

## Women and Minorities in Engineering

<http://www.foundationcoalition.org>

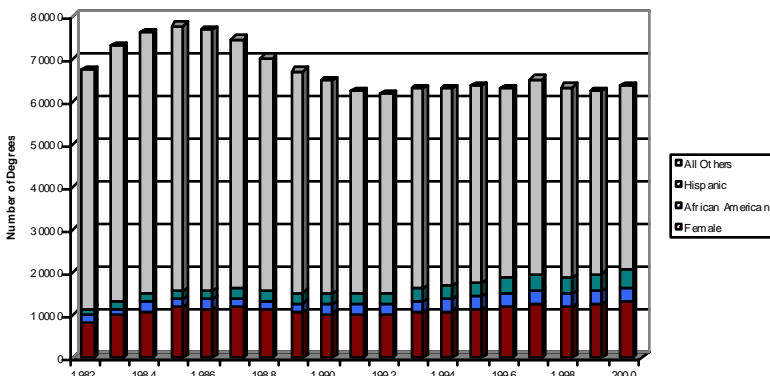
We approach problems differently - the Coalition has helped me tackle engineering problems.

*A minority student enrolled in a Coalition curriculum*

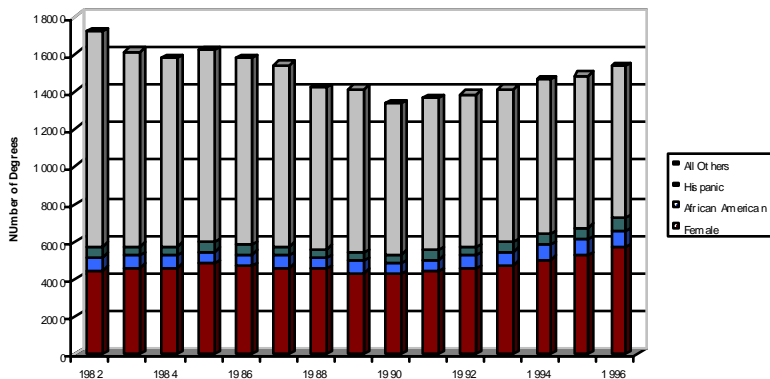
### Despite progress since 1982, we still have a long way to go!

The two graphs below show the total number of bachelor degrees in engineering and the physical sciences since 1982, as well as degrees earned by women, African Americans, Hispanics. Note that women make up less than 21% of engineering BS graduates compared to 37% in the physical sciences. Also, the percentage of degrees earned by African Americans and Hispanics is significant less than their percentages of the general population. Finally, although the number of degrees granted to women and underrepresented minorities are increasing, the total number of engineering degrees remains roughly constant over the past 10 years.

**Bachelor Degrees in Engineering<sup>1</sup>**



**Bachelor Degrees in the Physical Sciences<sup>2</sup>**



### Also, Did You Know That ...?

- Black full-time first-time undergraduate engineering enrollment dropped 16% from 1992-1996<sup>2</sup>.
- Hispanics and African Americans *combined* account for less than 5% of the engineering workforce<sup>2</sup>.

### Why Should This Data Alarm Us?

#### Because Insufficient Diversity Means Lower Quality Engineering!

- The range of design options considered in a team lacking diversity will be smaller.
- Design constraints will not be properly interpreted.
- The product that serves a broader international customer base, or a segment of this nation's melting pot, or our handicapped, may not be found.
- It is that the most elegant solution may never be pursued.

William Wulf, President, National Academy of Engineering, <http://www.nae.edu/>



#### Because We Need Every Human Resource

[Although the demand for engineering graduates has increased, the] number of engineering graduates has not increased, overall, for more than ten years despite major efforts by many to improve interest in the field. It is a major problem. We need women and minorities to enter engineering fields.

Bill Crumlett, Director, Human Resources Department, Southwest Research Institute, <http://www.swri.edu/>

#### Because Diversity Makes the Educational Experience Richer and More Valuable for All Students

Experience in a diverse student community makes available to students a wider variety of experiences as they interact with students whose gender and culture differ from their own. Seeing different ways to identify, define, assess, and solve problems provides a useful learning environment for students as they progress through the engineering curriculum. Successfully addressing team maintenance and process problems in groups with diverse members helps students gain useful abilities on conflict resolution, abilities increasingly sought by industry.

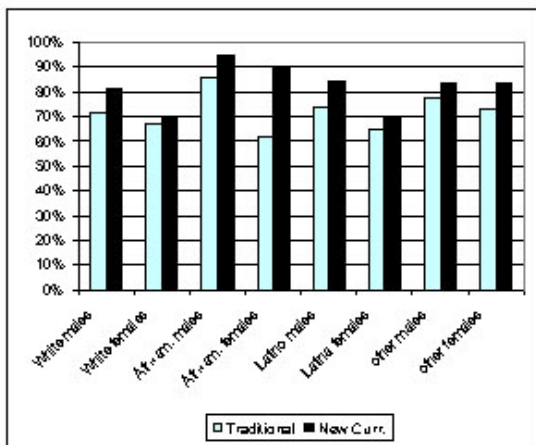
## What is the FC Doing in this Area?

Since its formation in 1993, the Foundation Coalition has sought to increase the numbers of women and minorities enrolling and graduating from our institutions. We have focused on both classroom pedagogy and curriculum content to accomplish our goal. For example, it has been shown that pre-college women have a preference for cooperative learning strategies<sup>3,4</sup>, and the role of pedagogy in retention, especially as it relates to women and minorities, has been documented.<sup>5</sup> Foundation Coalition curricula, now in place at each partner institution, include a major emphasis on cooperative or active learning and the establishment of formal learning communities. Special design projects<sup>6</sup> and spatial reasoning<sup>7</sup> activities have also been incorporated into the curriculum.

## Can you show me some results?

Results such as retention, exemplified below, have been encouraging, and we are hopeful that the changes we have made will continue to increase both the number of women and minority students enrolling in our engineering programs and the number graduating with degrees in engineering.

### Improved Retention of Women and Minorities at Texas A&M



The graph above depicts first-year retention in engineering during the academic years 1994-95 and 1998-99. First-year retention is measured as the percentage of students who started their first-year curriculum and returned for the following year in engineering. The graph shows substantial increases in retention from 1994 to 1998 for the following groups: white females, African-American females, and Hispanic females. It also shows substantial decreases in retention for the following groups: African-American males and Hispanic males. Based on this first-year retention data, it is currently concluded that inclusive learning communities are having a positive impact on the retention of women in engineering.

### Improved Retention of Women and Minorities at ASU

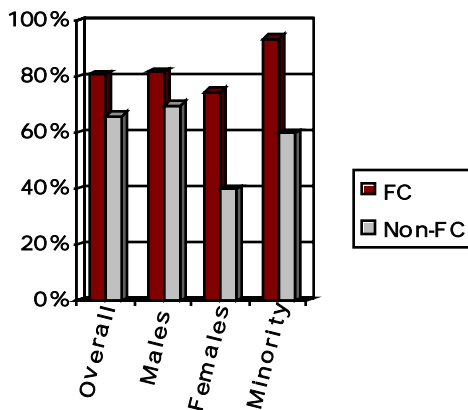


Figure 2: Retention Data, New vs. Old Curriculum - Arizona State



## FC Resources

Whether you're just getting started or looking for some additional ideas, the Foundation Coalition would like to help you increase the diversity of your engineering student body through workshops, web sites, lesson plans, and reading materials. FC partner institutions have produced both written and electronic materials that address the issue of women and minorities in engineering education. Visit our web site at <http://foundationcoalition.org/wmie> for online access to contact information and materials, or contact: Jeffrey Froyd at [froyd@ee.tamu.edu](mailto:froyd@ee.tamu.edu) or 979-845-7574. Other organizations that can provide assistance include:

American Indian Science & Engineering Society,

<http://www.aises.org/>

National Society of Black Engineers,

<http://www.nsbe.org/>

Society of Hispanic Professional Engineers,

<http://www.shpe.org/>

Society of Women Engineers, <http://www.swe.org/>

Women in Engineering Program Advocates Network,

<http://wepan.engr.washington.edu/>

## References

1. Engineering and Technology Degrees 2000, Engineering Workforce Commission, American Association of Engineering Societies
2. Women, Minorities, and Persons with Disabilities, Sept 2000, National Science Foundation Publication NSF00327
3. Higher Education Research Institute, UCLA Graduate School of Education & Information Studies, 3005 Moore Hall, Box 951521, Los Angeles, CA 9009
4. Johnson, D. W. and R. T. Johnson., "Cooperative Learning and the Achievement and Socialization Crisis in Science and Math Classroom," in A.B. Champagne, and L.E. Homig, eds., 1987, *Students and Science Learning*, Washington, DC: AAAS
5. Petterson, P.L., and E. Fennema, "Effective teaching: Student Engagement in Classroom Activities and Sex-related Differences in Learning Mathematics," 1985, *American Education Research Journal*, 11:309-335
6. Seymour, E. and N. Hewitt, *Talking About Leaving*, 1997, Westview Press, Boulder CO
7. Karr, C. and Todd, B., "Perceived Gender Inequities in Freshman Engineering Design Projects," Foundation Coalition, University of Alabama
8. Hsi, S., Linn, M., and Bell, J., "The Role of Spatial Reasoning in Engineering and the Design of Spatial Instruction," *Journal*