CHEMICAL ENGINEERING DEPARTMENT
IRA A. FULTON COLLEGE OF ENGINEERING AND TECHNOLOGY
BRIGHAM YOUNG UNIVERSITY

Faculty Development Plan

NAME
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The following is my Faculty Development Plan (FDP), intended to provide a self-assessment and set of goals for me as a new faculty member. This FDP will also facilitate communication between me, my faculty mentor (Tommy Knotts) and my department chair (Tom Fletcher) in addition to satisfying a requirement for the Faculty Development Seminar.

The plan is organized into three sections: Teaching, Scholarship and Citizenship. Each section begins with a brief statement of my vision of what I hope to become in the years that follow. I then provide (a) a self assessment of where I am in relation to that vision, (b) specific goals and plans to successfully achieve my vision, (c) an analysis of how my goals fit in the context of University and Department goals, (d) resources necessary to achieve those goals and (e) current progress and metrics by which success may be judged.

TEACHING

I want to become an excellent teacher, who contributes to the rigor, intellectual diversity and spiritually strengthening culture of the Chemical Engineering Department. Additionally, I want to encourage students to learn and pursue excellence in all aspects of their life by being an example, by earning their respect through thoughtful and caring interactions, and by developing quality mentoring relationships with as many students as circumstances will allow.

SELF ASSESSMENT

As a new assistant professor, I am unproven as a teacher, but I am not unprepared. I bring with me rigorous technical training from my PhD and postdoctoral studies, experience mentoring graduate and undergraduate students, teaching experience as a graduate student and postdoc, and years of church service and parenting. I anticipate that my strengths will be my organizational skills, work ethic and my ability to simply explain complex technical topics. In addition to being inexperienced, my weaknesses include a penchant for excessive mathematics and rigor, and a lack of experience with many "practical engineering" topics that are particularly appealing to some students.

GOALS AND PLANS

1. **Continuously Improve My Teaching in Assigned Courses** Thanks to the efforts of the department chair and the contributions of senior faculty, I anticipate teaching the same courses (ChEn 374 and ChEn 263) for at least 3 years. Additionally, I will teach a seminar class (ChEn 191, 391 or 691) in either Fall or Winter each year after my first. I have the following plans to continuously improve my teaching:

   a) Discuss my teaching evaluations with my faculty mentor (Tommy Knotts) and department chair.

   b) Invite at least one faculty member in addition to my mentor, to observe and critique either my course materials or my in-class teaching.

   c) Use teaching evaluations, the departmental course assessment process, colleague feedback and personal insights to make specific goals to improve course materials and/or my teaching techniques each semester to address instructor or course weaknesses.

   d) Document these goals and changes according to current Department practices.

   e) As needed, suggest updates to the curriculum/learning outcomes to the Chemical Engineering Undergraduate Committee.

2. **Teaching a graduate course in my area of specialty.** In addition to my previous course assignments, I am interested in teaching (or developing if necessary) a graduate course in my area of specialty. Courses of interest include: equilibrium or non-equilibrium statistical mechanics, polymer/colloid physics, and mathematical methods for chemical engineers. Courses on molecular modeling and polymer science currently exist in the department curriculum. To accomplish my goal, I plan to do the following:

   a) Discuss program needs with the Chemical Engineering Graduate Committee, my Department Chair (Tom Fletcher) and the current instructors of the molecular modeling and polymer science courses.

   b) Assess student interest through surveys.

    c) Research courses offered by other departments on campus.

    d) Obtain materials from colleagues at other institutions who have taught similar courses.

    e) Choose a course and develop a syllabus, schedule, lectures, etc.

3. **Develop mentoring relationships with students that are spiritually strengthening.** Finally, in order to develop mentoring relationships with students and provide a faith-building atmosphere, I will:

    a) Begin each class with a prayer.

    b) Prepare (or ask a student to prepare) a brief (2-3 min) spiritual thought to share on Fridays at the beginning of class (right after homework is due).

    c) Have a lunch-time office hour once per week with students in a common area (e.g. step-down lounge).

UNIVERSITY AND DEPARTMENT

The goals and plans outlined above fit well with the Department and University's needs and aspirations. The University aims to provide an education that is spiritually strengthening, intellectually enlarging, character building and leads to lifelong learning and service. The Chemical Engineering Department supports that mission by seeking to prepare students for lives of scholarship, service and contribution to society. The teaching goals outlined above will develop and improve courses that provide an intellectually stimulating and faith-building experience for students, and give them technical and problem-solving skills to help them contribute to society in the church, their families and their chosen fields. Additionally, the plan outlined above integrates with the extensive course assessment procedure established in the Chemical Engineering department.

RESOURCES

The resources I will need to accomplish these goals will consist of existing University facilities, teaching assistants and the time and feedback of colleagues.

PROGRESS AND METRICS

My long term ambition of becoming an excellent, rigorous, well-liked teacher is difficult to measure; indeed it is likely too subjective to truly capture. One standard by which all teaching is measured at BYU are teaching evaluations, which will certainly provide important feedback, and is incorporated into the goals above. Supplementary to this is the Chemical Engineering Department's course assessment procedure mentioned above. Finally, I have tried to break down my overall vision into five concrete goals and specific plans to achieve those goals. Since all of my plans are specific, my progress towards these goals can be directly measured. For instance, to date, I have finished parts (a)–(d) of goal 1 (Teach ChEn 374) and several others are in progress.

SCHOLARSHIP

My overall goal for scholarship is to develop a world-class research group studying the theory of soft matter and complex fluids. To me, being "world-class" means obtaining external funding by federal and private organizations, producing research that appears in high-caliber journals and at national conferences, and generating output with sufficient quantity and quality to gain an international reputation for excellence.

SELF ASSESSMENT

I have been fortunate to train with excellent scientists and mentors as a PhD student and as a postdoc, and therefore have had the opportunity to write journal articles, give talks at national conferences, advise undergraduate and graduate students and participate in the grant-writing and peer-review processes. What I have not done is demonstrate that I can independently generate new scientific directions and secure external funding for those ideas. Clearly, this must take place for me to develop a world-class research group. Additionally, as a young scientist, I do not yet have a large network of collaborators or an established reputation of producing excellent work.

GOALS AND PLANS

The following are my goals and plans for scholarship. These goals reflect what I hope to accomplish over the next several years (approximately by the time I reach the six-year review).

1. **Take on and support at least one new graduate student every year.** To achieve the necessary quality and quantity of output, maintain group continuity, and support the department's graduate programs, I will need to take on approximately one new graduate student every year. With an average time to graduation of around 4 years (depending on individual variation and the mix of PhD and Master's degree students), this will likely result in a group with about 4-6 graduate students. Funding to support this many students will be approximately $300 K/year, which requires 1-2 funded grants per year. Obtaining this funding is not a small task, and will require that I actively write proposals and seek for funding from industry.

   Therefore, to achieve this goal, my plans are to:
   - Write three proposals a year.
   - Seek for additional opportunities for funding from industry and other universities.

2. **Regularly present and publish research in quality venues.** Regularly presenting and publishing research is essential to both scholarly contribution and to student development and learning. With this goal in mind, my plans are to:
   - Personally present research at two or more national conferences a year

- Publish approximately one journal article per year per graduate student
- Support students presenting their work at national conferences.
- Write publications or proposals or do research every day.
- Maintain research momentum during the academic year by focusing on serially accomplishing research tasks with specific, self-imposed deadlines.

3. **Establish an undergraduate software development team.** BYU places an emphasis on involving undergraduate students in the research process. This is a challenge because many undergraduates have yet to encounter key principles in the curriculum or develop technical skills important for research. Indeed, at many institutions, undergraduate students are largely exploited to perform menial tasks, and most are not even marginally productive until they are juniors or seniors, when they understand enough to make a significant contribution. Therefore, making effective use of undergraduate students in research often requires an innovative approach. My idea for using undergraduates to contribute to research in a theory and computation group is to create an undergraduate software development team.

Developing scientific software is difficult and time consuming, but developing new methods and scientific software is often key for making truly novel contributions to the field. Indeed, some of the best soft matter research groups in the world maintain a competitive advantage by developing and maintaining unique software tools. This is a challenge for even the best-funded institutions because programming is not a core topic in chemical engineering, and many new graduate students are novice programmers. As such, software development often consumes years of time for graduate students and is frequently off-loaded to postdocs or staff-scientists.

Three key facts make it conceivable for a team of undergraduates to take on this significant research task. First, there are many bright BYU students who are interested in programming, and since an introduction to programming occurs early in the curriculum of many disciplines, *these students are already at the same skill-level (or better) as a first-year engineering graduate student.* Second, software development can be divided into higher-level design tasks (picking the numerical method, laying out the overall structure of the code) and lower-level tasks like coding, testing and creating documentation. The former skills are beyond the typical undergraduate, but the latter are certainly possible for a motivated student. Finally, recent programming paradigms have shifted to support distributed development and object-oriented programming, where development tasks can be divided much more easily, so that many people can make small contributions.

As such, I believe it could be highly-effective to create an undergraduate software development team to aid in the creation of scientific software. The benefits for the undergraduate researcher are clear. He or she would gain valuable research experience, paid employment (for some students), technical skills relevant for an increasingly tech-driven job market, and opportunities to work closely with a faculty mentor. The team also has the potential

to transform the research group by providing unique tools with broader scientific (and possibly commercial) value, a pipeline for training potential graduate students, well-tested and documented code (a big problem in science) and increased research efficiency as time-consuming programming tasks are re-directed away from graduate students and faculty. The main challenge will be the logistics of managing the group. However, note that while I will be responsible for methods and software design, it is likely that without postdocs or staff-scientists much of the programming burden would otherwise fall upon me.

Accordingly, my plan in this area is to:

- Maintain a team of 5-10 undergraduates interested in numerical methods and programming.
- Provide theory, design, directional support and management of the team.
- Establish a group hierarchy where graduate students or more experienced students can supervise less experienced students.

University and Department

The above goals are in alignment with the mission of the University and meet or exceed college and department expectations. For instance, the standards for Rank and Status advancement in the Chemical Engineering department states that the expectation for group size, publications and funding is: 3 PhD equivalent students, 3 publications per year and about $200 K/year in research expenditures. My goals are modestly above the department expectations for rank advancement. Furthermore, my goals are in line with the Chemical Engineering's "Department Ambition Statement", Priority 4 which states that the department is seeking to "enhance the reputation and visibility of our graduate program through increased publicity, increased levels of 'high-impact' funding and enhanced professional skill development and training."

Resources

The department has provided me with start-up funds for one PhD student for each of my first two years, funds for capital equipment and supplies and relief from teaching in the Spring during my first 2-3 years. These are invaluable for my goals of supporting a research group. I also have some additional funds from the department, college and from President Worthen's "Inspiring Learning" initiative to use for travel and for my undergraduate development team. I will also rely on the support, encouragement, feedback and advice from my colleagues as I try to navigate the startup process. My two biggest concerns in terms of resources are: (i) providing support for my first graduate student should I fail to secure funding by the Fall of 2018 and (ii) recruiting talented and motivated students.

As was the case with the Teaching section, I have tried to be specific in my goals and plans so that my progress can be easily measured.

CITIZENSHIP

I want to be an loyal and friendly colleague, a dependable asset to my department, an active citizen in the scientific community and someone who enhances the standing and reputation of the University and my department.

SELF ASSESSMENT

As is the case with teaching and scholarship, I am a new faculty member, so my main weaknesses are my lack of experience and reputation. However, I am dependable and sociable, and I believe I have a good sense of how I can begin to contribute.

GOALS AND PLANS

These goals reflect what I hope to accomplish over the next several years (approximately by the time I reach the six-year review).

1. **Be an active reviewer on journals and proposals.** In the long term, this means I will:
   - Review about 5 papers a year.
   - Review proposals when invited.

2. **Be involved in national professional organizations.** In my field, the relevant organizations are the American Institute of Chemical Engineers (AICHE) and the American Physical Society (APS). In the next few years, I would like to:
   - Become a session organizer for either AICHE or APS.

3. **Establish internal and external collaborations.** Collaborations are key to participating in academic discourse, securing funding, contributing to BYU's reputation, growing my network, and helping students find jobs. My goals in this are are to:
   - Maintain at least one active collaboration with another professor at BYU.
   - Maintain at least one active collaboration with an academic outside of BYU.

4. **Participate in graduate committee assignments.** My current committee assignment is to the graduate committee, so I plan to complete my assignments as needed. I am particularly interesting in helping grow the size of the graduate class commensurate to the increase of the number of faculty in the department.

5. **Attend devotionals, faculty retreats and the University Conference.**

6. **Participate in meaningful outreach activities.** I am particularly interested in exploring novel types of outreach activities enabled by the internet. One potential goal is the creation of a science podcast focused on soft materials, which are a commonly encountered in daily life.

UNIVERSITY AND DEPARTMENT

All of my goals described above are in concordance with the mission of the University and with the standards set by the Chemical Engineering department. Indeed, with the exception of my somewhat unorthodox idea of creating a podcast, all of goals I have described are typical of a new faculty member in engineering or the sciences at BYU.

RESOURCES

Most of the above goals require few resources, beyond my time to talk and engage with others, or to attend meetings. A few of the above goals require me to attend national conferences, funds for which have been given to me as part of my startup package. Creating a podcast will require minimal funds (basic recording equipment can be purchased for under $100).

PROGRESS AND METRICS

The previously stated goals are specific, and in most cases, easily measurable.

CONCLUSION

These goals and aspirations detailed above represent a high bar, and while I will hopefully achieve much of what I have outlined above, previous experience tells me that I will not be successful in all of my goals. However, rather than outline only the goals I feel I could safely accomplish, I have opted to provide a comprehensive list of the rosiest possible scenario. I have done so in an effort to strive for excellence, and as an exercise to think creatively about how I might have an impact in the next few months and years. I have also opted for over-ambition in an attempt to be transparent with my Department Chair about the directions I hope to go in the years to come.

One down-side of the comprehensive approach is that it may not adequately reveal my sense of priorities. So, to be explicit, my professional priorities (in addition to my personal, family and church priorities) are to (1) successfully teach my assigned courses, (2) recruit students and produce research results and (3) produce a steady stream of quality grant proposals to secure funding. All of the other goals are ancillary.