

# Diversifying Computing: Its Contradictions And Challenges

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# Outline

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1. Motivating the need for success for all.
2. Some failures, contradictions and obstacles including closing a meaningless K-12 gap.
3. Things we must do.



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Guiding Theme: Quality Education  
Leads to a Quality Workforce That  
Reflects Diverse Representation

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# The Science and Engineering Workforce

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## Old-Time Standard Rhetoric

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The supply of scientists and engineers will be maintained by turning to the country's underrepresented groups.



# Reality – Our History

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The supply of scientists and engineers has been maintained by turning to foreigners (It is our history).

- The easy fix (importation of solutions).



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# My Standard Old Argument

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## **Crisis in America**

“No first world nation can maintain its economic health when such a large part of its population is outside mainstream activity including all technological, scientific, and computational activity.”

Underrepresentation endangers the health of the nation, and not the the health of the various professions.



# Current World Trends

## The “Easy Fix” Threatened

- ◆ Many foreign nations on the move in science/engineering education and research.
- ◆ United States on decline in non-life sciences research spending and in science/engineering doctoral productivity.

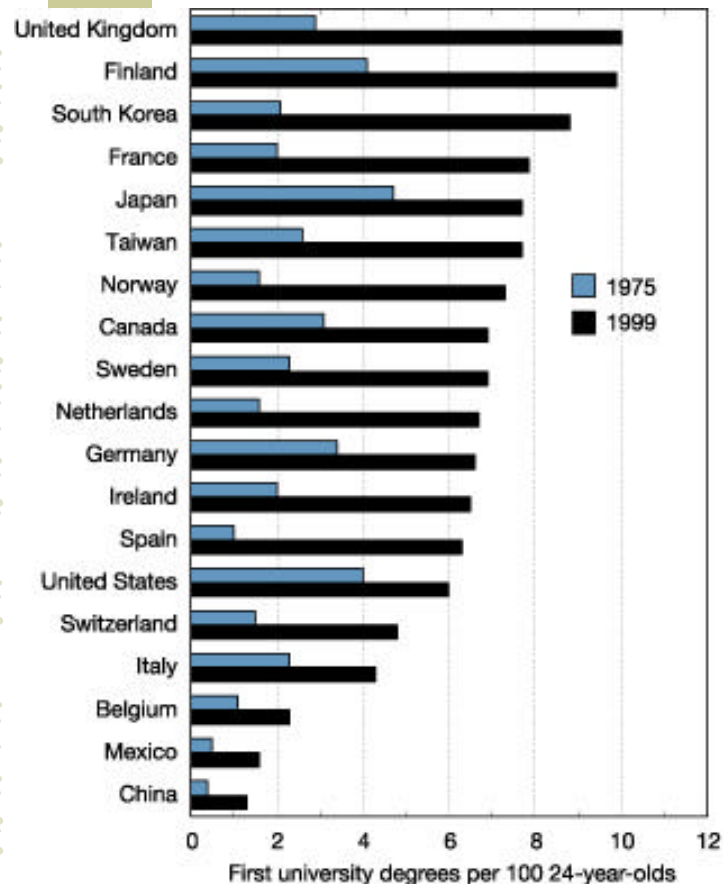


# Foreign Nations on the Move





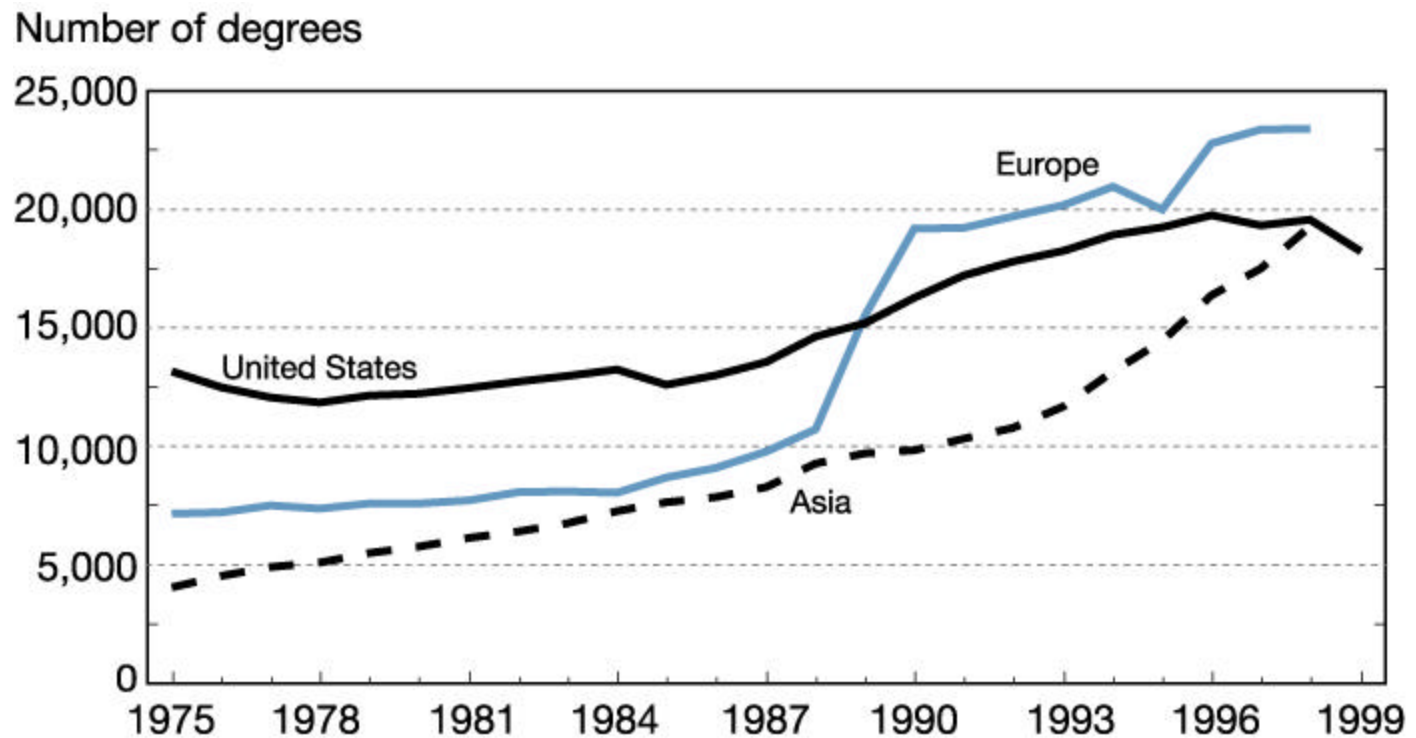
# Ratio of Natural Sciences and Engineering First University Degrees to 24-year Old Population



NOTES: Natural sciences include physics, chemistry, astronomy, and earth, atmospheric, ocean, biological, agricultural, as well as mathematics and computer sciences. The ratio is the number of natural science and engineering degrees to the 24-year-old population. China's data are for 1985 and 1999. Other countries' data are for 1975 and 1998 or 1999.

**Source:** National Science Board, *Science and Engineering Indicators-2002*

# Natural Sciences and Engineering Doctoral Degrees



NOTE: Europe includes France, Germany, and the United Kingdom. Asia includes China, India, Japan, South Korea, and Taiwan.

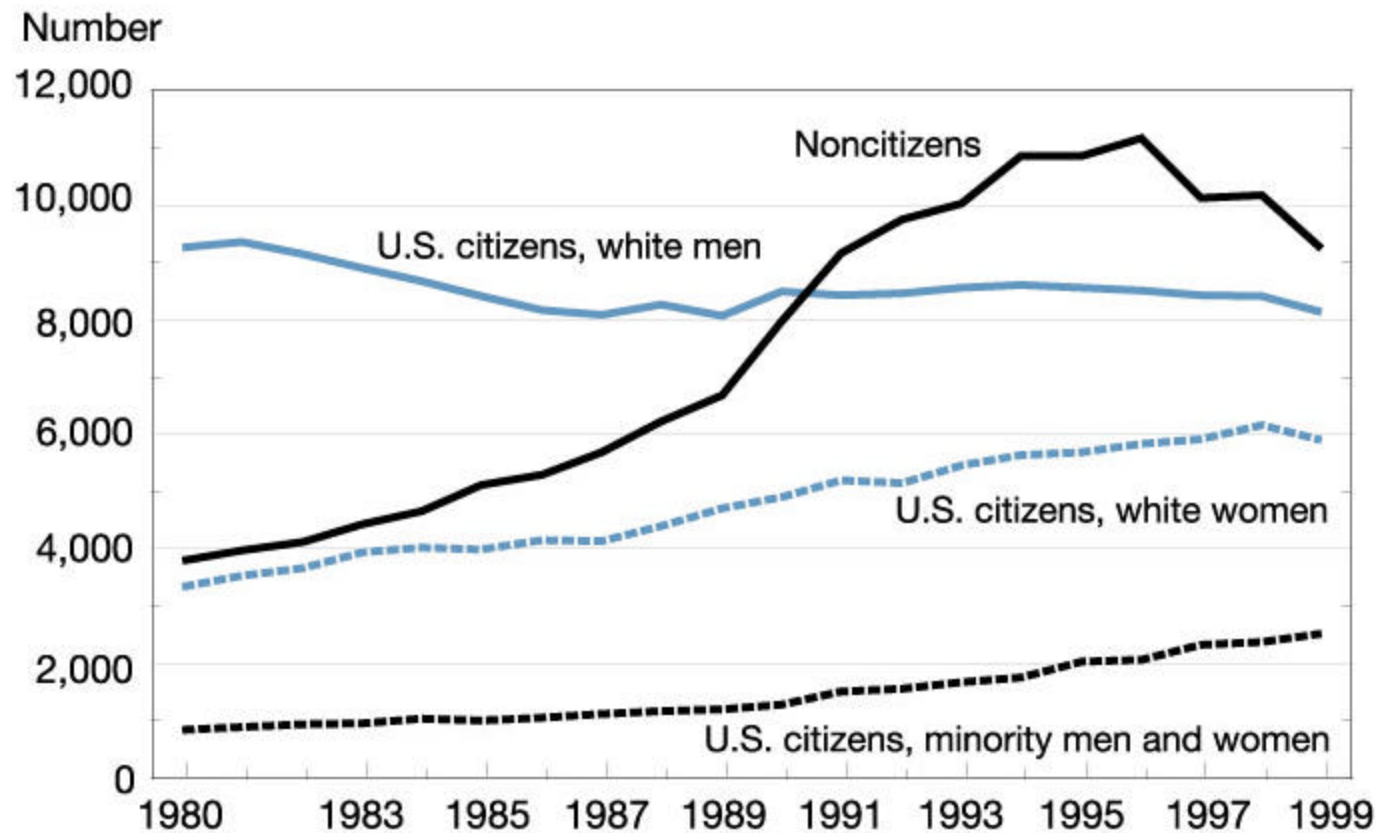


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# United States Doctoral Degree Productivity and Research Spending

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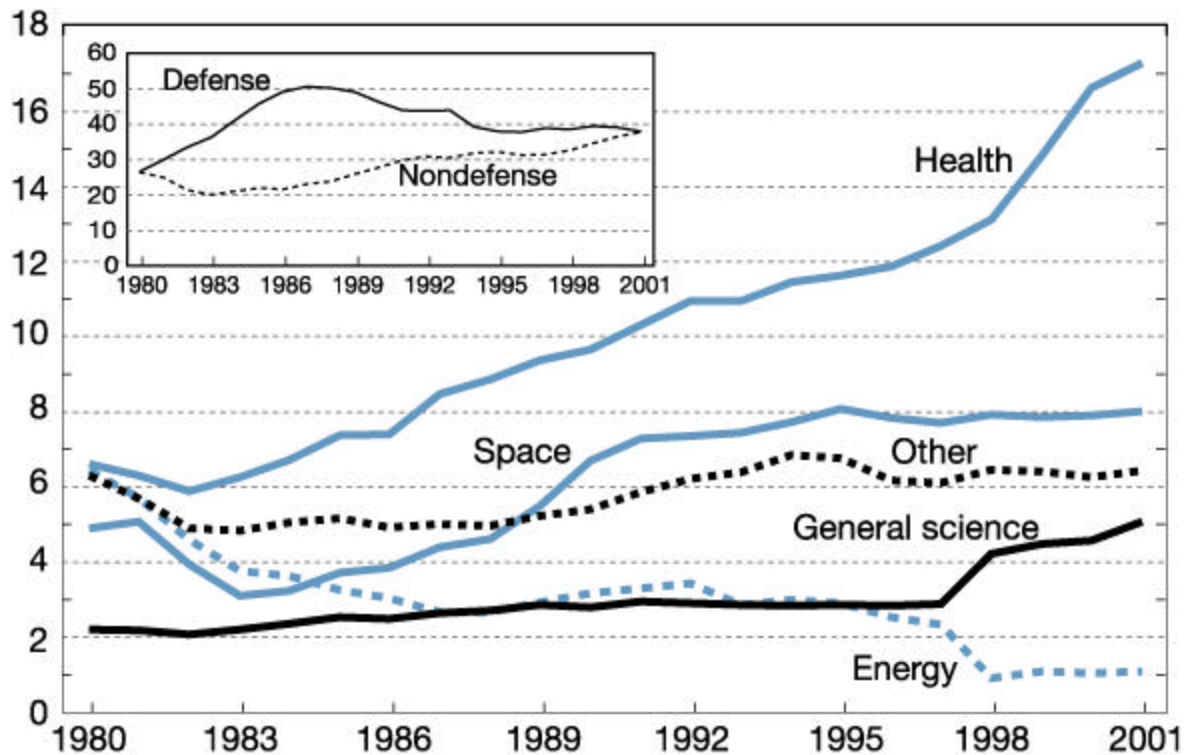
# S&E Doctoral Degrees



Source: National Science Board, *Science and Engineering Indicators-2002* 12

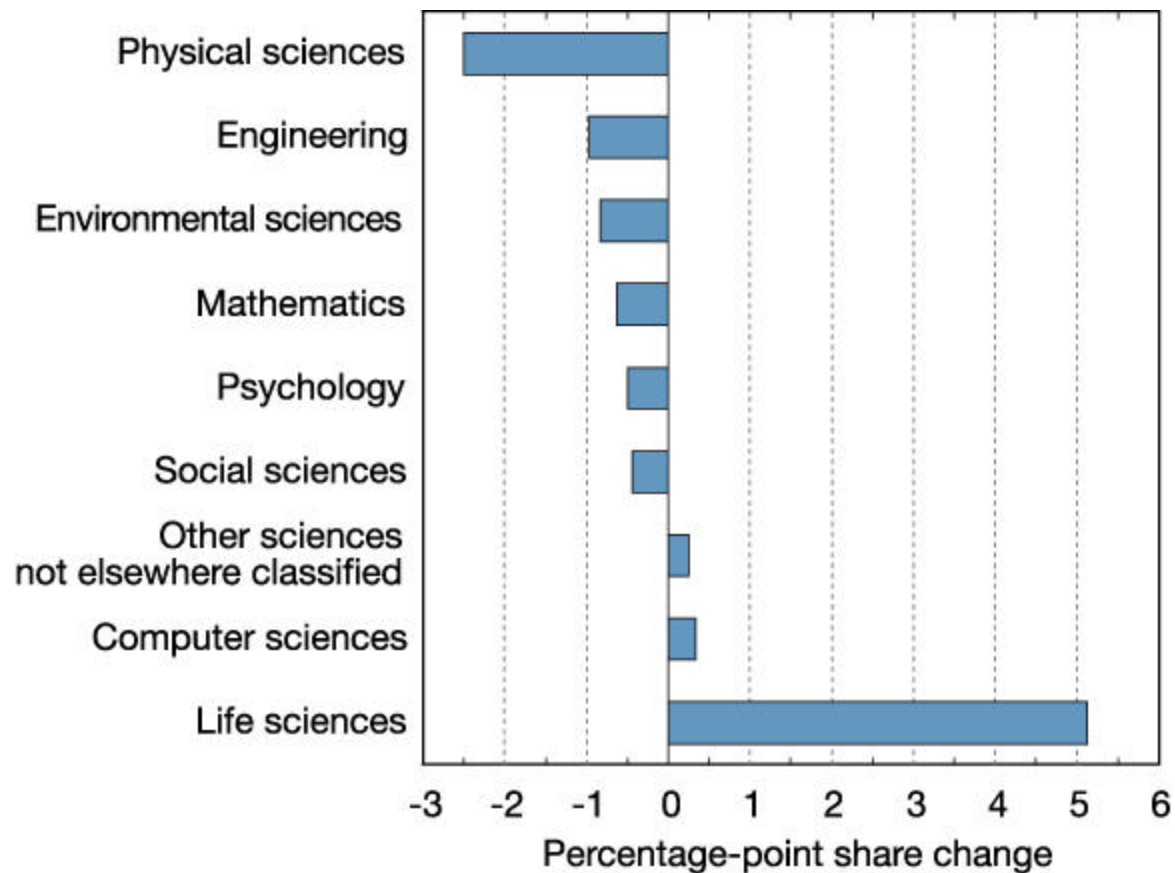
# Federal R&D Funding, by Budget Function

Billions of constant 1996 dollars



NOTE: The 1998 increase in general science and decrease in energy resulted from a reclassification.

## Changes in Share of Federal Academic Research Obligations, by Field: 1990-99



Source: National Science Board, *Science and Engineering Indicators-2002* 14



# My New Argument

- ◆ For the health of the domestic science and engineering enterprise we must now seriously consider the “hard fix” (inclusion of members of underrepresented groups in the science and engineering workforce).
- ◆ The hard fix is hard – we haven’t made much progress, if any, over the past decades.

# Problem at the Top: Ph.D's

**Severe underrepresentation of minorities in science, engineering, mathematics, and technology.**

	<b>1977</b>	<b>1998</b>
Total	9,003	12,051
White	85.5%	75.5%
Asian	7.0%	15.0%
Black	<b>1.2%</b>	<b>2.5%</b>
Hispanic	<b>1.2%</b>	<b>3.5%</b>
N. Amer	0.2%	0.4%
Other	4.9%	1.4%

Percent of the doctoral degrees in science, math, engineering, and technology earned by people of various races/ethnicities, 1977-1998.



# Problem at the Top: Bachelor's Degrees

	1975	1995
Af. Am, His, N.Am, <b>Of all degrees earned</b>	<b>6%</b>	<b>8%</b>

**But** grown to approximately **25%** of population.

# The Hard Fix

- ◆ A high point: US graduate education in science and engineering is the envy of the scientific world. We do it best.
- ◆ A low point: The current status of US K-12 education is not good.
- ◆ A contradiction? (Good graduate education – bad K-12 education) **No.**




# The Hard Fix



There exist pockets of excellence in our current K-12 system. We have a strong lack of homogeneity throughout and most underrepresented minorities live in cities and get the short end of the education stick.

# Managers and Chairs Say It's a Pool Problem

- ◆ Is it a pool problem (They just aren't there)?  
**Yes, but not completely.**
- ◆ Can we the universities solve the problem? **No.**
- ◆ Can we help? **Yes**
- ◆ OK, K-12 is not doing its part.
- ◆ Are we the universities doing our part? **No**
- ◆ Do we demonstrate meaningful commitment?  
(With bite) **No.**



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Universities greatly contribute to the loss of the precious few. Those few that do well in K-12, are talented, and want computing, or computational science, and mathematics in college.

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# The Loss of the Precious Few (Reflections on the Hard Fix)

## Failures, Contradictions, and Obstacles

- ◆ Our evaluation systems
  - Very one-dimensional; yet many view them as fair.
  - Very traditional – the question is not do they include bad people, but do they exclude good people?
  - Gets worse as we go up the ladder – k-12, undergraduate, graduate, faculty hiring.
  - Creativity – we value what we measure because we don't know how to measure what we value.
- ◆ Diversity versus underrepresentation (We seem to forget).



# The Loss of the Precious Few (Reflections on the Hard Fix)

- ◆ Minority leadership nonexistent – must be nurtured and developed.
- ◆ Society
  - Youth (especially minority) hold a negative view of science and engineering and those that practice these professions.
  - Value system for today's youth dictated by society (city) and popular media.
  - Lack of science and engineering role models that youth relates to or can interact with.

# The Loss of the Precious Few (Reflections on the Hard Fix)

- ◆ K-12 system
  - Closing gaps that are meaningless.
  - Meaningless accountability.
  - Very non-homogenous in terms of quality.
- ◆ Colleges and Universities
  - Selective schools – minority students migrate away from science and engineering towards areas where self-esteem can be maintained (they have not been adequately prepared).




# The Loss of the Precious Few (Reflections on the Hard Fix)

- ◆ Colleges and Universities (cont.)
  - Selective schools – minority students not guided to (indeed, discouraged from) graduate school in science and engineering (they were not the superstars).
  - Minority serving institutions – often don't give adequate preparation for graduate school or the workforce.
  - Colleges and universities are not held accountable for these crimes.

# The Loss of the Precious Few (Reflections on the Hard Fix)

- ◆ We criticize K-12 for not nurturing underrepresented minorities and driving them away from computing and science. Yet, in good undergraduate schools we do the same thing, with our sink or swim mentality.
- ◆ We do not nurture, we do not guide, we do not engage, we do not make them feel that they belong, or that they can contribute to a bigger picture (health of our people).
- ◆ Many excellent Rice students migrate from computing and physical sciences to the humanities (loss of the precious few).



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A Recent Questionnaire of Rice  
University Science and Engineering  
Faculty on Their Perceptions  
Concerning Underrepresented  
Minorities (Confidential Data)

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# Survey Response Rate by Faculty Member's Department

Department Name	Percentage
Statistics	71.4
Ecology & Evolutionary Biology	71.4
Chemistry	65.0
Biochemistry & Cell Biology	61.0
Chemical Engineering	56.0
Physics and Astronomy	48.6
Electrical and Computer Engineering	42.9
Computational & Applied Mathematics	40.0
Mechanical Engineering and Material Science	40.0
Mathematics	29.0
Computer Science	25.0

# Other Responses

- ◆ “Richard Tapia is very successful at attracting and retaining such students to our dept. This is **tolerated** to the degree that it does not **overwhelm** the dept.”
- ◆ “The department may very well have made a formal and written commitment to increasing and retaining underrepresented minorities, but I have seen no action to back up these words.”
- ◆ “The issue arises but not as a priority.”

# Other Responses

- ◆ “We have always attempted to recruit women and American minorities instead of foreign graduate students. We have never been rewarded for this policy. The other S/E departments frequently have more foreign graduate students than American ones. In the aggregate, the Administration could do much more to encourage recruitment of American women and minorities **INSTEAD** of foreign students.”
- ◆ “We always use academic performance in making admissions decisions.”

# Other Responses

- ◆ “My department is already following a policy of preferring American women and minorities over foreign students, in spite of the fact that foreign students frequently test better. I would suggest that, unless there is a definite plan to institute a policy of recruiting American women, minorities and economically disadvantaged in preference to foreign students, we should save ourselves time by stopping the discussion of it.”
- ◆ “The current chair is committed but I do not believe our department has ever established this as a goal.”



# Other Responses

- ◆ “The department recognizes that increasing the number of underrepresented minority students is desirable, however, we have no formal policy to that effect. We are as concerned in admitting a minority student that they have the skills to succeed. Our experience has been that bringing in under qualified minority students get us into a very bad situation and is probably not fair to the student.”



# Faculty Respondents' Perception of Departmental Activity

Departmental Activity	Percentage
In departmental meetings, strategies for increasing and maintaining underrepresented minority graduate students are discussed.	23

## How Members of Faculty Respondents' Department Generally View Underrepresented Minority Graduate Students

<b>Items related to underrepresented minority students</b>	<b>Percentage</b>
Preparation depends on quality of the undergraduate institution	63
Requiring a lot of time and effort	34
Prepared for graduate work	27
Lacking in research experience	27
Under-prepared for graduate work	26
Hard workers	20
Possessing talent in the field of study	6

## Faculty Respondents' Perspective on Which Factors Pose Challenges for Underrepresented Minority Graduate Students

Challenge Items	Percentage
Recruitment	67
Academic preparation	56
Retention	45
Financial support	30
Faculty culture	20
Admissions	18

## Faculty Respondents' Perception of Whether Funding Agencies Reward Researchers for the Recruitment of Underrepresented Minorities

Response	Percentage
Yes	37
No	44



# Success For All: Necessary Ingredients

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- ◆ Must have high expectations for all at all levels and successes.
- ◆ Monitoring of progress: Look for proportionate representation in advanced level courses, in garnering of awards and no score-differential on standardized tests at all levels.
- ◆ We must do what it takes to ensure that this happens. If minority students are behind at all earlier levels, they will stay behind. It is impossible to catch up on the job as a Science/Engineering professional (or graduate school).



# Success For All: Necessary Ingredients

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- ◆ We must ensure that we all finish the earlier laps of the academic race together. This will require a serious extra time commitment and enhancement programs for minorities along the line of the Escalante approach (*Stand and Deliver*) and Treisman's Emerging Scholar.
- ◆ The last thing that minority students need is a full summer off. This summer tends to make the educational gap wider. Summer activities for minorities do not include enough academic enrichment activities.



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We talk a lot, but are not really doing anything because it is not a real priority. We know what to do, but it takes significant resources and we are not willing to commit these resources.

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# Richard Tapia





# Josef Sifuentes



# Travis and Josef





# Car Heavy Metal

