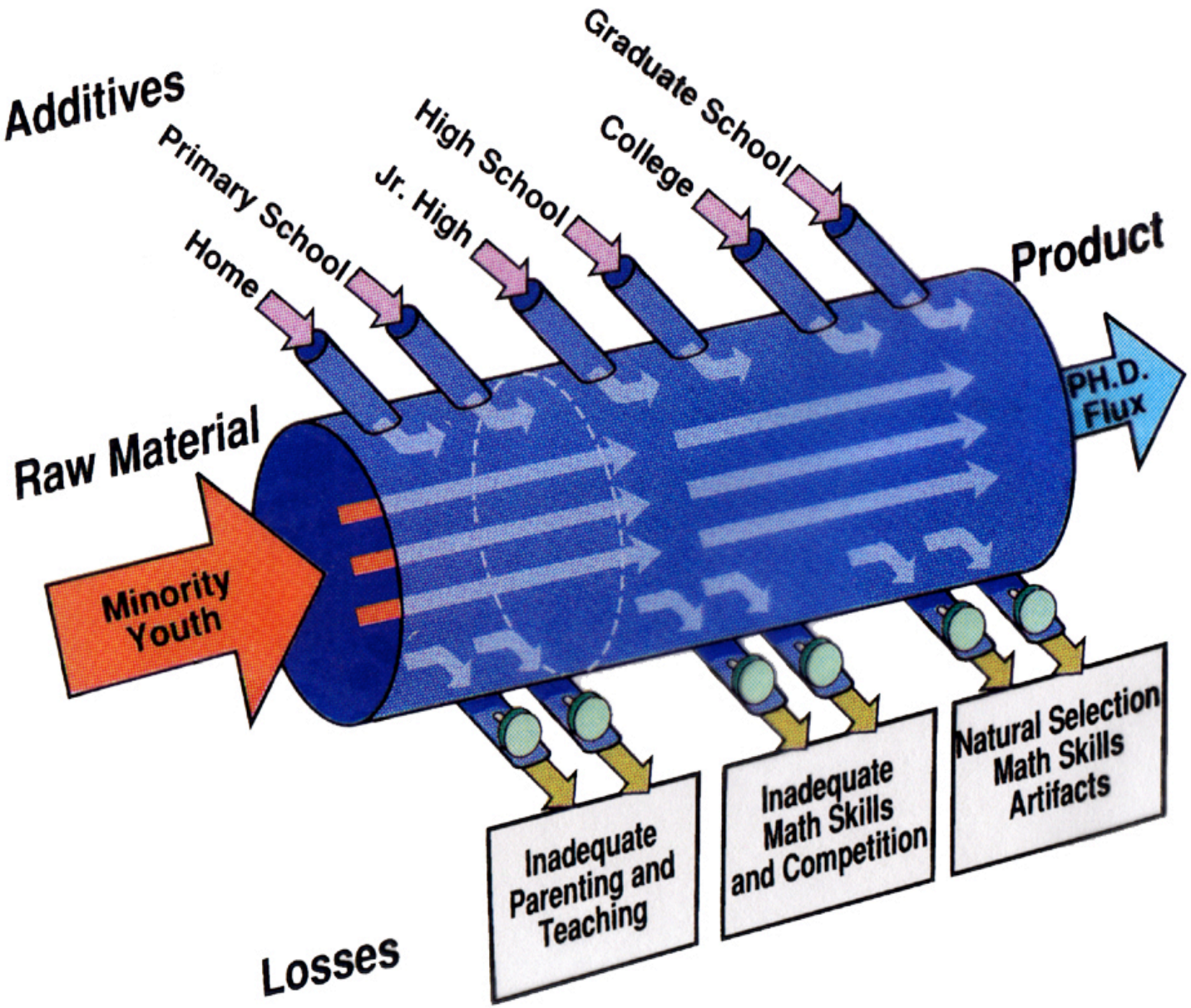
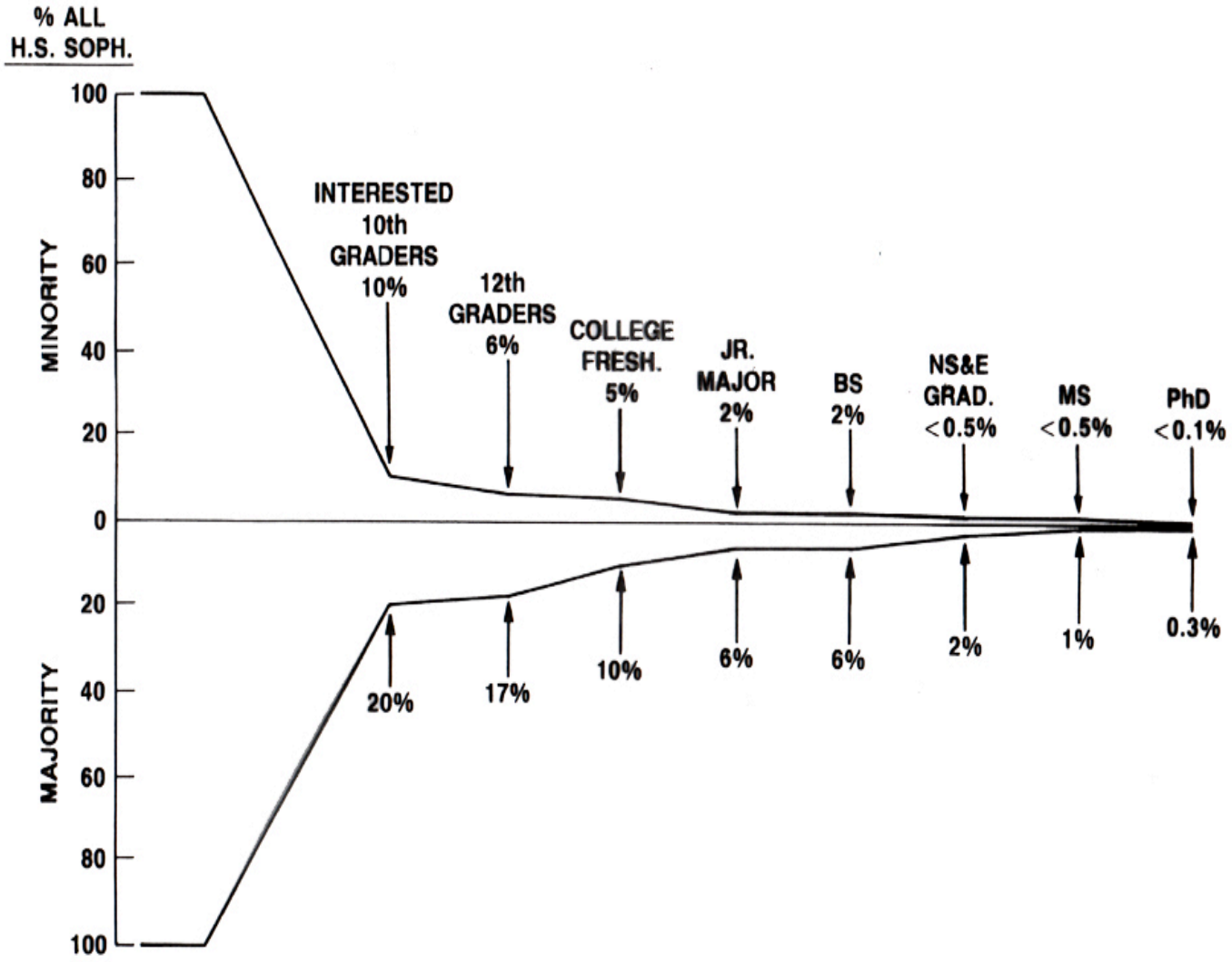
Materials Science Meeting, MIT,
Cambridge, MA, November 30, 2009

PH.D. PIPELINE FOR PROJECT 2012



James W. Mitchell, Howard University

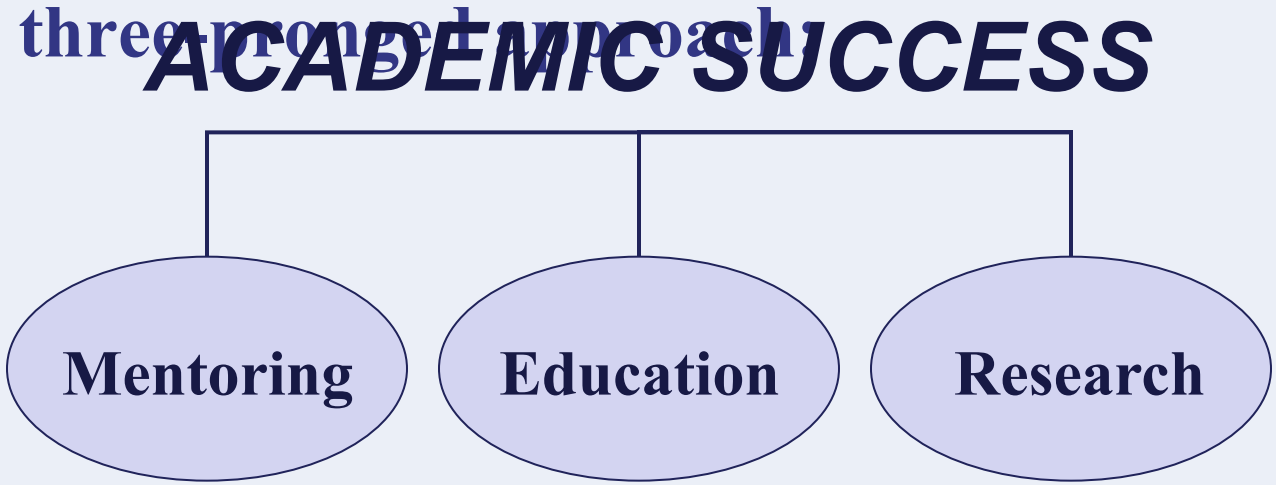
ETHNIC GROUP PARTICIPATION IN NATURAL SCIENCES & ENGINEERING



James W. Mitchell, Howard University

To Increase Diversity

Provide a supportive, motivating environment for all students which promotes academic success through a three-pronged approach:



Mentoring

Mentors function in four primary roles:

1. Teacher

imparting knowledge or skill to the mentee by example or experience

2. Counselor

exchanging opinions and ideas with the mentee to reach a decision or deliberate plan of action

3. Intervener

influencing the mentee's attitudes and behaviors

4. Sponsor

assuming responsibility for assisting the mentee in gaining greater academic success


ACADEMIC SUCCESS
Mentoring
Education
Research

Education

Provide all students with what they need to be successful in STEM:

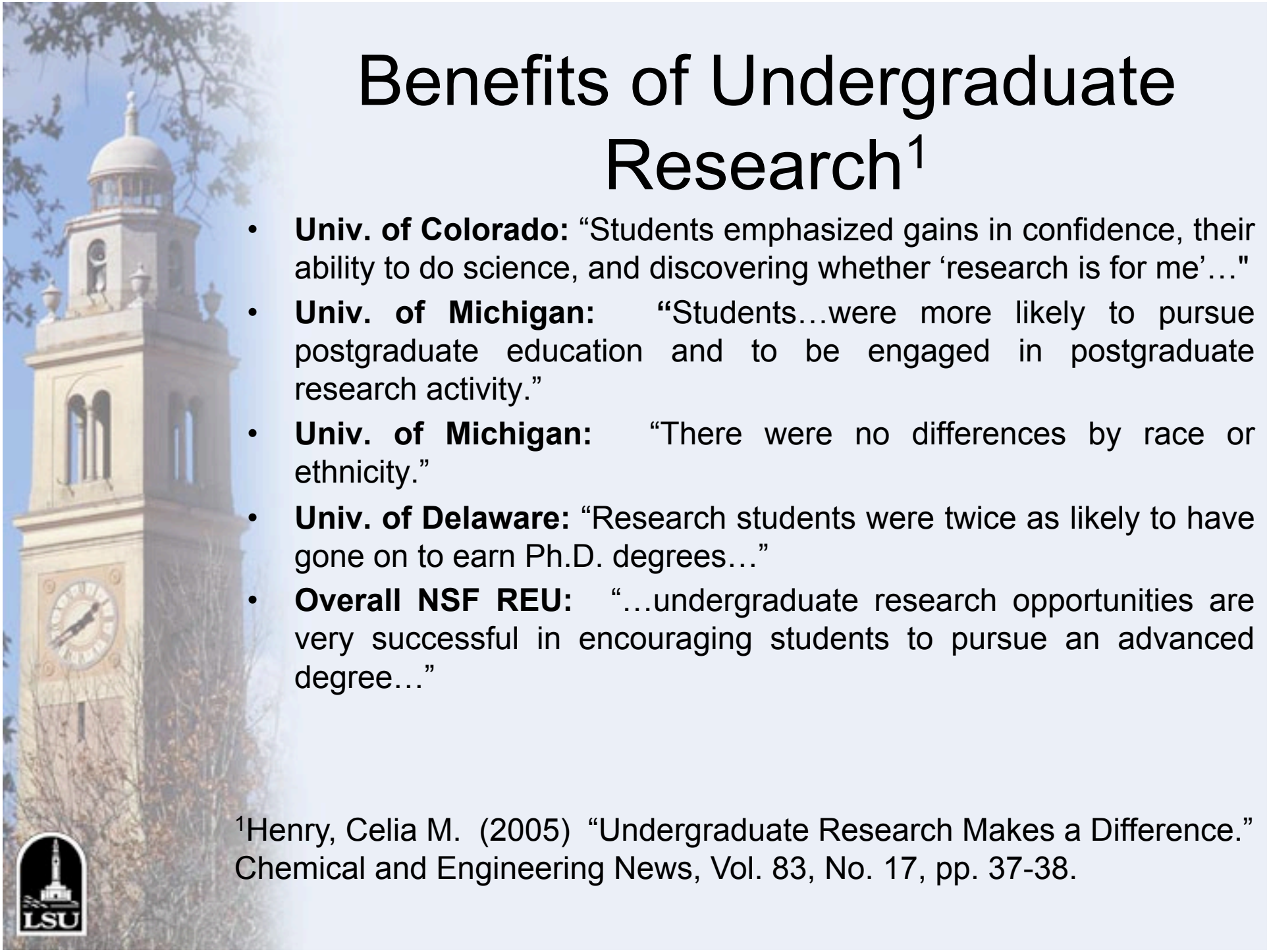
- Refined problem-solving skills
- Time management and organization
- Enhanced interdisciplinary learning
- Ability to make connections between coursework and real-world experiences
- Metacognitive abilities (learning how you learn best and monitoring your own learning)
- Writing skills (yes, even for STEM majors)


ACADEMIC SUCCESS
Mentoring
Education
Research

Research

To be successful in Research, students should

- **receive extensive preparation for research during their freshman year or before (summer bridge)**
- **be working in a research lab by their second semester as freshmen**
- **have a research mentor to offer guidance and support**
- **have the opportunity to participate in summer research programs all over the country**
- **complete a major research project and write a senior thesis**

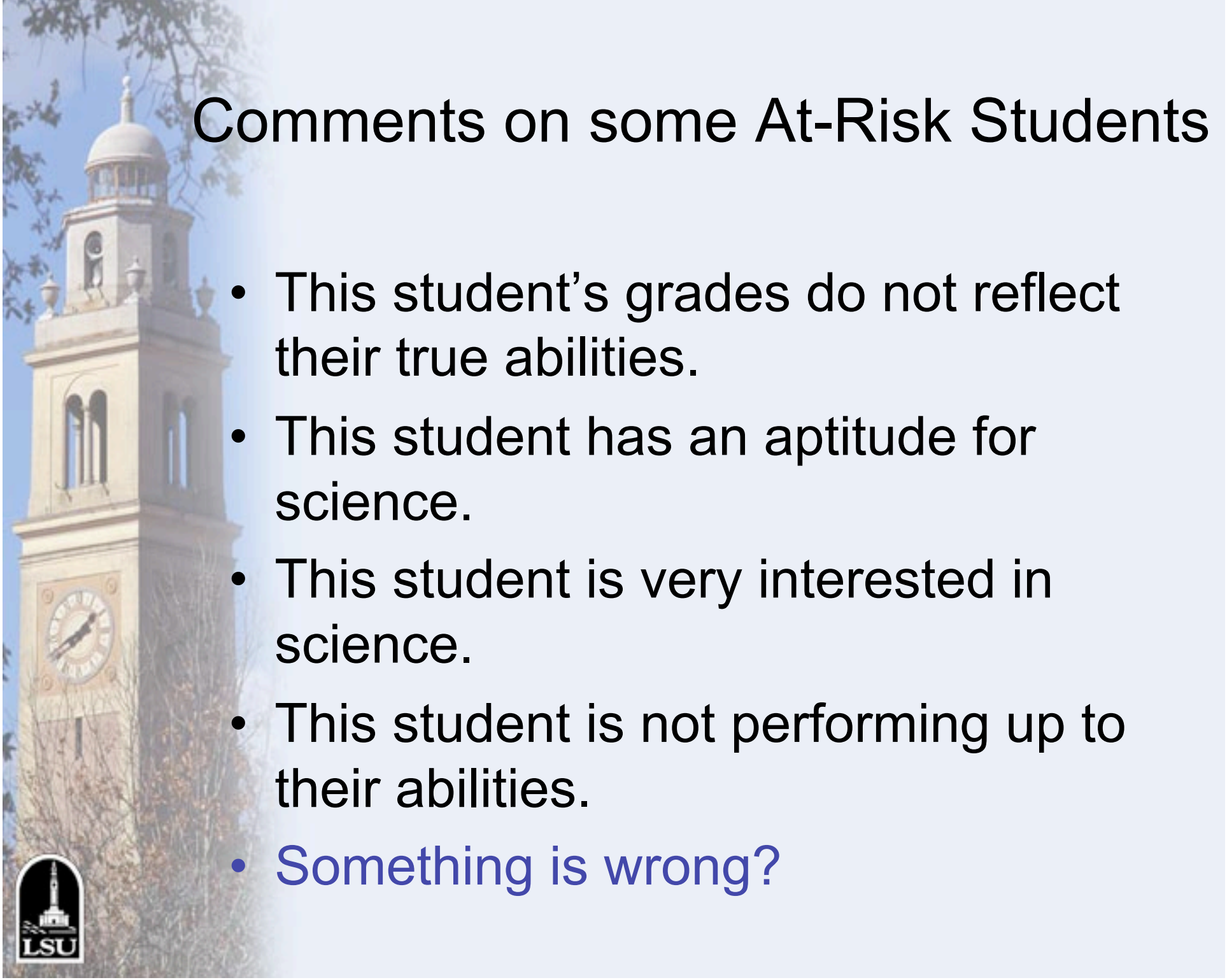


Benefits of Undergraduate Research[1]

- **Univ. of Colorado:** “Students emphasized gains in confidence, their ability to do science, and discovering whether ‘research is for me’…"
- **Univ. of Michigan:** **“**Students…were more likely to pursue postgraduate education and to be engaged in postgraduate research activity.”
- **Univ. of Michigan:** “There were no differences by race or ethnicity.”
- **Univ. of Delaware:** “Research students were twice as likely to have gone on to earn Ph.D. degrees…”
- **Overall NSF REU:** “…undergraduate research opportunities are very successful in encouraging students to pursue an advanced degree…”

[1]Henry, Celia M. (2005) “Undergraduate Research Makes a Difference.” Chemical and Engineering News, Vol. 83, No. 17, pp. 37-38.

LSU Undergraduate Programs



Comments on some At-Risk Students

- This student's grades do not reflect their true abilities.
- This student has an aptitude for science.
- This student is very interested in science.
- This student is not performing up to their abilities.
- Something is wrong?

Louisiana State University

HHMI Professors Program

LSU

HHMI

HHMI Professors Program

- This program focuses on underrepresented, undergraduate students with low GPA (2.5-3.0) in STEM, but have the potential for improvement and a desire to pursue a graduate degree. HHMI Professors Program currently has **17** undergraduate participants.

- **81** students total have been associated with HHMI:

Ethnicity	Female	Male
API Asian, Pacific Islander	2	0
BNH Black Non-Hispanic	26	32
HIS Hispanic	2	1
WNH White Non-Hispanic	13	5

HHMI Professors Program

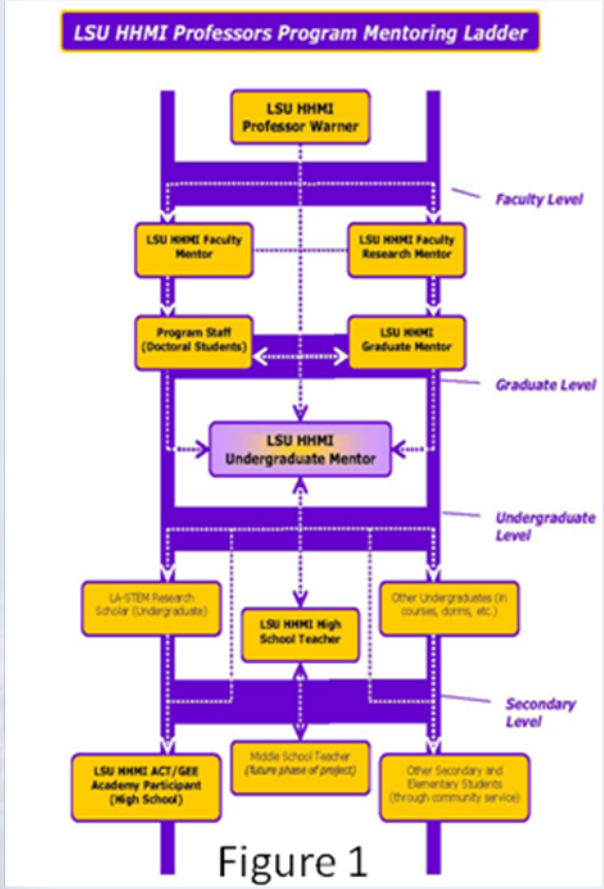


Figure 1

Summer Bridge Program:
•Build a community of learners
•Serves as an intensive orientation to the demands of college coursework

The remainder of their tenure focuses on development of **education, research,** and **mentoring** skills.

•Enroll in a non-credit course each semester where they learn fundamental tools needed to move up Bloom's Ladder.
•Engage in undergraduate research
•Mentored by STEM faculty
•Assigned peer mentors and mentees in their field of study
•Participate in community service
•Receive academic advising and monitoring from program staff

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
17 Week 1 **AUGUST**	18 Orientation	19 Orientation	20 Orientation	21 Orientation	22	23
24 Week 2	25 Classes Begin	26 ***Getting On Course to your Success***	27	28 ***Accepting Responsibility & Time Mgmt: Schedules***	29	30
31 Week 3	1 **SEPTEMBER** *Labor Day Holiday*	2 ***Goal Setting & Self Motivation***	3	4 ***Self Motivation***	5	6
7 Week 4	8	9 ***Notetaking & Mentoring***	10	11 ***Study Strategies I***	12	13
14 Week 5	15	16 ***Preferred Learning Styles***	17	18 ***Self Discipline & Interdependence*** Career Fair	19	20
21 Week 6	22	23 ***Grad Student Research Presentation & Grad School Application Overview***	24	25 ***Self Awareness: Are You Off Course?***	26	27
28 Week 7	29	30 ***Mentor & Review of Midterm Study Schedule***	1 **OCTOBER**	2 *Fall Holiday*	3 *Fall Holiday* GAELA	4 Conference
5 Week 8 @ Tulane	6 Classes resume	7 ***Study Strategies II***	8	9 ***Is 24 Hours Enough?***	10	11
12 Week 9	13 **MIDTERMS**	14 **MIDTERMS**	15 **MIDTERMS**	16 **MIDTERMS**	17 **MIDTERMS**	18 **MIDTERMS**

HHMI Community College Program

This past summer we welcomed our first cohort. The demographic makeup of the group is as follows:

- Average GPA – 3.68
- Majors – Microbiology, Computer Eng, Chemistry, Chemical Eng, and Mechanical Eng.
- Gender - 1 Female and 4 Males
- Ethnicity -2 White, 1 Black, 2 Hispanic

The students participate in a research basics course and complete a minimum of 10 hours a week in a research laboratory each summer. In the fall and spring semesters, they continue their research with a research mentor, meet with HHMI staff for mentoring, are assigned an undergraduate mentor from LA-STEM/HHMI, as well as meet with a faculty advisor from the Community College.

HHMI High School Science and Mathematics Summer Program

Summer 2008 participants included 18 rising 9th through 12th graders from Louisiana and Texas who worked with 3 high school teachers and 3 college mentors.

The program included:

- Math and Science integrated courses taught by high school teachers
- Teacher facilitated laboratory projects
- Mentors facilitated computer training
- Mentor facilitated scientific research and exploration projects
- Student PowerPoint presentations on current scientific research to undergraduate STEM class
- Weekly field trips and fun activities
- LSU faculty facilitated STEM research in laboratories

*Participants are current high school students with projected semester GPA:3.89

Quote from Former HHMI Student

"I was interested in being part of the HHMI Professors Program because it … allowed me to participate in research and mentoring, and helped me to become a better student. I have always wanted to earn a PhD. However, my grades were not high enough to grant me entrance into a degree program. HHMI helped me to understand how I learn, which in turn helped me to reach my academic potential. It was also great to have a group of people who were taking the same classes … and were having (similar) problems. We were able to recognize our strengths and weaknesses and use them to help others and ourselves. Additionally, the research and mentoring aspects of the program helped to better prepare me for graduate school."

Where is she now?

She is in her third year of a PhD in Bioinformatics!

Louisiana Science Technology Engineering Mathematics

LA-STEM

Research Scholars Program

Louisiana State University

LSU

LOUISIANA STATE UNIVERSITY

LSU

Expectations

LA-STEM Research Scholars are expected to

- Complete a freshman summer bridge program
- Hold research positions each semester
- Enroll in the LA-STEM *Success in Mentoring, Education, and Research* course each semester
- Actively prepare for graduate school
- Maintain the highest academic standards (3.5+ GPA)
- Participate in regular mentoring meetings
- Perform community service
- Function as an active member of the LA-STEM/HHMI community

LA-STEM COHORTS Vs. LA-STEM

	LA-STEM Cohorts	LA-STEM
number	658	25
HS GPA	3.79	3.70
ACT	27.2	27.8
1st Year GPA	3.29	3.72
Senior College	50.9%	88.0%

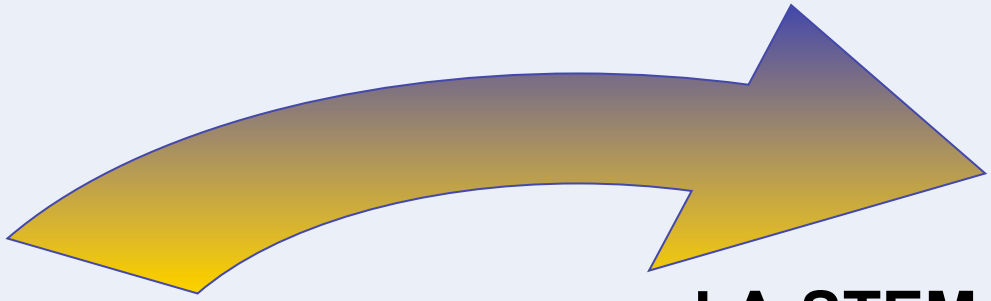
OVERALL LA-STEM Vs. LA-STEM URM

	LA-STEM	LA-STEM
number	25	8
HS GPA	3.70	3.66
ACT	27.8	25.2
1st Year GPA	3.72	3.77
Senior College	88.0%	75.0%

LA-STEM Research Scholars Program

HHMI Professors Program

Success through Collaboration



> 3.5

LA-STEM students who lose eligibility for the program because of the GPA requirement can transfer to HHMI

HHMI students whose GPAs qualify them for LA-STEM can transfer from one program to the other

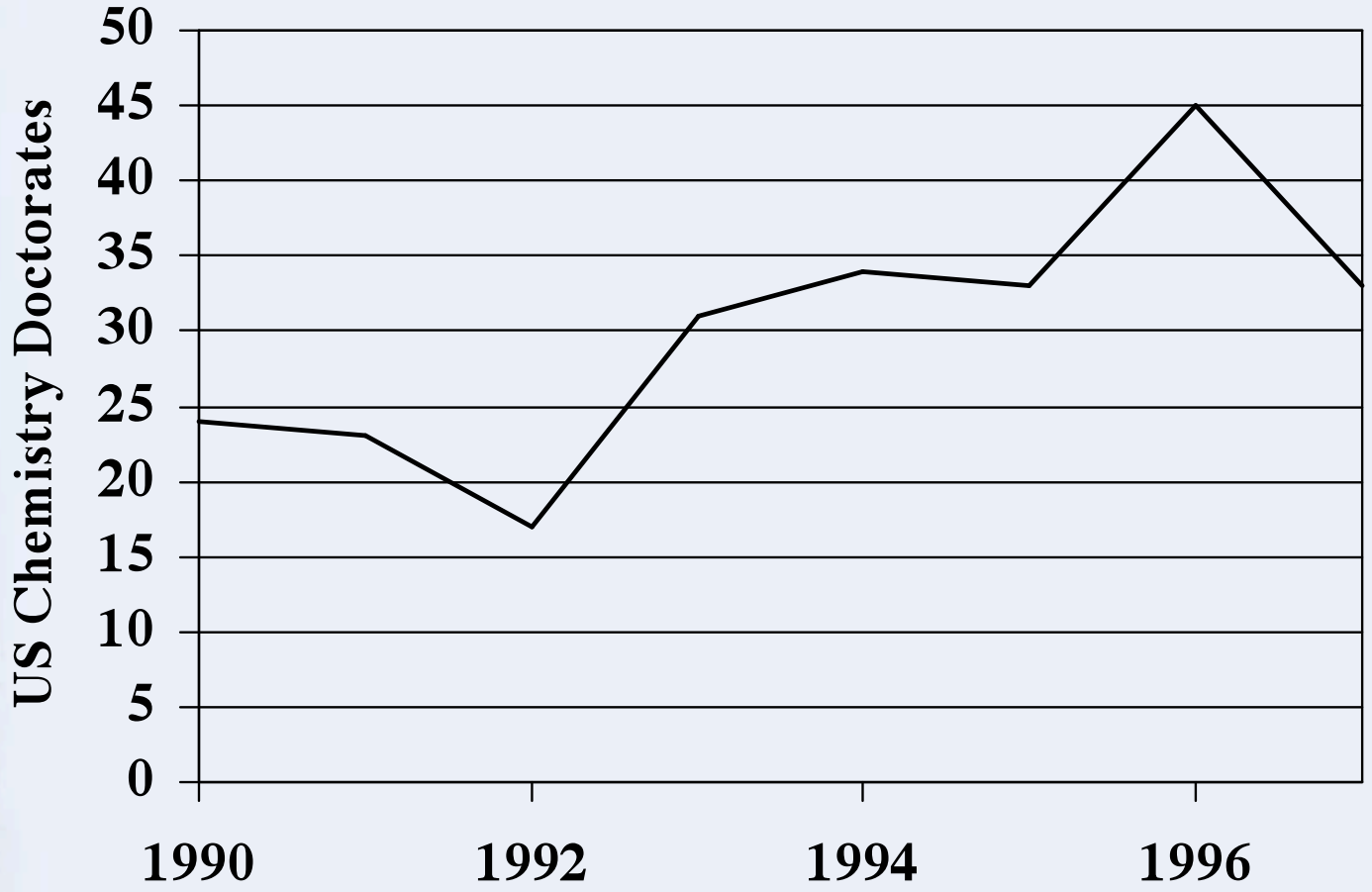
2.5 to 3.0

In HHMI and LA-STEM,
we provide a supportive, motivating, diverse, learning community for students which promotes academic success.

Why is diversity important to this process?

Transformation of Louisiana State University's Graduate Chemistry Program

African American Chemistry PhDs



Chemical & Engineering News, December 10, 2001, Volume 79, Number 50, pp. 39-42

PHOTO BY GEORGE STANLEY

FRESH FACES Nadia St. Luce (left) and Rolanda Johnson are third-year organic chemistry Ph.D. students at LSU.

PERSPECTIVE

WHAT IS LOUISIANA STATE DOING RIGHT?

LSU, largest producer of African American chemistry Ph.D.s, boasts a model graduate education program

SIBRINA N. COLLINS, GEORGE G. STANLEY, ISIAH M. WARNER, AND STEVEN F. WATKINS, LOUISIANA STATE UNIVERSITY

THE LOW PARTICIPATION OF MINORITIES in graduate chemistry programs has been discussed extensively (1–3). In general, the picture is dismal at almost all major universities across the country. However, recent developments at Louisiana State University (LSU) provide a more optimistic picture. Indeed, the last decade of the 20th century was a period of unparalleled growth and development for minority education in the LSU department of chemistry. During the 1999–2000 academic year, 11 African Americans earned doctoral degrees in chemistry at LSU; in 2000–01, seven African American students earned Ph.D.s.

The progress over the past 10 years is even more remarkable given the historical context in which the LSU program evolved. The program did not develop in a vacuum: National and local developments have contributed to the current profile. However, some unique success factors can be identified for this program.

In the last decade of the 19th century, Homer A. Plessy sued the East Louisiana Railroad for requiring "separate but equal" accommodations for blacks and whites. He contended that this requirement was in violation of the 14th Amendment to the U.S. Constitution (4,5). Judge John H. Ferguson ruled against Plessy, and the U.S. Supreme Court upheld that judgment. Justice John Marshall Harlan II, in his lone dissent, asserted that the doctrine of "separate but equal" would delay full implementation of the equal rights promised in the 14th Amendment. His vision was indeed prophetic.

A MAJOR CONSEQUENCE of the Plessy decision was the growth of historically black colleges and universities (HBCUs). In the state of Louisiana, HBCUs have done an extraordinary job of educating African American undergraduates in the face of exceedingly modest educational resources from the state. The vast majority of resources have been awarded to majority institutions in the state of Louisiana. The half-realized legacy of Plessy (separate, but vastly unequal) has certainly impeded the participation of African Americans in the chemistry enterprise, not only in Louisiana but throughout the nation.

IN THE 100 YEARS following the American Civil War, some African Americans were able to pursue a graduate education in chemistry at majority white schools. James M. Jay (6) reported that the top three majority institutions producing African American Ph.D. chemists during this time were Wayne State University, the University of Chicago, and Ohio State University. However, our research indicates that there were more African American Ph.D. chemistry graduates during this time than Jay indicates (7). Iowa State University, for example, had at least 13 African American Ph.D. chemistry graduates during this period, whereas Jay reports seven African American Ph.D.s.

In the past 30 years, advanced-degree production in chemistry for blacks has risen 40-fold. However, these numbers are still disproportionately low. For example, in 1993, African Americans represented 12% of the U.S. population, but earned only about 1% of the Ph.D.s in chemistry (8).

LSU is a product of the antebellum South, and its highly touted traditions of southern charm, warm hospitality, and a beautiful oak-forested campus clashed resoundingly with the less admirable traditions of racial intolerance, white exclusivity, and segregation. Since the 1954 Supreme Court decision in *Brown v. Board of Education* (4,5), numerous desegregation lawsuits have involved LSU. Many of the LSU desegregation initiatives in the latter part of the 20th century have resulted from agreements reached in those suits, agreements that continue to be monitored by the courts (9).

In order to recruit and retain African American students in a majority white institution, several key factors have been recognized: academic support, financial support, professional support, and social support (2). LSU has attempted to address each of these factors, but only in the 1990s were meaningful and successful programs instituted to promote diversity. For example, in 1991, the LSU graduate school im-

LSU Graduate Program

- Historical Context
- LSU - Developments in the 90's
- Chemistry - Profile of the 90's
- Success Factors

Milestones

CAP 1991

-Cooperative Assistantships for HBCU students

Huel Perkins 1994

-Fellowships for African American Doctoral Students

External (McNair, GEM, NSF, NIH)

Minority Infrastructure in the 90's

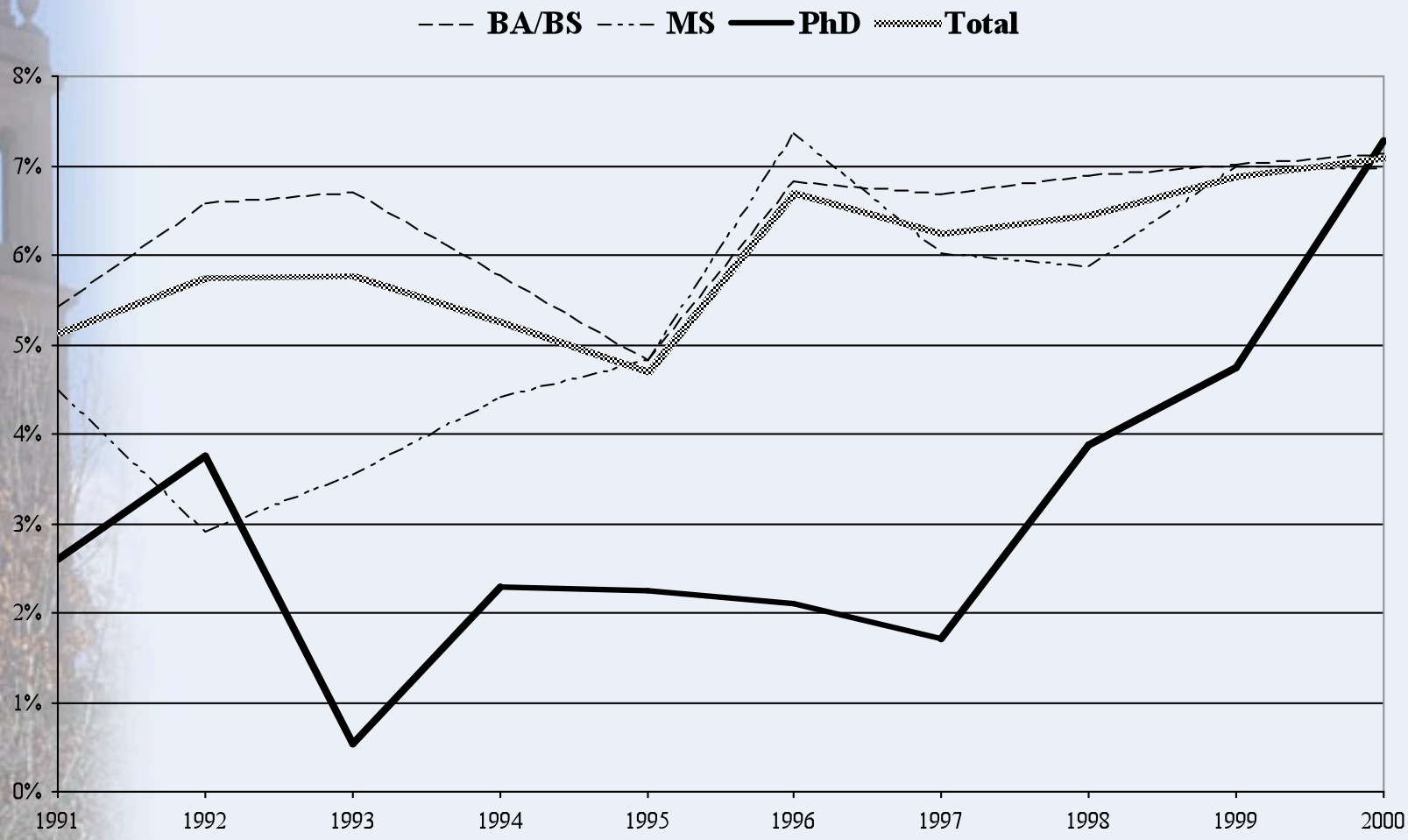
-OMA, AACC, BFSC, many student organizations

-Intercampus initiatives

-Vice Provost for Diversity

African American Degrees

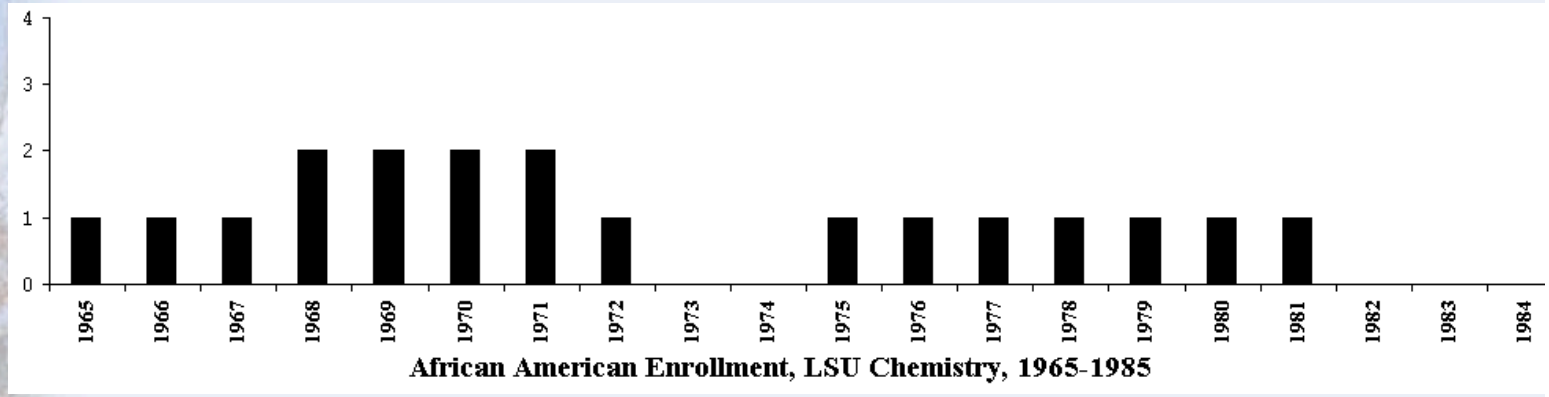
(as % of Total LSU Degrees)



The Beginning Years - 1965 to 1985

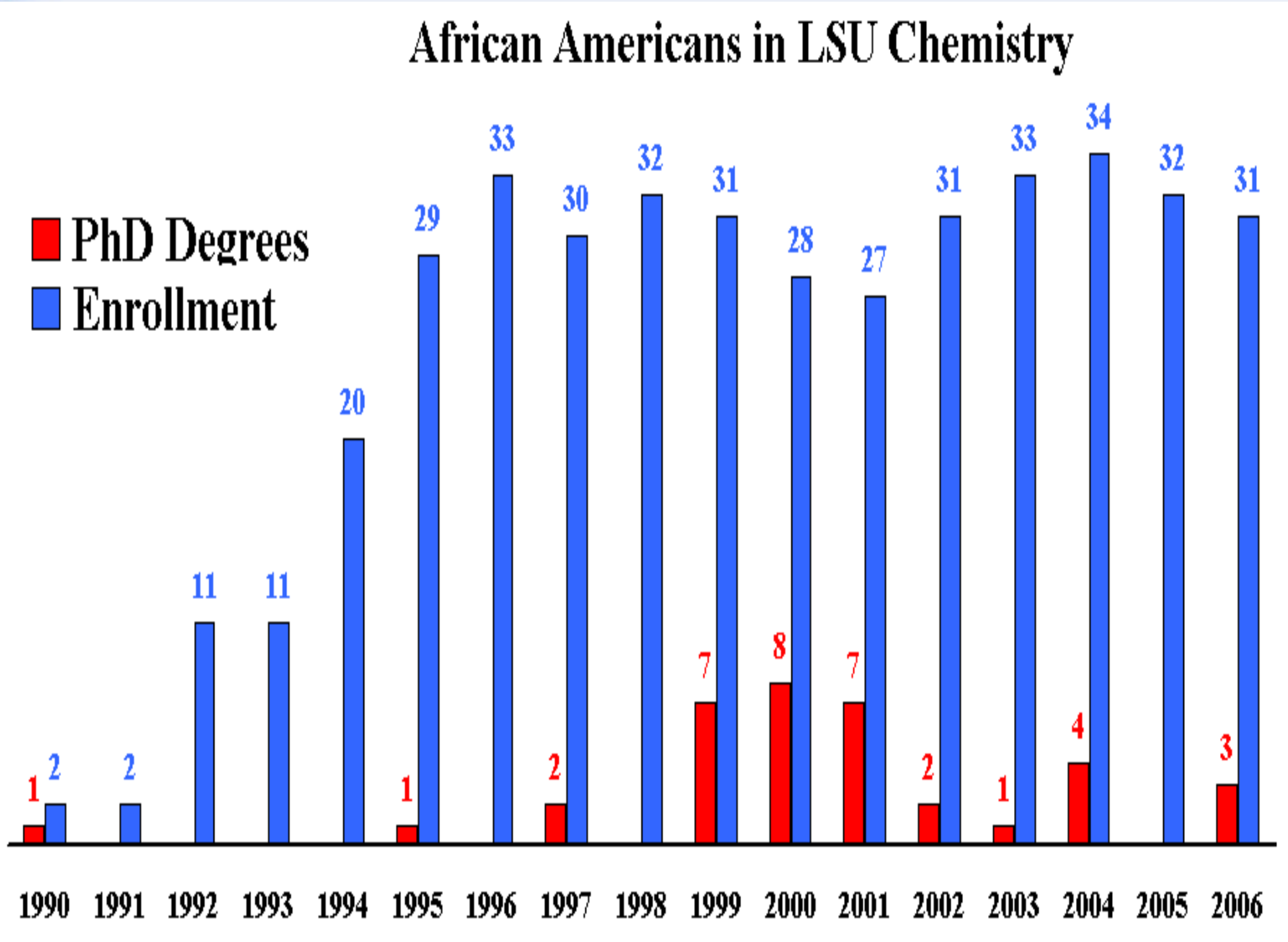
3 PhD Degrees:

1. Richard Evans, PhD, 1965-1971
2. Mildred Smalley, PhD, 1968-1972
3. Don Prier, PhD, 1975-1981



African American Enrollment, LSU Chemistry, 1965-1985

The Recent Years



Selection Criteria

CHEM

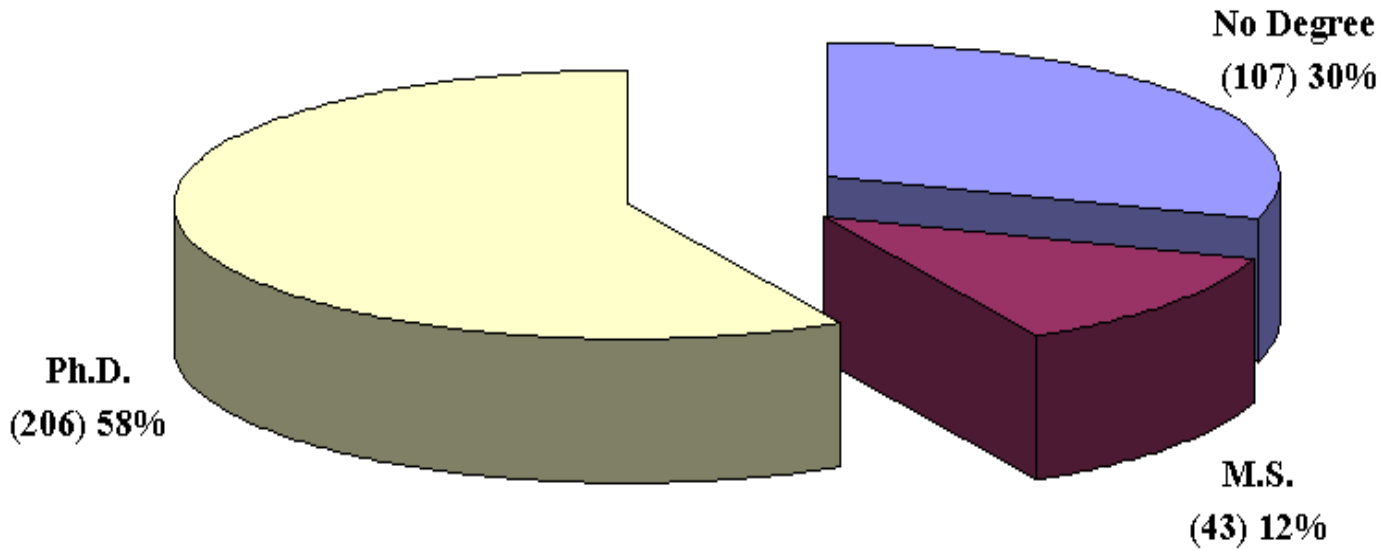
- **GPA**
- **Letters of Reference**
- **GRE (Verbal and Quantitative)**
- **Personal Interview**

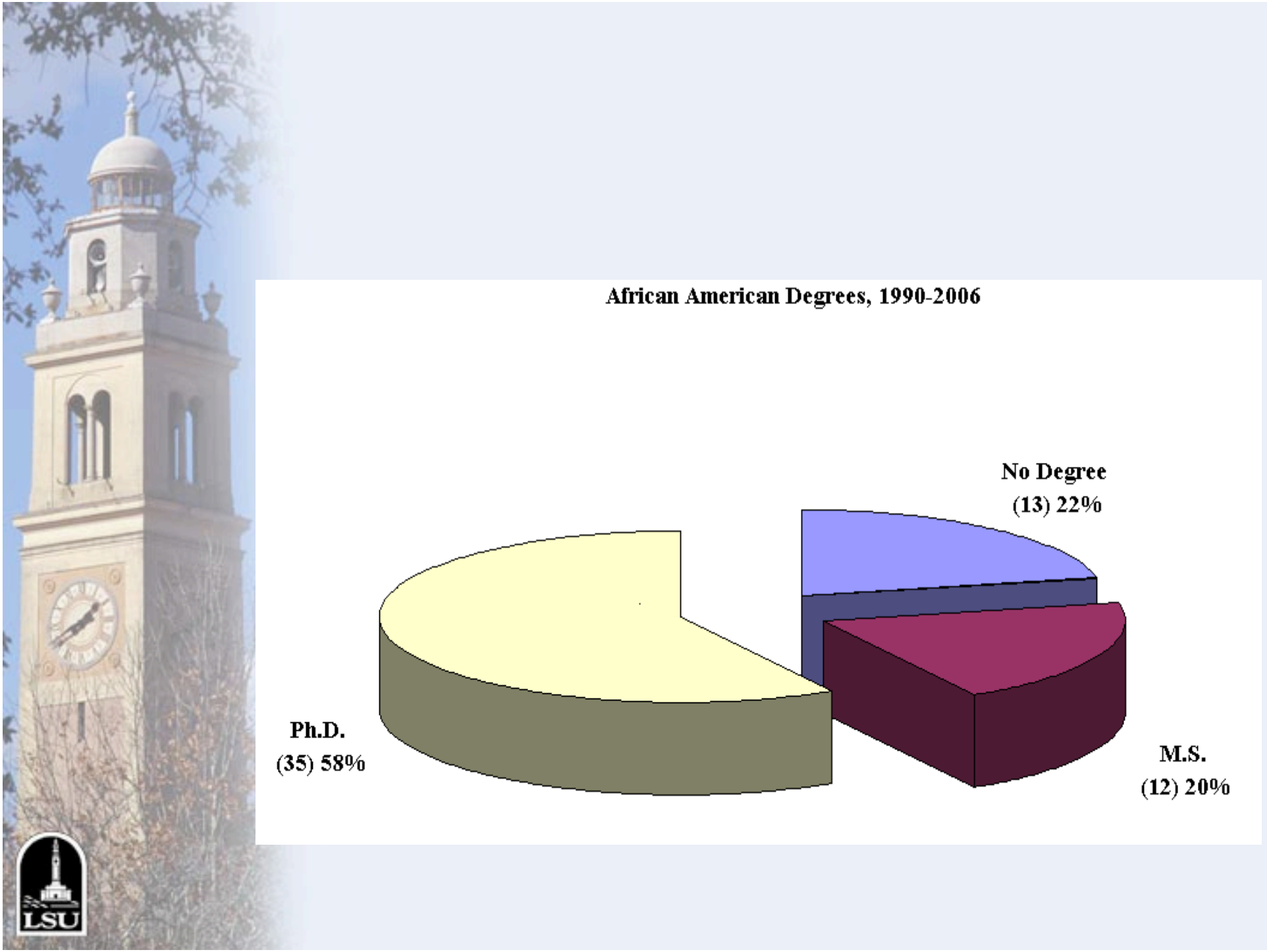
CHEM

Success Factors

- Mentoring and Support
- Proximity of HBCU's
- Critical Mass
- Self-Sustained Recruiting
- Employability

All Degrees, 1990-2006



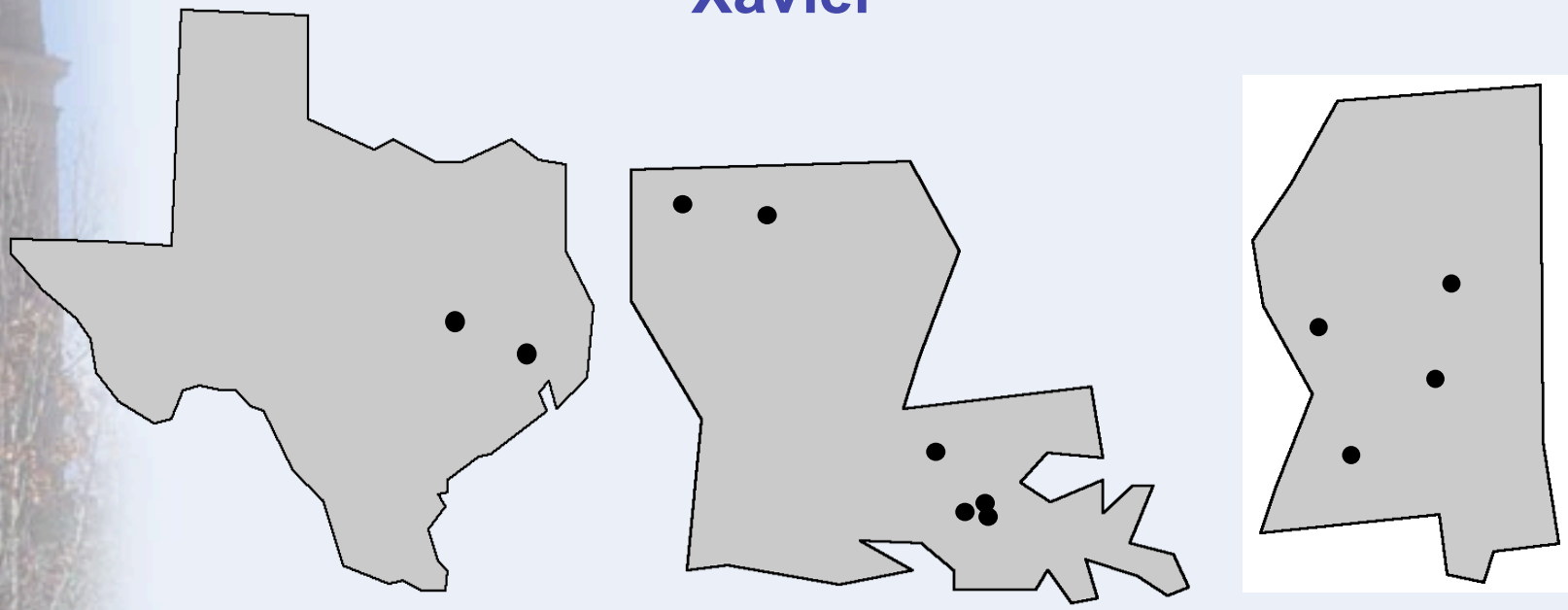

African American Degrees, 1990-2006
No Degree
(13) 22%
Ph.D.
(35) 58%
M.S.
(12) 20%

HBCU's

Prairie View
Texas Southern

Dillard,
Grambling
Southern NO
Southern BR
Southern
Shreveport
Xavier

Alcorn
Jackson State
Mississippi Valley
Tougaloo



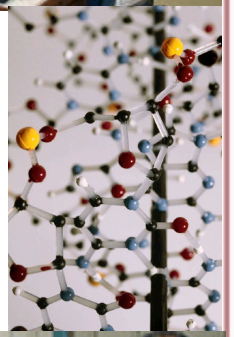
LSU African American Chemistry Graduate Student Community Success

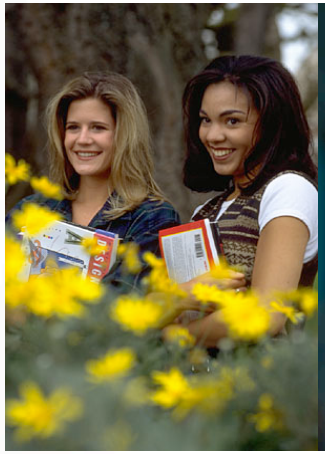
- Active in LSU/SU campus leadership activities
- Active as campus tutors in Center for Academic Success
- Active in community charitable activities
- Active as role models for undergraduates, elementary, middle school, and high school students
- LSU listed as “Hot Spot for Diversity” by U.S. News

CHEM

LA-STEM/ HHMI

Scholars/Mentors





Louisiana State University

LA-STEM

Howard Hughes Professors Program

Research Scholars

Program

The LA-STEM Research Scholars Program is funded by the National Science Foundation, Research Corporation, and Louisiana State University

Supported by

Howard Hughes Medical Institute

RESEARCH CORPORATION
A foundation for the advancement of science


LSU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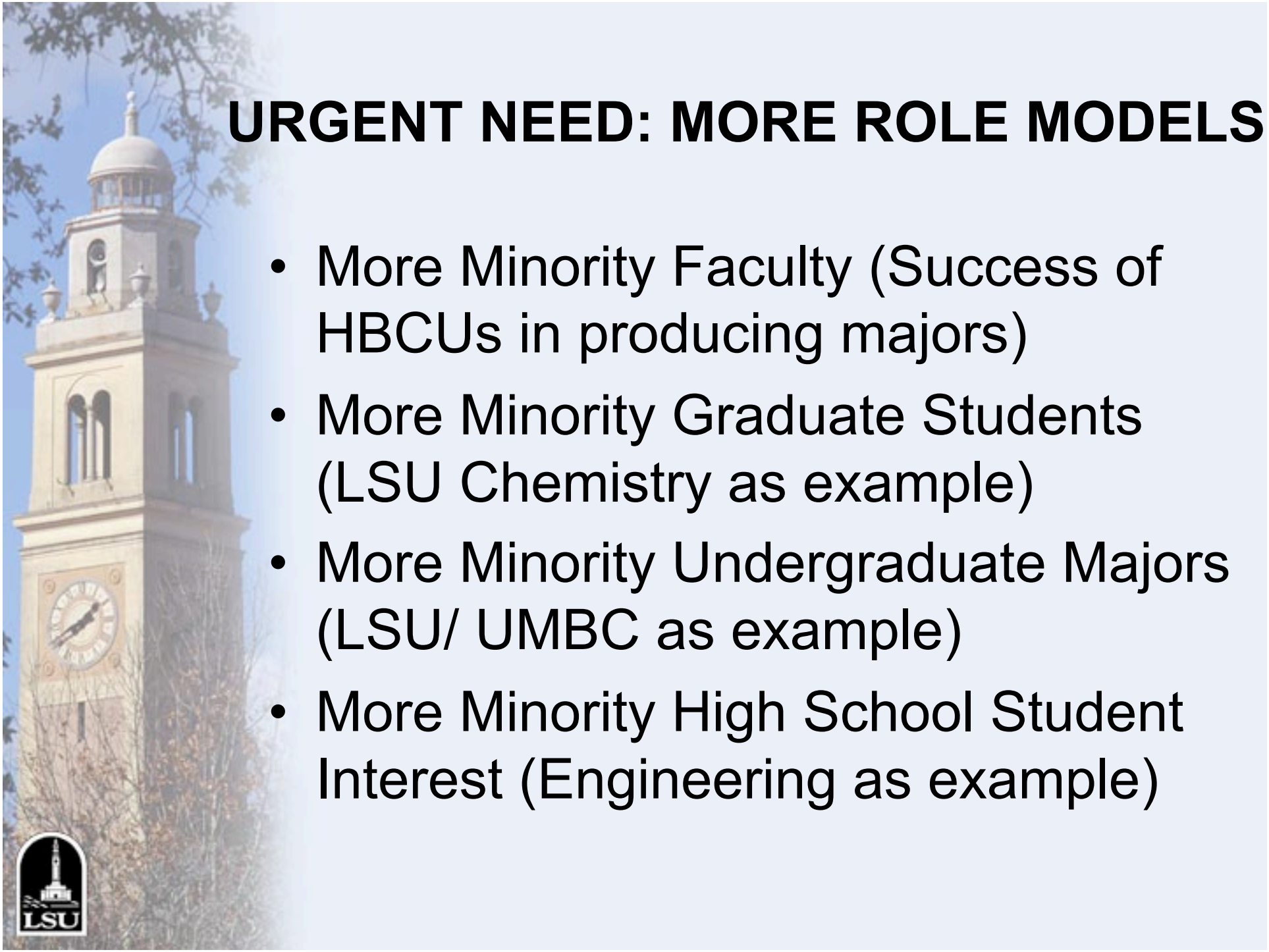
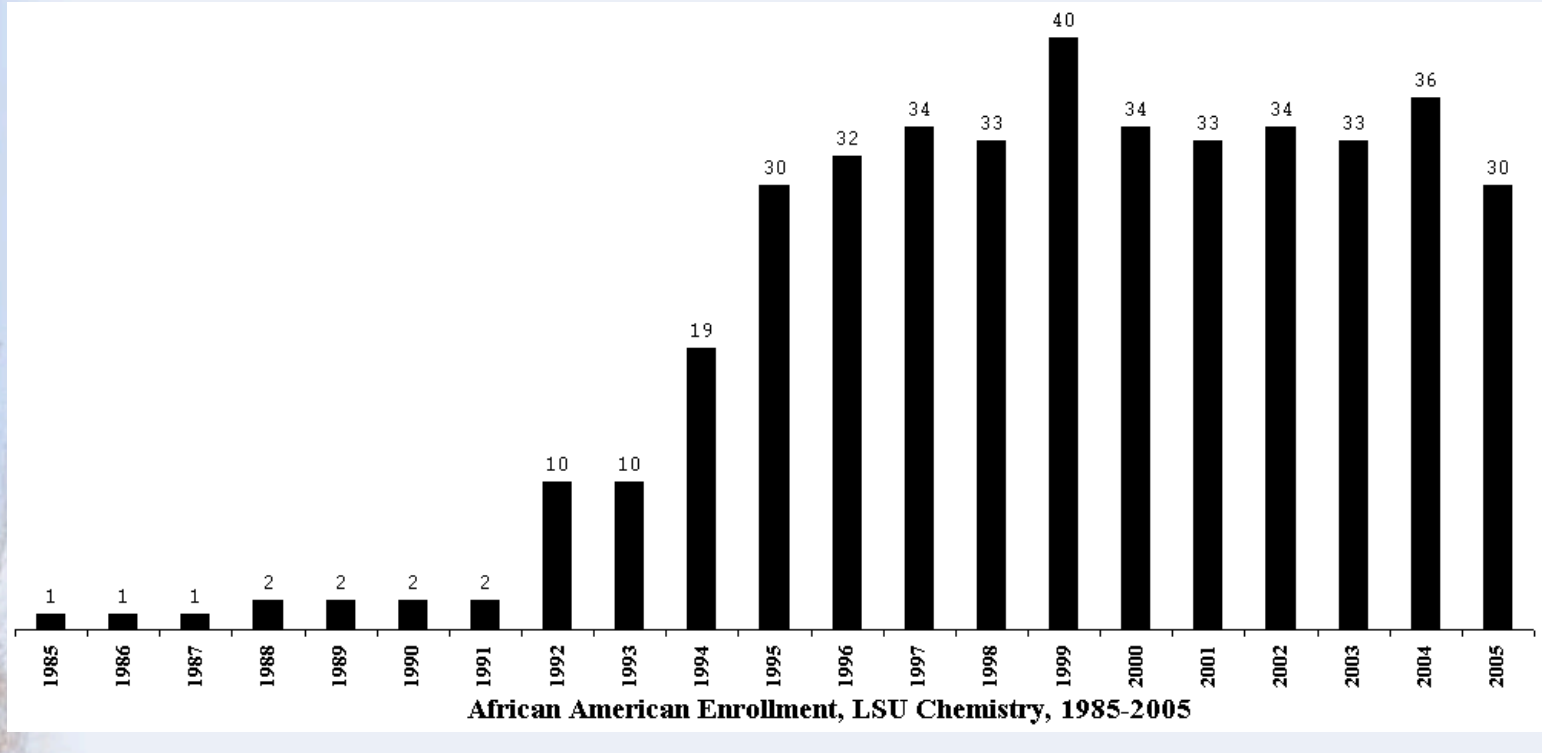


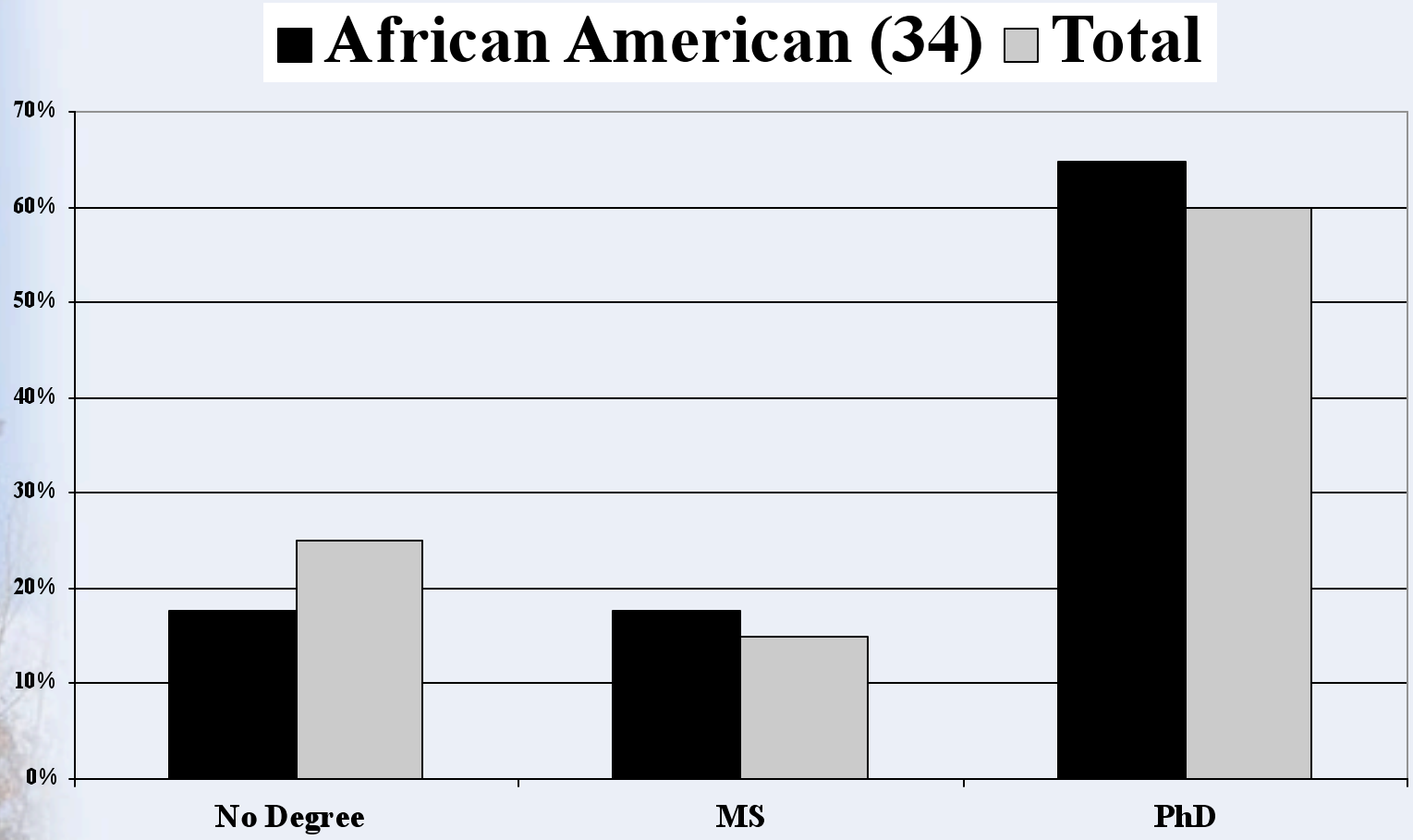
URGENT NEED: MORE ROLE MODELS

- More Minority Faculty (Success of HBCUs in producing majors)
- More Minority Graduate Students (LSU Chemistry as example)
- More Minority Undergraduate Majors (LSU/ UMBC as example)
- More Minority High School Student Interest (Engineering as example)

LSU AFRICAN AMERICAN CHEMISTRY GRAD POPULATION: 1985 to 2005



LSU African American Success Rates



LSU Success Factors

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