DIVERSITY ACTION PLAN

CIVIL & ENVIRONMENTAL ENGINEERING UNDERGRADUATE STUDENT REPORT

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Introduction

In alignment with the College of Engineering strategic goals, this report provides detailed information regarding the state of diversity in Civil and Environmental Engineering (CEE). The purpose of the report is to facilitate the department's ability to make data-driven decisions that will enable CEE to attract increasing numbers of highly sought after diverse undergraduates.

The report begins with recommended actions based on the analysis of data collected, including: national and institutional comparative demographic data regarding 2012 enrollment and degrees collected from the American Society from Engineering Education; undergraduate climate survey data collected in the spring and fall of 2013 respectively; undergraduate student focus group data collected in the fall of 2013; and information regarding current departmental practices collected from various sources, such as advisors, web pages, and departmental documents. Next the report provides a detailed discussion of study findings that informed the recommended actions. The report also includes an Action Plan Worksheet, which is meant to provide a template for the department to start mapping out a plan to implement one or more actions based on report recommendations. Appendices include information about the research methods used to collect and analyze the data, as well as supplementary data tables.

Recommended Actions

For ease of review, these actions are organized with the same headings used to describe the findings throughout this report. A brief summary of the findings, based on estimated means from the multilevel model and focus groups, can be found within each subsection. The first section related to "Recruitment" is included as a counterpart to suggesting improvements to the department's demographic profile.

Recruitment

Goal. Increase the number of students in CEE from each of the different underrepresented groups in engineering. Given their small numbers, recruiting 1-2 more Hispanic, African-American, and Native American students in each cohort would dramatically improve the diversity profile of the department.

Action 1: **Encourage and create opportunities for faculty, graduate students, and undergraduate students to connect with pre-engineering students.**

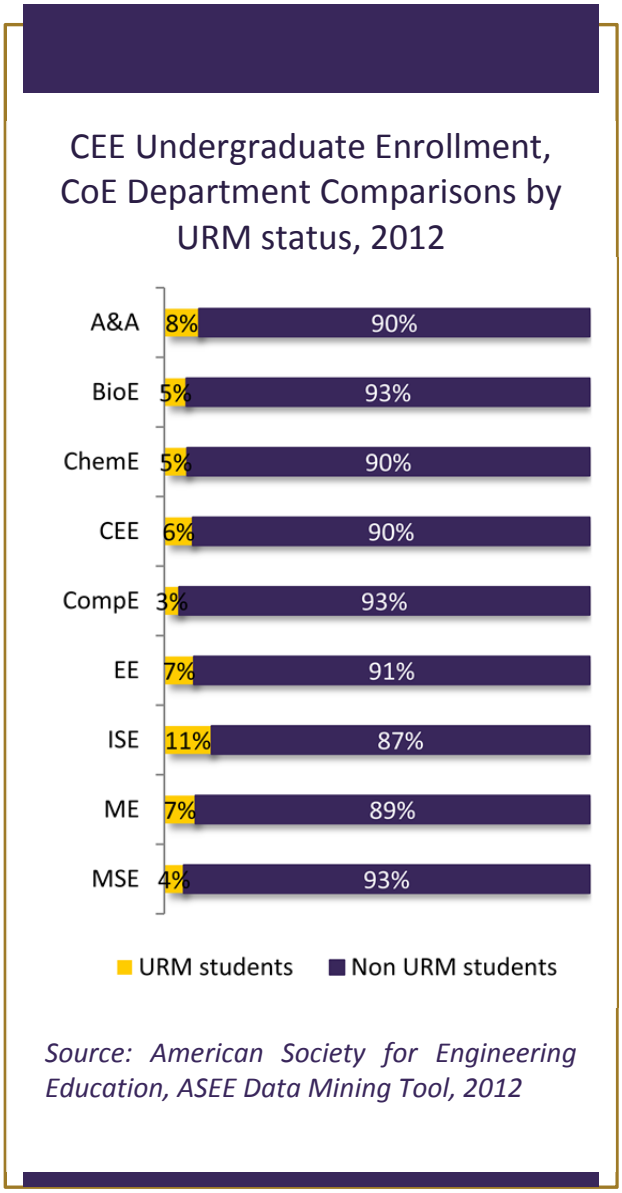
Why It's Important. Professors have a critical role in facilitating student engagement, which can be defined as students' levels of active involvement in their undergraduate programs and related elements, such as learning inside the classroom, in student organizations, and in research experiences.[1] Faculty acknowledgement and interaction is particularly important for underrepresented groups.[2, 3, 4] Therefore, it is important to identify and implement initiatives that foster relationships between faculty and future CEE students. Faculty participation in programs and activities targeting underrepresented pre-engineering students may spark student interest in CEE and encourage their application to the department.

Interactions with peers can also play a pivotal role in students' undergraduate engineering experience. Social belonging, or seeing oneself as socially connected, acts as a basic human motivation which can contribute to favorable outcomes.[5] How students perceive themselves and how they believe others perceive them, impacts both their sense of belonging and feelings of difference in their academic environment[6] . Although a sense of belonging operates as a belief held by students, external factors, such as interactions with faculty and peers, contribute to this belief.[7, 8] Interacting with engineering undergraduates and graduate students directly can both motivate pre-engineering and high school students to pursue an engineering degree and start to develop peer support networks that enable students to succeed in an engineering program. Moreover, when students play a supportive role for younger and/or potential engineering students, this offers motivation for them to continue in their programs,[9] and it helps confirm students' commitment to their field and their institution. [10, 11]

Recruitment Findings

CEE enrolls and graduates fewer African-American, and Hispanic-American undergraduates than the national averages while it enrolls and graduates more Native American and Pacific Islander undergraduates than the national averages. These differences may be due in part to the different demographic composition of Washington State. CEE has a high enrollment of women compared to national civil engineering enrollments and other UW engineering departments although other CoE departments are catching up to CEE levels. Thus, CEE should continue to target recruitment of URM and women students to increase its numbers to national levels. The CEE web site offers links to a variety of resources and organizations on campus, but it is unclear how actively or proactively these resources are utilized to target recruitment of diverse students.

What to do. To help connect CEE faculty, graduate students, and undergraduates with pre-engineering and high school students and raise awareness of CEE as a department of interest to these students, CEE faculty and/or staff can connect with the coordinators of the programs listed below to identify ongoing opportunities for CEE involvement. This may include presentations about research, sharing the work of civil and environmental engineers, talking about career pathways, mini-research opportunities for students, and informal conversations. CWD has worked with many of these programs and can help CEE establish relationships with key individuals.



Source: American Society for Engineering Education, ASEE Data Mining Tool, 2012

1) To recruit first and second year students on campus. Within UW, numerous programs serve first and second year pre-STEM/pre-engineering students "of interest" who, if recruited successfully, could increase diversity in the CEE student body. Programs serving pre-engineering students include:

- STate Academic RedShirt Program (STARS)
- Women in Science & Engineering (WiSE)
- Minority Scholars Engineering Program (MSEP)
- Emerging Leaders in Engineering
- Engineering Summer Bridge/STEM Institute
- Pacific Northwest Alliance for Minority Participation (PNW LSAMP)
- College Assistance Migrant Program (CAMP)
- Early Identification Program (EIP)

2) To recruit high school students. UW is also involved with several outreach programs and activities designed to encourage students to matriculate here. CEE can leverage these resources to increase pre-college student awareness of civil and environmental engineering with a low cost and time commitment. These programs and resources include:

- Washington Mathematics Engineering Science Achievement (MESA)
- Making Connections
- Mathematics Academy
- Math Science Upward Bound
- Gaining Early Awareness of and Readiness for Undergraduate Programs (GEAR UP)
- Early Engineering Institute
- Educational Talent Search (ETS)

3) To recruit community college students. UW has several programs that target potential engineering transfer students such as the PNW LSAMP and MESA Community College Program. Through the LSAMP program, additional partnerships are being established with community colleges in Idaho and Oregon. In addition, UW offers *Transfer Thursdays* to

encourage future transfer students to see campus and encourage their application and enrollment. The MESA Community College Program has deepened UW's relationship with several community colleges that offer engineering transfer programs including:

- Seattle Central Community College
- Highline Community College
- Olympic Community College
- Edmonds Community College
- Yakima Valley Community College
- Columbia Basin College

Action 2: **Develop a student ambassadors program.**

Why It's Important. The research literature shows that peer-to-peer interactions promote persistence, achievement, and learning and are highly influential for students of color.[12, 13, 14] Putting pre-engineering students in contact with their "near-peers" can facilitate community building within the department and help create a welcoming and comfortable climate for students, encouraging their application to CEE.

What to do. A strategy used by engineering programs at other institutions has been to implement an "ambassadors" program where engineering students are selected to serve as representatives and share their experiences with first and second year students and high school students, giving prospective majors another opportunity to learn about the department, the major, and possible career pathways from students who are one or more steps ahead of them. It also helps build a sense of community within the department and reduce isolation, particularly for underrepresented groups. Encouraging these direct student relationships among current CEE students and potential CEE students could be a powerful recruiting tool to yield students into the department.

Professors

Goals. Improve faculty awareness and understanding of negative impacts of stereotypes; improve quality and consistency of instruction department-wide to better engage student interest.

Action 1: **Educate faculty about stereotypes and their impact.**

Why It's Important. Stereotype threat impacts students when a particular part of their identity is named salient.[15] For instance, research has shown that women score lower on math tests when reminded of their gender prior to the exam and that white male engineering students score lower than usual on tests when told that Asian students typically get better grades than students from other groups.[16, 17, 18] Identity-safe environments where students are not reminded of stereotypes can encourage high expectations of performance for all students.[19] Working to recognize biases and developing ways to combat them will help CEE faculty and teaching assistants work more effectively with students of all demographic groups, both in and out of the classroom.

What to do. Encourage faculty to take the STEM and Gender Implicit Association Test (www.projectimplicit.net) in the privacy of their own offices to make them aware of their hidden biases. Raising awareness will help discourage behaviors that perpetuate stereotypes from occurring in the classroom. Faculty and teaching assistants should participate in professional development activities that will help identify personal biases, particularly those based on gender and race/ethnicity, that research indicates we all exhibit. CoE's Center for Institutional Change offers many resources to support professional development training. Department efforts to incentivize faculty professional development related to diversity issues will encourage their involvement.

Findings related to Professors.

Based on a set of 20 items from the climate survey, CEE students rated their professors almost a 3.82 on a 5 point scale of satisfaction which is approximately the average rating for all CoE students. Thus, CEE could make some improvements to outperform the other departments in this area. In the CEE department, 14% of students reported hearing faculty unconsciously express racial and ethnic stereotypes, while 23% heard them express gender stereotypes. The CEE students participating in the focus group (all identified with a population of interest) had positive comments regarding access and support from faculty. They expressed mixed opinions about the quality of instruction with respect to the pacing on classes and faculty prioritizing research over teaching. College-wide, underrepresented students had significantly lower levels of satisfaction for items in this survey section, summarized in Appendix 4 (separate attachment).

Action 2: **Facilitate increased student engagement.**

Why It's Important. Given the critical role that professors play in facilitating student engagement[20], it is vital for faculty to develop and practice various strategies aimed to increase student engagement. Further, because acknowledgement and interaction with faculty is particularly important for underrepresented groups,[21, 22, 23] CEE would better serve and retain these students with faculty who both understand the importance of this and reflect that understanding in their practice.

What to do. Faculty are more likely to change their approach to teaching when new practices show research-proven results or they learn new practices from respected peers. Small changes, such as learning student names in class, help engage students in class. ENGAGE, a project funded by the National Science Foundation, offers many simple tips on their web site to improve faculty-student interactions (www.engageengineering.org under "Faculty-Student Interaction Tips"). Leadership (i.e. department chair) could encourage faculty to adopt some of these practices into their teaching. For example, the department chair could set aside a few minutes at a faculty meeting to discuss these tips and provide a handout. Additionally, faculty members could volunteer to try out one or more practices and share how it went with the rest of the staff at the next faculty meeting. Faculty members could also pair up, each try a new practice, and discuss with one another how it went and what could be improved.

Action 3: **Integrate relevant applications into the curriculum.**

Why It's Important. Providing students with real-world applications in the classroom, getting students involved in meaningful research projects, and encouraging professors to bring industry and research experiences into the classroom would benefit all students. Women and URM students gravitate towards practical, collaborative, applied work.[24, 25] Therefore, integrating applications into the teaching of fundamental concepts would improve recruitment and retention of these groups.[26, 27, 28] Students enjoy hands-on experiences and projects; for many, their enthusiasm for these types of activities motivate them to major in engineering.

What to do. CEE students are highly engaged and motivated by the subject matter. Encourage faculty to connect coursework back to their research and research by other CEE faculty. ENGAGE also provides many examples of how faculty may bring real world applications into course material through the *Everyday Examples in Engineering* section of its website (www.engageengineering.org). In addition, ENGAGE offers a free newsletter to share effective practices. Department leadership could once again use some staff meeting time to encourage faculty to implement some of these practices. The chair could also identify faculty who are using such practices, and have them briefly share how they do this and how it benefits students.

Teaching Assistants

Goal. Ensure that TAs have the necessary English language skills and are properly trained to provide high quality instruction and support to students.

Action 1: **Improve language skills of TAs.**

Why It's Important. Engineering students note that TA accents frequently detract from their learning, which ultimately can discourage their attendance in class.

What to do. It is recommended that the department recognize this barrier to communication, evaluate each teaching assistant's English language abilities, and provide additional training if necessary. UW's English department offers ESL classes and they list resources on their webpage (http://depts.washington.edu/engl/esl/ell.php)

Action 2: **Encourage TAs to seek training as needed.** To ensure that TAs are properly prepared to fulfill their role, they may require training and support.

What to do. It is recommended that the department work with faculty to ensure that they provide their TAs with the information they need to serve students well. Additionally, UW's Center for Teaching and Learning (CTL) provides training to teaching assistants. Encouraging TAs to attend the annual TA/RA conference sponsored by CTL would provide them with information, tools, and resources that could contribute greatly to the educational experience of undergraduates, while also developing the skill base of TAs.

Findings related to Teaching Assistants.

On the climate survey, CEE students rated their satisfaction with teaching assistants higher than other engineering students, with a section rating of 3.74 compared to the 3.62 average for the CoE. Students in the focus group offered a mixed opinion of teaching assistants, citing both general satisfaction as well as frustration with being given bad information in a class. In examining differences by student subpopulation within the CoE, women, students with disabilities, and students in larger majors indicated lower satisfaction.

Resources, Programs, and Activities

Goal. Ensure the types of resources, programs, and activities that best support students are available and accessible to a wide range of students, including transfer students and students who are parents.

Action 1: **Encourage all students to participate in research opportunities.**

Why It's Important. Undergraduate research experiences influence STEM students' successful academic progress, retention, career goals, and consideration of graduate programs.[29, 30, 31] These faculty-student interactions provide students with career guidance and greater engagement with the subject matter for all students. [32, 33, 34] Undergraduate research opportunities also open another door to understanding all of the different applications of an engineering degree. Summer research experiences, for example, are supportive of increased retention, as well as students deciding to pursue further education.

What to do. Encourage faculty to offer brief research experiences to students in their early years at the UW. While they may not have the academic background to make solid contributions, it would be an investment in their recruitment and retention to place them in CEE faculty labs. Additionally, the Undergraduate Research Program, located in Mary Gates Hall, coordinates the posting and placement of students into undergraduate research positions on campus, culminating in an Undergraduate Research Symposium at the end of the academic year. While the URP serves the entire campus, it may be possible to discuss with them how to offer programming specific to the CEE department or pull the CEE-specific opportunities onto a webpage on CEE's site. Faculty should also be encouraged to apply for NSF supplemental grants to sponsor undergraduate student stipends for research participation.

Findings related to Resources, Programs, and Activities.

CEE students indicated a 3.66 level of satisfaction with their access to resources, which is the same as the CoE average. Examples of resources include study centers, class sizes, and advising. In the focus group, students noted that their involvement in research, student organizations (e.g. Concrete Canoe), and internships help to support them and identify mentors. Students indicated wanting more opportunities to interact with peers and faculty in the department, and some students expressed frustration about trying to fit in some critical extracurricular activities (i.e. Engineers Without Borders, Concrete Canoe, Steel Bridge) due to family obligations or scheduling conflicts. Students also expressed a desire to participate in co-ops without having to add time or additional costs to their program. Students were satisfied with the quality of advising, although they would prefer increased access to the advisor on a quarterly basis. They also wanted to have increased access to practical and applicable information for the workplace, such as how to dress and the kinds of things they would be expected to do on the job.

Action 2: **Increase student access to mentoring.**

Why It's Important. Research indicates that mentoring has a positive impact on engineering students. [35, 36] Women students, in particular, benefit from mentoring relationships, both mentors and mentees.[37] However, one study found that women science and engineering students were more likely than men in these fields to say they lacked mentoring support.[38] Typically, students are unfamiliar with the workplace and are not aware of the wide range of jobs that make use of an engineering skill set, many of which could be more appealing to underrepresented groups.[39] Developing stronger relationships between students, faculty, and engineers in industry builds student confidence, increases student engagement, and increases student understanding of opportunities in engineering.[40, 41]

What to do. Various models of mentoring have been proven effective, such as peer mentoring, faculty-student mentoring, group mentoring, and pyramid mentoring, among others. "Near-peer" mentoring could be a casual approach to mentoring that connects lower-classmen to upper-classmen. More formal, structured programs between students (undergraduate and graduate) and faculty or alumni, when administered effectively and appropriately, may yield tremendous benefits to both the mentor and mentee as well as provide student professional development. In addition, encouraging direct student relationships among current CEE students and potential CEE students could be a powerful recruiting tool to yield students into the department. A peer mentoring program could be an avenue to address many of the recommendations listed throughout this report. CWD has coordinated a variety of mentoring programs and was honored with the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM) and the 1998 WEPAN National Women in Engineering Program Award. Both awards were directly related to increased retention, programmatic efforts, and the design, development, and dissemination of a Curriculum for Training Mentors and Mentees in Science and Engineering.

Action 3: **Improve students' knowledge of engineering careers.**

Why It's Important. The stereotypical view of engineering careers is one that is very demanding, non-traditional for women, and focused on unappealing, uninteresting problems. [42, 43] Students are unfamiliar with the wide range of jobs using engineering skills, which could keep them interested in their major.[44, 45, 46] Developing stronger relationships between students and engineers in industry builds student confidence, increases student engagement, and increases student understanding of opportunities in engineering.[47, 48]

What to do. Contact alumni and industry partners to encourage them to offer short presentations to students about various CEE-related projects they have worked on throughout their careers. For industry partners looking for deeper engagement, encourage them to offer site visits to view active work sites or discuss relevant projects in the area. Invite all students, as well as pre-engineering students, to attend these events or participate in these activities. Be intentional in inviting industry partners, alumni, and/or faculty from diverse groups who can serve as role models to attract diverse students into CEE. Sponsor the development of short videos to illustrate the work of industry partners and alumni and make them readily available on CEE's web site; ensure these videos reflect diverse populations. Similarly, developing hallway posters with interesting and relevant examples of CEE applied research could continue student interest. Offering a one-credit course or seminar series with CEE-related guest speakers could also attract students within and outside of the department.

Action 4: **Offer more opportunities for academic and social integration into the department.**

Why It's Important. Much of the research literature on student retention and attrition is based on the theory that the more students are integrated academically (e.g. classroom, faculty engagement) and socially (interactions with peers) in the institution or department, the more likely they are to stay in the department.[49] Thus, satisfaction with these interactions is critical to a positive departmental climate.

What to do. Hosting quarterly events or activities which promote interactions with students and faculty in a casual setting will help students feel integrated into the CEE community. If these activities are already being held, conducting a formative assessment for how they can be improved to encourage interactions across groups would be beneficial.

Student Interactions

Goal. Ensure that ample opportunities exist for all students in the department to connect with one another and build a strong CEE community, paying particular attention to integrating students who may face challenges in feeling connected and part of the community.

***Action 1:* Facilitate communities for women and minorities.**

Why It's Important. Building professional and social networks can counteract the isolation many women and minorities experience and provide them with the information, support and knowledge they need to persist through graduation.[50] Alienation is generally a greater barrier for women than men; [51, 52, 53, 54] therefore, feelings of acceptance – psychological sense of community – are particularly important for women. Additionally, URM students in engineering undergraduate programs may face challenges, such as differences in cultural values and socialization, stereotypes, isolation, perceptions of racism, and inadequate program support.[55, 56, 57, 58] They also may lack peers, faculty role models, and mentors who look like them due to typically small numbers of minority students and faculty in engineering programs.[59, 60]

What to do. Remind students of organizations that will help them feel as if they are part of a smaller community on campus. STEM diversity groups on campus include the Society for Women Engineers (SWE), American Indian Science and Engineering Society (AISES), the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), and Out in Science, Technology, Engineering & Mathematics (oSTEM).

Findings related to Student Interactions.

The survey revealed that on average CEE students rated their interactions in the department at a 3.65 level of satisfaction (out of 5 points). Student interactions in CEE are above average compared to other CoE majors. "Interactions" refers to such items as study group involvement and community sense of belonging. In the focus group, underrepresented students described peers as their primary source for support. They also expressed feeling comfortable asking other students for help even if they do not know them.

***Action 2:* Facilitate integration of transfer students:**

Why It's Important. Community college/transfer students may be treated as "second class" students because of preconceived notions of their academic abilities.[61] As a result, they may be excluded from informal study groups because of their nontraditional pathways to university.[62]

What to do. Some universities, like Arizona State University, offer a one-credit course that helps integrate community college/transfer students and helps "bridge the gaps" between 2-year and 4-year colleges and universities. Some of these programs are incentives-based and provide scholarship money linked to participation in the one-credit course, meeting with their advisors, and other activities that could help them integrate into their new campus.

Satisfaction with the CEE Major

Goal. Continue to build a positive CEE climate for students, where they find satisfaction with the major and feel confident in their abilities to succeed.

Actions. See actions in sections above. *They will all contribute to greater student satisfaction with the major.*

Findings related to Satisfaction with Major.

CEE students rated their satisfaction with and self-efficacy in their major to be substantially higher than other engineering majors, giving their "Major" rating a 4.49 compared to 4.24 for CoE. Students in the focus group described activities such as the Concrete Canoe as giving them confidence to succeed as well as pre-college activities that motivated their interest in CEE. They had positive experiences while in CEE as well. College-wide, differences emerged by group of interest, as detailed in Appendix 4.

Findings

This report presents findings regarding undergraduate student experiences in Civil and Environmental Engineering (CEE). Data were collected over the course of several months, using various sources. These include a CWD-administered undergraduate climate survey, demographic data on undergraduate civil engineering students (ASEE) from ABET-accredited institutions, and an undergraduate CEE student focus group.

Washington Demographic Makeup

The most recent data from the US Census shows an increase in Washington's racial and ethnic minority population from 20.6% in the year 2000 to 27.3% in 2010[63]. The Hispanic population is the fastest growing group, growing by 71.2% over these ten years and now makes up 11.2% of Washington's overall population. The Non-Hispanic Multiracial population increased by approximately 62%, making them the second largest growing group, although they only account for 3.6% of Washington's population. The Asian and Pacific Islander population increased by 48.8% between 2000 and 2010 and accounts for 7.7% of the state's populace. Although Washington's Black/African-American population increased by 22.3% over the decade, these individuals only make up 3.4% of the overall population. The state's Alaskan Native and American Indian population also grew by 3.2%; however, this group is Washington's smallest racial/ethnic minority, only comprising 1.3% of the total population. Paralleling these statistics, the state's overall population grew 14.1% over the same decade.

Washington State Population

Washington State differs from the national population with higher proportions of Whites (82% versus 78%) and Asians (8% versus 5%) and inversely, lower proportions of African-Americans (4% versus 13%) and Hispanics (12% versus 17%).

Washington State demographics differ from the national population[64] with higher proportions of Whites (82% versus 78%) and Asians (8% versus 5%) and inversely, lower proportions of African-Americans (4% versus 13%) and Hispanics (12% versus 17%).

Demographic Data – National Degree and Enrollment Comparisons

The data source for the demographic analyses is the American Society for Engineering Education's ASEE's Engineering Data Management System (EDMS), which provides race/ethnicity and gender data on student enrollments and degrees for participating ABET-accredited programs. Rankings for each institution are based on total number of students enrolled/degrees granted. EDMS data for 2012 shows 202 students enrolled in the UW civil engineering (CE) undergraduate program, with a national enrollment rank of 134 out of 246 ABET-accredited CE programs. Programs with similar enrollment numbers included Gonzaga University, University of Dayton, University of Louisiana at Lafayette, and the University of Idaho (see appendix tables for more information). The American institution with the highest undergraduate enrollment was Texas A&M with 965 students, while the institution with the lowest undergraduate enrollment was Brown University with 15.

National Enrollment and Degree Comparisons by URM

Table 1 shows CEE[1] undergraduate enrollment and degree data in comparison to national CE data aggregated from all ABET-accredited CE programs in the US and Canada. The gold cells highlight the groups where CEE is above the national civil engineering averages. Deeper gold means the difference is over 5%. URM status is defined as belonging to an underrepresented minority group in the sciences, including African American, Hispanic, Native American, and Pacific Islander students. The Non-URM status includes Asian American, White, and Foreign students.

Table 1: CE Enrollment & Bachelor's Degrees, National Comparisons by Race & Ethnicity

	Enrollment		Bachelor's Degrees	
Race/Ethnicity	**National**	**UW**	**National**	**UW**
African American	4%	0%	3%	3%
Asian American	7%	24%	8%	23%
Hispanic	13%	4%	10%	4%
Native American	0%	1%	0%	1%
Pacific Islander	0%	1%	0%	1%
White	53%	57%	60%	66%
Foreign	7%	8%	4%	2%
Multiracial	2%	0%	1%	0%
Unknown	12%	4%	14%	2%
*URM Status	17%	6%	13%	8%
**Non-URM Status	67%	89%	72%	90%

Source: ASEE Engineering Data Management System, 2012
* and ** may not add up to 100% due to rounding

Table 1 above indicates that UW's CEE enrollments by race and ethnicity are very similar to the bachelor's degree data; although, foreign students comprise a higher share of undergraduate CE enrollment at UW than they do nationally. The cells with gold-fill highlight the groups where UW CEE is above the national CE averages. Enrollment data showed that CEE has above average enrollment of Asian American (24%), Native American (1%), Pacific Islander (1%), Foreign (8%), and White (57%) students. With regard to African-American and Hispanic student enrollment, the CEE department fell below national averages, much like the differences between state and national demographic comparison. Figure 1 provides a visual representation of these comparisons.

[1] CEE will be used to refer to the UW department of Civil and Environmental Engineering throughout the report, while CE refers to civil engineering.

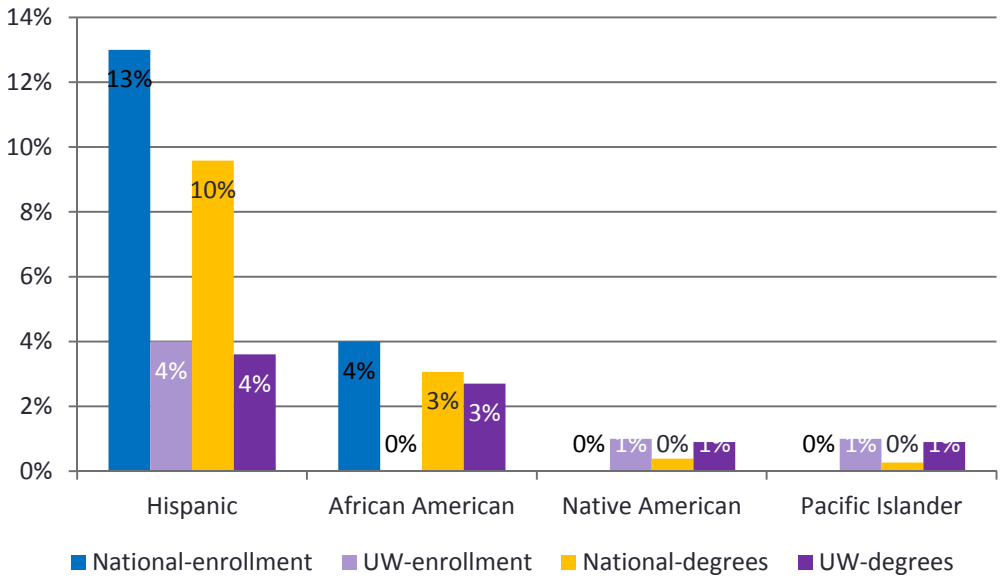


Figure 1. CE Undergraduate Enrollment and Degrees Awarded, National Comparisons by Race/Ethnicity, 2012
Source: ASEE Engineering Data Management System, 2012

As of 2012, the University of Washington was listed 27th in civil engineering degree granting programs, with 111 degrees awarded. CE programs conferring a similar number of degrees included University of Minnesota -Twin Cities, University of California-San Diego, University of Alabama, and Missouri University of Science and Technology. Virginia Tech awarded the most civil engineering bachelor's degrees (255) while University of South Alabama awarded the fewest (3).

The CEE department comes in above national averages for bachelor's degrees awarded to Asian-Americans (23%), Native Americans (1%), Pacific Islanders (1%), Whites (66%), and Women (32%). The department came in below or equal to the national averages for African-Americans and Hispanics, as one might expect given the difference between the state and national populations. (See Figure 1).

National Enrollment and Degree Comparisons by Gender

In terms of enrollment by gender, UW civil engineering enrolls well above the national average of women undergraduate students (27% compared to 21% nationally). Similarly, CEE is well above the national average in bachelor's degrees conferred to women (32% compared to 21% nationally). See Table 2.

Table 2: CE Enrollment & Bachelor's Degrees, National Comparisons by Gender, 2012

	Undergraduate Enrollment		Bachelor's Degrees	
Gender	**National**	**UW**	**National**	**UW**
Men	79%	73%	79%	68%
Women	21%	27%	21%	32%

Source: ASEE Engineering Data Management System, 2012

Demographic Data – UW College of Engineering Enrollment and Degree Comparisons

Based on fall 2013 enrollment numbers, CEE is the third largest department in the College of Engineering (CoE), with 266 students. First is Electrical Engineering (EE), which has 472 undergraduates, followed by Mechanical Engineering (ME), which has 348.

UW College of Engineering Enrollment and Degree Comparisons by URM status

Table 3 displays undergraduate student enrollment in UW College of Engineering majors by race and ethnicity. All engineering departments enroll a high number of Asian American undergraduates, while Biomedical Engineering (BioE), Electrical Engineering (EE), and Industrial & Systems Engineering (ISE) enroll the highest proportion of foreign undergraduates. CEE is second highest in terms of its White undergraduate enrollment. While the department is similar to other CoE departments with regard to overall URM undergraduate enrollment, it has the least number of African American undergraduates (0.5%) across the CoE. With regard to Hispanic and Native American undergraduate enrollment, CEE is roughly average compared to other CoE departments.

Table 3. CEE Undergraduate Enrollment, UW CoE Comparisons by Race/Ethnicity, 2012

	African American		Asian American		Hispanic		Native American		Pacific Islander		Foreign		White		Multiracial		Unknown	
A&A	1	1%	40	27%	7	5%	2	1%	1	1%	9	6%	83	56%	0	0%	4	3%
BioE	3	2%	56	36%	5	3%	0	0%	0	0%	24	15%	66	42%	0	0%	3	2%
ChemE	1	1%	31	23%	3	2%	1	1%	2	1%	16	12%	76	56%	0	0%	6	4%
CEE	1	*0%	48	24%	8	4%	2	1%	2	1%	17	8%	116	57%	0	0%	8	4%
CompE	3	2%	44	25%	2	1%	1	1%	0	0%	17	9%	105	59%	0	0%	7	4%
EE	14	3%	152	31%	17	3%	1	*0%	1	*0%	84	17%	205	42%	0	0%	13	3%
ISE	2	2%	30	27%	9	8%	0	0%	1	1%	21	19%	45	41%	0	0%	2	2%
ME	6	2%	66	20%	12	4%	4	1%	1	*0%	23	7%	202	62%	0	0%	13	4%
MSE	1	1%	41	31%	4	3%	0	0%	1	1%	12	9%	72	54%	0	0%	3	2%

Source: ASEE Engineering Data Management System, 2012

*Due to rounding, some percentages may not reflect precise values

Race and ethnicity data demonstrates that CEE is majority white. Additionally, CEE awarded the most bachelor's degrees to this group out of the entire CoE (73, 66%). For all other groups, CEE came in below the CoE average in degrees awarded.

Table 4. CEE Undergraduate Degrees Awarded, UW CoE Comparisons by Race/Ethnicity, 2012

	African American		Asian American		Hispanic		Native American		Pacific Islander		Foreign		White		Multiracial		Unknown	
A&A	1	2%	13	23%	2	4%	0	0%	0	0%	4	7%	35	61%	0	0%	2	4%
BioE	0	0%	18	39%	0	0%	1	2%	0	0%	6	13%	21	46%	0	0%	0	0%
ChemE	1	2%	21	33%	2	3%	0	0%	0	0%	5	8%	30	48%	0	0%	4	6%
CEE	3	3%	25	23%	4	4%	1	1%	1	1%	2	2%	73	66%	0	0%	2	2%
CompE	1	2%	10	18%	0	0%	0	0%	0	0%	5	9%	35	64%	0	0%	4	7%
EE	5	3%	58	36%	6	4%	0	0%	0	0%	12	7%	69	43%	0	0%	11	7%
ISE	2	4%	11	22%	2	4%	0	0%	0	0%	17	33%	17	33%	0	0%	2	4%
ME	0	0%	23	21%	2	2%	0	0%	2	2%	6	6%	68	62%	0	0%	8	7%
MSE	0	0%	5	16%	4	13%	0	0%	0	0%	3	9%	20	63%	0	0%	0	0%

Source: ASEE Engineering Data Management System, 2012
*Due to rounding, some percentages may not reflect precise values

UW College of Engineering Enrollment and Degree Comparisons by Gender

In terms of women's enrollment in engineering, 27% of undergraduates enrolled in CEE are women. Four CoE departments outrank CEE with regard to enrollment of undergraduate women. These include BioE (41%), ChemE (32%), ISE (35%), and MSE (29%). CEE awarded the largest overall number of bachelor's degrees to women (36). In terms of the proportion of bachelor's degrees awarded, the department came in third, along with Chemical Engineering (32%). Bioengineering awarded the highest percentage of degrees to women (41%), followed by Industrial and Systems Engineering (39%). Table 5 provides the gender breakdown for undergraduate enrollments and bachelor degrees.

Table 5: CEE Enrollment & Bachelor's Degrees, CoE Comparisons by Gender, 2012

	Undergraduate Enrollment		Bachelor's Degrees	
	Men	Women	Men	Women
A&A	86%	14%	84%	16%
BioE	59%	41%	59%	41%
ChemE	68%	32%	68%	32%
CEE	73%	27%	68%	32%
CompE	87%	13%	87%	13%
EE	81%	19%	86%	14%
ISE	65%	35%	61%	39%
ME	87%	13%	88%	12%
MSE	71%	29%	84%	16%

Source: ASEE Engineering Data Management System, 2012

CEE General Student Experiences

An undergraduate student climate survey was conducted across all engineering departments at University of Washington in the Spring of 2013. For the UW Civil and Environmental Engineering (CEE) major, a sample of 26 students responded to this survey. Their responses are compared with the students from the remaining 9 engineering majors surveyed. Appendix II shows responses rates by major and student demographic.

Results for the survey were assessed for six broad outcomes. Each outcome was created as an average of multiple survey items. Table 6 contains descriptions and reliabilities of each outcome. A table of specific survey items included in each outcome can be found in Appendix V.

Table 6: Outcome measures, number of items included in measure, reliability, and description

Outcome	# items	Cronbach's α	Description
Professor	20	0.874	Perceptions of experiences with professors
Teaching Assistant	6	0.810	Perceptions of experiences with TAs
Resources	4	0.645	Class size, study center, advisors, job placement service
Student Interaction	7	0.717	Experiences with study groups, group projects, and community
Major	4	0.552	Satisfaction with current chosen major
Campus Life	19	0.873	Satisfaction with overall student experience at UW

Source: CWD, 2013 Engineering Undergraduate Climate Survey

For each outcome, an unconditional model was run to estimate the mean value for that outcome across all engineering majors, as well as the variance across students and the variance across majors. The estimated mean is the estimated, average value of that outcome across all engineering majors, based on a five-point rating scale with three being the mid-point. Table 7 below summarizes the outcomes for all engineering majors, including CEE. The largest deviations from the mean (more than three times the standard error listed in the appendix table) have been highlighted in dark purple, and the lesser deviations from the mean (more than two times the standard error listed in the appendix table) have been highlighted in lighter purple. Those cells not highlighted have lesser deviations (the mean value for that outcome for that major is approximately equal to the overall expected mean for all majors for that outcome).

Table 7: Deviation from overall expected mean and estimated mean for each outcome, by major

Major	Professor	Teaching Assistant	Resources	Student Interaction	Major	Campus Life
A&A	-0.10	0.06	-0.18	0.08	0.12	0.07
BioE	0.06	0.11	0.47	0.18	-0.10	0.00
ChemE	-0.01	-0.07	-0.12	0.05	-0.14	-0.03
CEE	0.05	0.14	0.09	0.13	0.25	0.05
CSE	0.15	0.05	0.18	-0.19	0.20	0.04
EE	-0.10	-0.10	-0.11	-0.07	-0.12	-0.06
HCDE	0.04	-0.01	-0.11	-0.03	-0.17	0.01
ISE	0.07	-0.05	0.04	0.02	-0.04	-0.02
MSE	0.00	-0.09	0.06	-0.08	-0.03	0.01
ME	-0.17	-0.04	-0.32	-0.10	0.04	-0.05
Model est.mean	*3.78*	*3.62*	*3.57*	*3.52*	*4.24*	*3.64*

Source: CWD, 2013 Engineering Undergraduate Climate Survey

For example, the multi-level model estimated CEE majors, on average, to rate their satisfaction with their teaching assistants 0.14 points higher on a 5-point rating scale compared with the expected average rating of satisfaction with teaching assistants (the mean value of 3.62 is shown on the last line of the Table 7; Appendix III provides more details.). Therefore, CEE majors have an expected average rating of satisfaction with their teaching assistants of 3.76 on a five-point rating scale. *Looking across all of the outcomes, CEE is either approximately average or above average in all survey outcomes compared to the other undergraduate engineering majors.*

As the above table concisely summarizes, survey data reflect that, in comparison to other engineering majors, CEE students did not report that the department was below average on any of the climate areas covered in the survey.[2] CEE students reported **approximately average satisfaction** compared to other UW engineering majors for the following subsections:

- *Professor*: CEE students are roughly as likely as students from other majors to be satisfied with their experiences with their professors in areas such as feeling comfortable asking questions and being able to understand course material.
- *Resources*: CEE students are roughly as likely as students from other majors to be satisfied with the size of classes, study centers, advisors, and job placement services.
- *Campus Life*: CEE students are roughly as likely as students from other majors to be satisfied with the overall student experience in areas such as feeling more overwhelmed or insecure about classes and friends.

CEE students reported **higher satisfaction** compared to other UW engineering majors for these subsections:

- *Teaching Assistant*: CEE students are more likely than students from other majors to be satisfied with their experiences with their teaching assistants in areas such as efficacy, knowledge, and comfort.
- *Student Interaction*: CEE students are more likely than students from other majors to be satisfied with group projects, study groups, and other academic interactions between students.
- *Major*: CEE students are more likely than students from other majors to be satisfied with their choice of major.

Qualitative Findings related to Student Groups of Interest

The undergraduate survey provides a general overview of student perception of their engineering major but is limited in what it can report about the experiences of specific student populations of interest such as underrepresented minorities (URM – African-American, Hispanic-American, Native-American, and Pacific Islander), women, low income, veterans, and first generation college students. The sample size for these populations was too small to draw any

[2] While the variance across all students is much higher than the variance across the 10 engineering majors, the outcomes reported here are where CEE majors rated the department at least two standard errors away from the mean, suggesting CEE is different from other engineering departments for the outcomes highlighted in purple in Table 6.

conclusions at the major/department level. While the engineering student survey findings for these populations of interest are briefly summarized below, Appendix IV contains a detailed narrative of the survey findings with respect to these groups.

To provide richer, department-specific data related to these groups of interest, we conducted focus groups in Fall 2013 with undergraduate students who self-identified as belonging to one or more these groups in order to capture information about their experiences. All CEE undergraduate students were emailed invitations by the undergraduate advisor, and those students who identified with one or more under-represented groups (or other groups of interest) in engineering were invited to participate in a focus group with CWD staff. The focus group was conducted with four CEE undergraduate students in October 2013. Student participants represented the following groups: women, Hispanic/Latinos, low-income students, and transfer students. Some students identified with more than one group. These findings are organized to match up to the survey outcome categories presented above; however, due to the semi-structured nature of focus groups, not all survey outcome categories have corresponding focus group findings.

Professors

All CEE students (all identified with a population of interest) had positive comments regarding CEE professors' approachability and availability. They described their experiences with professors as positive and indicated that the CEE faculty is generally supportive. One student stated, "Professors want you to come to them." A transfer student explained how her experience with CEE faculty at UW differed from her last school/program, "I've had a bit of an opposite experience before. Definitely tougher when your professors don't want you to succeed. I love it here."

In terms of the quality of instruction received by professors, students indicated that there was a mix. For example, one student stated "Some professors are great, spend a lot of time preparing, and others not as great. In general, it's been okay." Another student explained, "Some professors [are] probably great researchers, but it's hard to understand because it's too detailed…I'd like if they slowed it down."

CoE survey results regarding Professors.

Women were less likely to report that their professors treat them with respect. Further, both female students and students in large engineering majors were less likely to report feeling comfortable asking questions in class. Students in large majors, along with transfer students, first-generation American students, and first-generation college students, all indicated that professors move through course material too quickly and that they are less likely to understand course material. Pell eligible, transfer, and first-generation college students all indicated that professors' accents make it difficult to understand them. Military students were the only group who were less likely to report being able to understand what professors expect of them. Finally, students from large majors were more likely to report that professors encourage them to attend office hours; first-generation American students were more likely to report that professors keep the office hours that they set; and female engineering students were more likely to report meeting with professors for extra help.

Teaching Assistants

CEE students in the focus group all indicated that they were generally satisfied with TA experiences and support. One student described a little frustration with misinformation she received from a TA in terms of what would be included on an exam, but she indicated that it was likely due to the fact that the TA was new.

CoE survey results regarding TAs.

Survey data highlighted different feelings with regard to TAs for different groups. For example, URM students were less likely to report feeling satisfied with the assistance they receive from teaching assistants. Transfer students, on the other hand, were more likely than non-transfer students to report that teaching assistants are less effective at teaching. SWD reported feeling less comfortable meeting with teaching assistants for academic help; while students from large majors were more likely to perceive that cultural differences have made them less likely to meet with their teaching assistants.

Student Interactions, Supports, Resources, Organizations, Programs & Activities

When CEE undergraduate students were asked where they turn for support, all described their peers as a primary source, if not the primary source. Students talked about the computer lab as a place they go to work and get help from other students. They explained that student support could come from within or across cohorts, and they also talked about not necessarily knowing a student before asking for help, but feeling comfortable approaching someone they recognize from class. One transfer student expressed a desire to have more formal study sessions, particularly those focused on the Fundamentals of Engineering exam.

In terms of other sources of support, the women in the group described finding mentors through various organizations, such as Engineers without Borders and ASCE, and as a result of doing research with faculty, and/or having internships. A Latino male, on the other hand, indicated that he did not have a mentor. Two of the women described how they benefitted from internships in addition to finding mentors. One explained, “Internships are very valuable. You know what it’s like and [what you’re] getting into. Civil is so broad, multi-faceted. Internships help you decide what you like and don’t.”

One woman described how participating in Concrete Canoe provided her with an intimate experience that allowed her to do work and get credit for the class, while having the opportunity to compete with other schools. Interestingly, she mentioned that this year more women are involved in the program than men. Another woman explained how being a member of ASCE has been a great resource for getting to know and develop relationships with faculty.

Another student explained that she has been unable to participate in an internship or Engineers Without Borders because she is a parent, “Students with kids can’t part icipate in some of these [programs].” Two students who commute to Seattle and UW talked about how this frequently prevents them from participating in extracurricular activities that they are interested in, such as Engineers without Borders, Steel Bridge, and Concrete Canoe, because of when they are scheduled.

CEE undergraduates indicated that it would be helpful if the organizations were more integrated and involved with one another, possibly under the ASCE umbrella. They explained that officers in ASCE seem to benefit the most from the organization, and that as non-officers, they do not have much of a sense of what the organization does. They did, however, men tion that the Luncheon Learners put on by ASCE were very useful, and that the advice offered by industry professionals, such as important classes to take, provided valuable information.

Students described the undergraduate advisor as "good" and said that it would be great to meet with her one-on-one every quarter. However, they said that her calendar is packed, and she is overloaded with work. As a result, she is unable to help as many people as she would like. Students suggested that it would be helpful to have more than one advisor for the department.

Students in the group offered a few different suggestions related to integrating career preparation and professional development into their program. For example, students expressed a desire to have a paid co-op program that is available during the school year and that is geared towards CEE students. They hope that such a co-op would not require extending their program and paying for another year of school. They also wanted to have increased access to practical and applicable information for the workplace, such as how to dress and the kinds of things they would be expected to do on the job.

CoE survey results regarding Student Interactions and Supports.

In regards to student interactions, URM students were less likely to report that other students take their comments and suggestions seriously and are less likely to take advantage of disability services and more likely to participate in minority student programs. First-generation college students are more likely to participate in mentoring programs, co-op programs, and minority student programs. Military/veteran students are less likely to report that students help each other succeed in class while first-generation college students are more likely to perceive that students compete with each other in classes. Pell eligible students are less satisfied with job placement help and more likely to be involved with student study groups and participate in co-op programs. Women are less likely to participate in student government. Transfer students are less likely to participate in internships, volunteer work, or intramural athletics and are less satisfied with the size of classes, study centers, and job placement help. Students from large majors are less likely to report satisfaction with the size of classes.

Student Perceptions of their Major

When asked how they decided to major in Civil and Environmental Engineering at UW, two female students pointed to their interest in the environment. One of them also mentioned an interest in oceanography and that UW is strong in both. Another woman explained, "I wanted to build really big things." One transfer student indicated that her experience in CEE at UW has been very positive, and that she would like to continue. "UW, couldn't be happier. I want to do grad school here." A Latino transfer student explained that family and salary potential were big influences on his decision to major in CEE.

Students described various kinds of activities and programs they did in high school and community college that helped prepare them for their program. A Latino male explained that participating in Running Start in high school helped prepare him. He also mentioned that his coursework and his participation in the physics club in community college both helped. Through the physics club, he had access to the lab and could do various experiments.

Another student who started in community college before entering a four-year program described that she had various mentors along the way who helped her "[bridge] the gap between community college and college," one of whom she met through a class. She explained that it was a for credit class where students could prepare for the demands of engineering - all engineering. Students could qualify for this program, which came with a scholarship, for all their time at the school as long as they met course requirements. Students learned ho w to qualify for scholarships and maintain their GPA. The program also offered industry talks and graduate school preparation. She described this experience as a "huge force behind my success in engineering." She went on to explain how critical it was for transfer students because they often feel left out because they don't have certain relationships. "So they helped us bridge the gap."

Another female CEE student mentioned that participating in Concrete Canoe gave her confidence in her major. She went on to explain that the engineering advisors in the CoE's Student Academic Services also helped her by talking to her about various options.

CoE survey results regarding Student Perceptions of their Major.

Undergraduate survey results for all engineering students: URM students are more likely to report that they expect to complete their degree in the declared or expected major. Female students are more likely to feel pressure from parents to choose their major. Transfer students are more likely to agree that they have no desire to declare a different major, and less likely to feel pressure from parents to declare their major. Military/veteran students are more likely to agree that they have no desire to declare a different major, and less likely to feel pressure from parents to declare their major. They are more likely to report that they expect to complete their degree in the declared or expected major.

Next Steps

The quantitative and qualitative data findings suggest a series of recommendations to improve undergraduate student recruitment as well as the overall climate and the student experience for underrepresented and all students in Civil and Environmental Engineering. The next step after reviewing this report is to determine which actions are the most feasible and of the departmental priority to undertake. An effective strategy to identify the actions to take would be to bring department stakeholders together and discuss departmental priorities and actions that may be fairly simple to implement. CWD can help facilitate this action plan development in your department and help CEE complete worksheets to move forward.

On the following page is an "Undergraduate Student Diversity Action Plan Worksheet" that can be used to think about how to effectively and realistically begin to take action in a meaningful way. The "Recommended Actions" section above provided names of resources that can be leveraged for efficiency. CWD also has many years of experience in running student programs and evaluating the effectiveness and success of such programs, believing in using research to better inform practice. Through its work with units at UW and beyond, CWD can help CEE implement these actions by providing technical assistance, making introductions to key organizations, and monitoring the outcomes of initiatives undertaken.

Undergraduate Student Diversity Action Plan Worksheet Winter 2013

(Please use a separate sheet for each activity pursued.)

1. **What action that addresses gender equity and/or diversity will you undertake?**

2. **What does the department hope to achieve by pursuing this specific activity?**

3. **How will you know you've been successful? How will success of this activity be measured?**

4. **Who is responsible for the day-to-day implementation?**

5. **Who will oversee the implementation of the action?**

6. **What resources and assistance are needed to conduct this activity? (e.g. staff members, faculty, department chair, CWD, campus partners, budget, other partnerships, etc.)**

7. **What is the timeline for successfully accomplishing this activity? What steps need to be accomplished at various points in the academic year?**

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