

Session Division: Multimedia 2793

**Understanding the Numbers:
Increasing the Number of Minority Engineering Students**

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Abstract

In order to begin to increase the number of minority engineering students, the current state of affairs must be understood and analyzed. The analysis shows a lack of representation of minority engineering students. This representation is lacking with respect to all engineering students and with respect to the U.S. population percentages of minority people. Within these under-representations, in both all bachelor degrees awarded and all engineering bachelor degrees, an interesting discrepancy is apparent. The statistics show that the two main groups within the minority population, Blacks and Hispanics, do not earn as many bachelor degrees nor engineering degrees as the remainder of the minority group. Another disheartening statistic is the next generation of minority students, the high school graduates. The statistics do not give much hope for the future. The future population trends have been predicted by the U.S. Census Bureau, and if the current state of minorities in engineering is not improved, the field of engineering will suffer. This paper will address all of the above items: the current U.S. population and education statistics, the trend of some minority groups to obtain higher percentages of both bachelor and engineering degrees over other minority groups, the next-generation of college students, the projected future populations, and some possible solutions to increasing the numbers of minority students in the engineering field.

Literature Search

In researching this area, one finds a plethora of information, yet not all address the accurate state of minority students in engineering. Some references, including those published by NSF^{1,2}, state accurate information, but focus on the increase in the numbers of minority students, not the racial groups within the minority groups or the relationship between these numbers and the U.S. population. Also, accurate information regarding engineering students is missing. According to the NSF's Science and Engineering

Indicators, Chapter 2, Higher Education in Science and Engineering, “The trend of increasing enrollment of underrepresented minority students in undergraduate programs has persisted for over a decade and accelerated in the 1990s. Black enrollment increased 3.6 percent annually in the 1990s, reaching 1.3 million in 1995. Hispanic enrollment in higher education increased at an even faster rate during this period (7.1 percent annually).” While this is accurate, and may paint a rosy picture for minority education, it hides many problems: it does not indicate engineering students, it does not indicate the increase in U.S. population for Blacks and Hispanics, and does not state the original numbers. The research in our paper accurately discusses the past, present, and future for minorities in engineering, and is based on U.S. Census Bureau data.

Another unique aspect of our research is the discussion of the future of engineering and the United States based on projections of the population for the year 2100. In one hundred years, the racial make-up of this country will be very different than it is today. This paper discusses the difference in population in 2100 and this difference’s effect it may have on the country, assuming the numbers of Blacks and Hispanics in engineering remain low.

History of U.S. Population and Education Figures

In order to fully comprehend the educational trends and future of minorities, one must understand the educational history of minority populations. This section will discuss the historical trends with the 1940, 1950, and 1994 census information.

The U.S. Census Bureau in 1940³, used the term “Negro” instead of “Black” and other minorities were not differentiated but rather included in statistics as “Other Races.” All minorities constituted 9.1% of the U.S. Population, with Negroes comprising 8.7% of the U.S. population, and other races constituting 0.4%. Within the minority population, Negroes were overwhelmingly the largest sector, at about 96%.

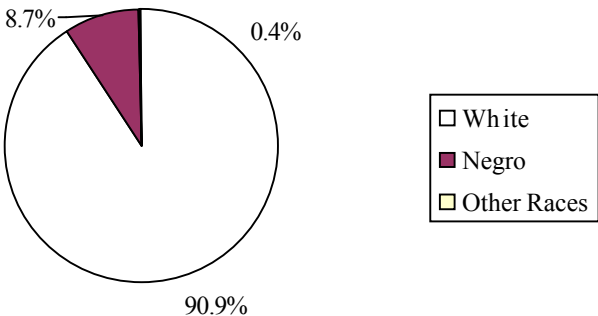


Figure 1. Percentages of U.S. Population with Respect to Race, 1940

The census gives the number of school years obtained by race as well. Using the numbers for four years or more of college, the percentage of all U.S. people obtaining this level of education is 4.6%. Of this percentage, the overwhelming majority is White, at over 97.4%. Negroes constituted only 2.4% and Other Races only 0.2%, as can be seen in figure 2.

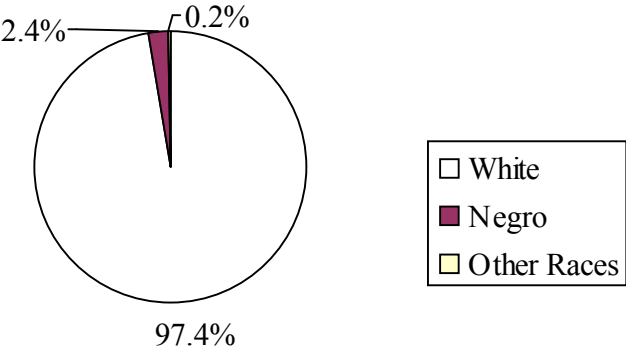


Figure 2. Percentages of Minorities Completing Four Years of College with Respect to Race, 1940

With respect to all minorities, Negroes constituted the majority of the minority population, at 96%, but a smaller percentage, 92%, obtained four or more years of college. This can be seen in figure 3.

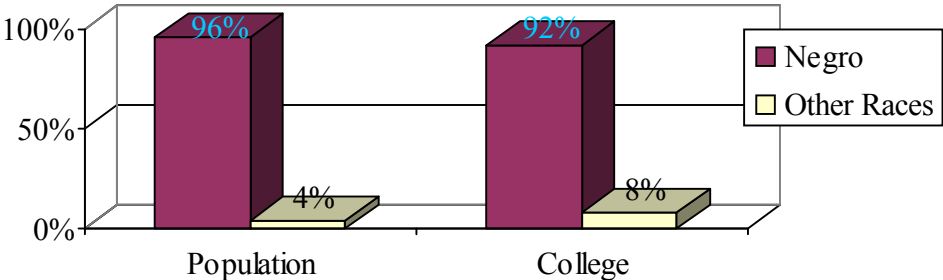


Figure 3. Percentages of Minorities Completing Four Years of College with Respect to Race, 1940

In 1950⁴, the classifications were separated into White and Non-White⁵ populations. Non-Whites constituted 9.3% of the U.S. population. There is an increase in the number of people obtaining four or more years of college; this number increases to 6%. There is an increase in the number of Non-White people who obtain four or more years of college as

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well, this percentage rises to 3.4%.

Jumping to 1994⁶, there is an overall rise in education in all categories. At this time, people were categorized as White, Black, and Hispanic, but Hispanic can be of any race. The break-down of the U.S. population in 1994 was White: 84%, Black: 11.7%, and Hispanic: 9.2%. (Note that the sum is greater than 100% due to overlap of Hispanic with respect to race, i.e., a Hispanic person may consider himself or herself Black and Hispanic.) At this time, 13% of the U.S. population held bachelor’s degrees, with Whites constituting 86.7% of these degrees, followed in percentage by Blacks at 7%, and Hispanics at 3.5%.

Thus, there is an optimistic trend with respect to minorities and education in U.S. history, as can be seen in figure 4. This trend shows great strides, but unfortunately masks the woefully low numbers of minorities obtaining bachelor’s degrees with respect to the minority population and the numbers of minorities in engineering.

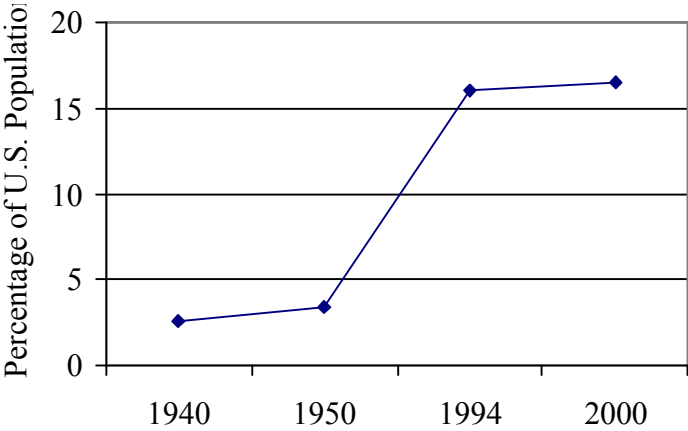


Figure 4. History of Minorities Obtaining Bachelor Degrees (Percentage of Minorities obtaining four or more years of college with respect to U.S. Population in a given year)

Current U.S. Population Figures, Including Minority Populations

According to the U.S. Census 2000, minorities constitute 29% of the total U.S. population. Of this total, minorities are grouped into different groups, such as Black, American Indian, etc., and sometimes these groups are differentiated as to Hispanic and non-Hispanic. In this paper, Hispanic will be a specific group and not contained within the other groups, if possible, from the data. For example, stating a group as “Black” means “Black, non-Hispanic.” Also, within this paper “engineering” constitutes all disciplines of

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engineering and includes computer science. Note that all statistics are from the U.S. Census Bureau.

Of the U.S. minority population, the 29% mentioned above, the break-down of minority groups is as follows: Black people comprise 12.2%, American Indian people at 0.7%, Asian and Pacific Islander at 4%, and Hispanic people constitute 12.1%. This can be seen in figure 5 below. So, one would expect the numbers of engineering students to be approximately within these percentages. Unfortunately, that is not the current situation.

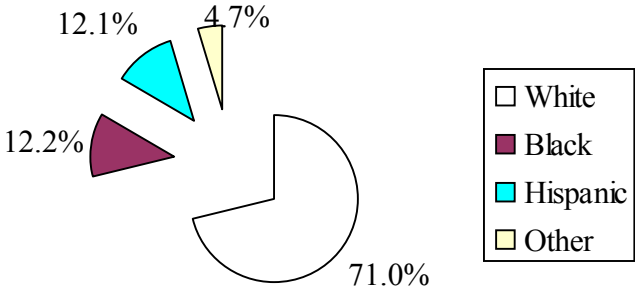


Figure 5. Percentages of U.S. Population with Respect to Race

To fully understand the numbers of minorities in engineering, a break-down of the minority groups is needed. Of the overall minority groups, Blacks constitute about 42.1%, Hispanics 41.7%, and other minorities at 16.2%, as seen in figure 6 below. So, Blacks and Hispanics make up the bulk of the minority community in the U.S. What will be proven in this paper is that the minority community as a whole is underrepresented in engineering, and that the numbers of Blacks and Hispanics within the minority sector are unsatisfactory.

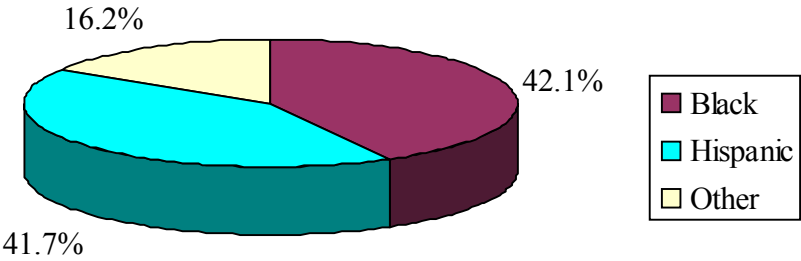


Figure 6. Percentages of Minority Groups With Respect to All Minorities

Current U.S. Education Figures, Including Minority Populations

Minority populations earn 16.5% of any type of U.S. bachelor degrees⁷. Obviously, this percentage is below the expected 29% of the total population. On closer inspection, we see that Blacks constitute 6% of the bachelor's degrees, Hispanics 4%, and other minorities 6.5% of the total, as seen in figure 7 below.

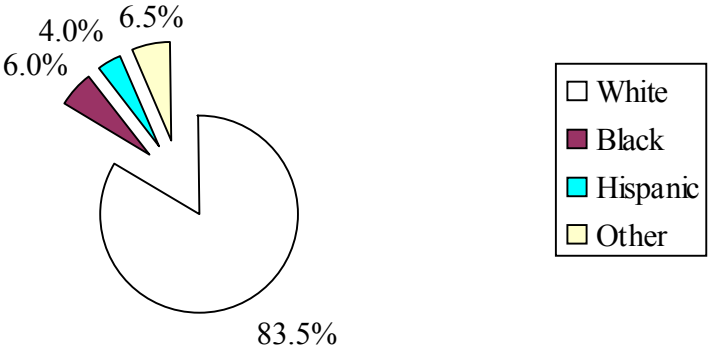


Figure 7. Percentages of U.S. Bachelor's Degrees with Respect to Race

This indicates an interesting trend; instead of the Black-Hispanic-other percentages of the population given above, i.e., 42.1%, 41.7%, 16.2%, the numbers within the minority sector with respect to bachelor's degrees are 36.4%, 24.2%, 39.4%, as seen in figure 8. This means that the smaller minority sector of the "other" – American Indian, Asian and Pacific Islander non-Hispanic – is clearly the majority of all U.S. bachelor degrees in the total minority domain.

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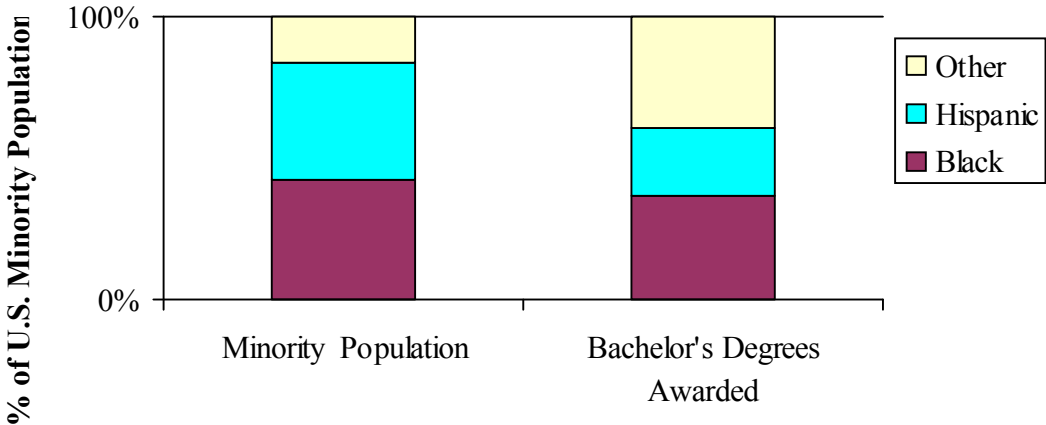


Figure 8. U.S. Minority Population and Bachelor's Degrees

Engineering Fields with Respect to Minority Students

Does engineering show more realistic numbers? With respect to all U.S. bachelor degrees awarded, approximately 7% are engineering bachelor degrees. Of this 7%, minorities constitute 23%, which is closer to the national percentage of minority populations, but this percentage is misleading with respect to individual minority populations. Of this 23%, Blacks total a mere 2.4%, Hispanics a smaller 1.5%, and other minorities are at a high of 19.1%. Therefore, although one might see the 23% of the total engineering minority bachelors as a success, it really hides the fact that Blacks and Hispanics constitute woefully small numbers.

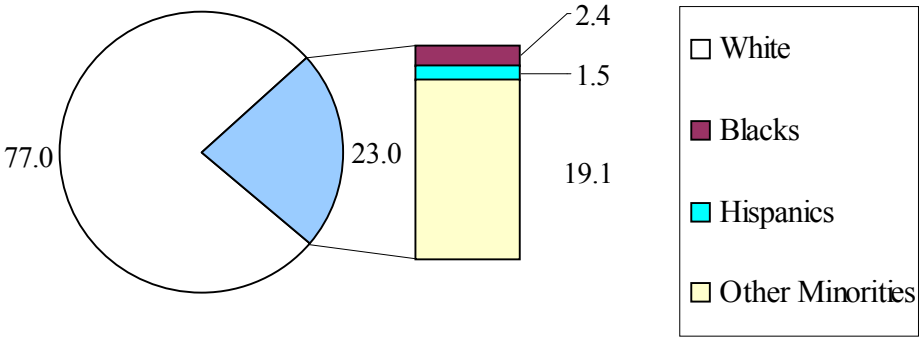


Figure 9. Percentages of Engineering Degrees Awarded with Respect to Race

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Trend Within the Minority Group

Specifically analyzing the minority sector of the engineering bachelors, the low numbers of Black and Hispanic graduates can be further understood. Looking at these numbers more closely, Blacks constitute 10.4%, Hispanics 6.7%, and other minorities are at a whopping 82.9% of the total minority groupings with respect to bachelor's degrees in engineering. So the trend of the "other" minority sector overshadowing the Black and Hispanic minority groups is worse in engineering than in the total of all bachelor's degrees awarded.

There are two questions, of many possible questions, that can be asked here: Why are the numbers for minorities so small? Why is the "other" minority group overshadowing Blacks and Hispanics with respect to bachelor's degrees? One possible way to answer these questions is to determine the number of minorities graduating from high school.

Of the total U.S. population aged fifteen years of age and older, 27.1% are minorities including 11.7% Black, 10.7% Hispanic, and 4.7% other. Of the total U.S. population aged fifteen years of age and older, 78.5% are high school graduates. Out of these high school graduates, Blacks constitute 10.8%, Hispanics 7%, and other minority groups comprise 5.2%. Again, the smaller portion of the total minority sector is gaining overall.

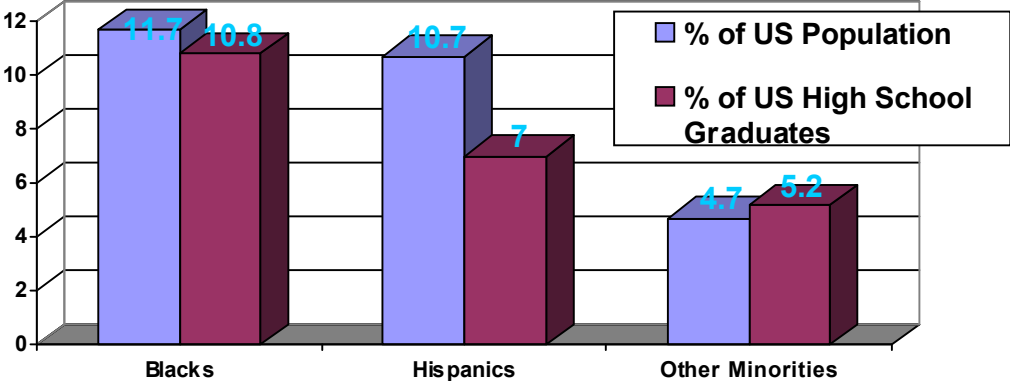


Figure 10. Percentages of Minorities with Respect to U.S. Population and U.S. High School Graduates

More specifically, of the entire Black minority population in the age group of 15 years and older, 72.1% has a high school diploma. The Hispanic minority sector has fewer diplomas within its population, only 52.9%. Those in the "other" minority sector have more diplomas, 79.7% of all in this group have graduated from high school. This group is close to the non-minority population figure of 83.3% of its group graduating from high school.

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Next Generation of College Students

An investigation of the next generation of college attendees, those in the 18 to 19 year old range, and then those in the 20 to 24 year old range further illustrate the problem. In the 18 to 19 year old range, 56% of the U.S. population has graduated from high school. Yet, in the minority sector, 49.8% of Blacks and 43.6% of Hispanics have graduated. The "other" sector has a much higher rate of 62.6%, which is even greater than the national average. In the older age group of 20 to 24 years, 85.5% of the U.S. population holds a high school degree. Again, in this age group there is a smaller percentage (80.5%) of Blacks graduating from high school and an even smaller percentage of Hispanics graduating. A huge discrepancy is seen in the "other" minority sector at this age group, 92.9% hold high school degrees.

Thus, in order to increase the numbers of minority students in higher education programs such as engineering, the students must be eligible for college; the students must graduate from high school. Secondly, the numbers are misleading with respect to individual groups within the minority sector. As a group, the "other" minorities, American Indian, Asian and Pacific Islander non-Hispanic, people, are graduating from high school in high percentages and are attending college in the technical fields.

Future Projection of Minority Populations

According to the U.S. Census Bureau⁹, the year 2100 will reflect different population distributions than the 2000 population. As stated above and shown in figure 5, the breakdown of the U.S. population is 71% White and 29% minority. Of the minority population, Black people comprise 12.2%, American Indian people at 0.7%, Asian and Pacific Islander at 4%, and Hispanic people constitute 12.1%. In the year 2100 the numbers are predicted to change; the White population will be 40.3% and the "minority" population will be 59.7%. A breakdown of the minority population shows that the Black population will be 13.0%, American Indians at 0.7%, Asian and Pacific Islanders at 12.6%, and Hispanics at 33.3%. The comparison of the population distributions of 2000 and 2100 can be seen in figure 11.

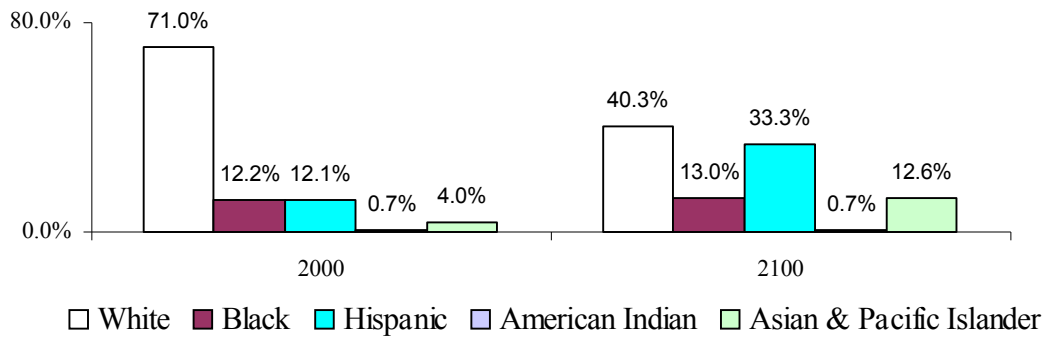


Figure 11. Percentages of Population Distributions of 2000 and Projected 2100 with Respect to Race

Thus, over the next century, the minority population will outnumber the majority population, due mainly to the sharp increase in the Hispanic Population. As educators, we must be cognizant of this trend and prepare for the predicted population. In one-hundred years, the United States will have to depend more on its “minority” population than on its “majority” population. If the current trend of woefully small percentages of Blacks and Hispanics in engineering continues, the future of engineering in the United States is bleak.

Solutions to Increase Numbers of Minority Students

The title of this paper states one goal: to increase the number of minority engineering students. The information in this paper supplies current and predicted data for 2100 on population statistics and educational attainment. We have shown that the number of minority engineering students is in proportion to the minority population, but that this statistic hides the fact that the numbers of Hispanics and Blacks with engineering degrees is woefully low. We have also shown that the future of the United States will depend on the minority populations as the minority population is predicted to outnumber the majority population in the year 2100. Now the goal must be addressed.

The goal of increasing the number of minority engineering students depends on sub-goals. As seen in figure 10 above, certain groups within the minority population are not graduating from high school in the same percentages as other groups. Specifically, the Black and Hispanic populations are not graduating from high school in the percentages that correspond to the population percentages. If one does not graduate from high school, one cannot attend college, let alone become an engineer. This is the first sub-goal: to encourage Blacks and Hispanics to graduate from high school.

The second sub-goal is to encourage Blacks and Hispanics to attend college. This may

seem like a trivial step, but as we have seen in figure 8; Hispanics, in particular, are not obtaining the appropriate percentage of any type of bachelor degree. Therefore, college attendance is necessary.

The final sub-goal is to introduce engineering to minority students prior to college enrollment, or as soon as possible once the student has matriculated. As any engineer knows, the progression of future college engineering courses depends on the first-year courses, so the sooner the student enters engineering, the better for the student.

How can these three sub-goals be met? Everyone, including state and federal governments and college educators, must be willing to focus more on middle and high school students. A partnership between middle and high schools and colleges would be beneficial. Professors and college students could come to the middle and high schools and introduce engineering as a field of study and college as a necessary goal for the student. Interaction and introduction is the key.

Conclusion

In our goal to discuss increasing the number of minority engineering students, we have presented the current state of affairs showing a lack of representation of minority engineering students. We have showed that the statistics indicate that the two main groups within the minority population, Blacks and Hispanics, do not earn as many bachelor degrees, engineering degrees, or high school diplomas as the remainder of the minority group. We have also showed that the minority population will become the majority population in a century. If the current state of minorities in engineering is not improved, the field of engineering will suffer. We have also discussed our goal by breaking it into three sub-goals: (1) Increase the number of Black and Hispanic high school graduates, (2) Increase the number of Black and Hispanic college applicants, and (3) Introduce engineering to potential college students and current college students as close to matriculation as possible. The way in which all three of these goals can be obtained is to partner with middle and high schools. We must encourage our Black and Hispanic minority students to finish high school, apply and attend college, and take as their major an engineering discipline. The fate of engineering in the U.S. in the future depends on our minority population; we must act now.

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¹NSF, "Minority Students Make Gains in Science and Engineering," *Frontiers: The Electronic Newsletter of the National Science Foundation*, <http://www.nsf.gov/od/lpa/news/publicat/frontier/7-97/7minor.htm>, (July/August 1997).

² NSF, *Science and Engineering Indicators*, Chapter 2, Higher Education in Science and Engineering, 1998.

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All remaining information comes directly from tables found at the United States Census Bureau, <http://www.census.org>.

³ U.S. Census Bureau. Table 1. Persons 25 years old and over, by years of school completed, race, and sex, for the United States, urban and rural, 1940.

⁴ U.S. Census Bureau. Table 2. Years of school completed by the total population 14 years old and over, by age and sex, for the United States: April 1950.

⁵ U.S. Census Bureau. Percent distribution by years of school completed for nonwhite persons 14 years old and over, by age and sex, for the United States: civilian population, March 1957, and total population 1950.

⁶ U.S. Census Bureau. Educational attainment of persons 15 years old and over, by age, sex, race, and Hispanic origin: March 1994.

⁷ U.S. Census Bureau. Table 1. Educational Attainment of the population 15 years and over, by age, sex, race, and Hispanic origin: March 2000.

⁸ U.S. Census Bureau. Bachelor's degree field by sex, race and ethnicity, and age, 1996. Release date: April 10, 2001.

⁹ U.S. Census Bureau. Projections of the resident population by race, Hispanic origin, and nativity: middle series, 2075 to 2100.

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