R1 UNIVERSITY N
University Letterhead Here

Department of Bioengineering
Address 1
Address 2
R1 University K
Location, USA 00000

Marty McFly, Ph.D.
R1 University N
Brown Lab, Pharmaceutical Chemistry
Address
Location, USA 00000
Lab: 000-000-0000
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11/9/2017

Dear R1 University K (RUK) Bioengineering search committee chair,

I am writing to apply for the assistant professor positions at RUK Bioengineering. I am currently a ***postdoctoral fellow working with Prof. Emmett Brown*** in the Department of Pharmaceutical Chemistry at the R1 University N (RUN). My research focuses on ***tissue engineering models that self-organize on the milli-to-small length-scales*** for studying tissue mechanics, collective cell dynamics, and disease a. I would contribute a quantitative biology research program that is strongly complementary to your department, enabling highly collaborative forward-engineering approaches to reconstructing developmental processes.

Developmental transitions involve large-scale coordination of cellular self-organization and tissue-scale folding mediated by complex cell-cell and cell-matrix interactions. Current loss-of-function approaches are limited in scope, despite identifying signaling and micro-environmental factors crucial to such transitions***. I believe that a systems-level understanding of tissues will come through reconstituting them from scratch by bringing developmental principles under engineering control.*** I will pursue this goal by developing high-throughput synthetic tissue fabrication and imaging methods to study cell type c streaming and self-organization, and structure A. These research interests directly impact the understanding of human disease, since around a third of all congenital birth defects and several forms of disease A are derived from cell type c, while dysregulation of cellular organization in the structure A is a hallmark of hyperplasia and autoimmune disorders.

While a ***Lorraine Baines postdoctoral fellow*** in Prof. Brown's lab, I contributed to two innovative engineering approaches to building synthetic tissues with spatially controlled cellular and extracellular compositions at the milli-scale. My work to image and analyze dynamic growth and spatial organization of arrays of thousands of mammary cell type a milli-tissues at single-cell resolution resulted in a second-author publication in *Nature Methods*. Further, I spearheaded an approach to encode tissue curvature and extracellular anisotropy using the intrinsic contractility of cell type b networks (one patent application and one manuscript currently submitted; six invited or conference oral presentations). ***This work is a fundamental step towards building tissues within a new paradigm, where small-scale tissues are built hierarchically from the bottom-up by understanding and engineering cellular interactions at the milli-scale.***

My lab will drive engineering advances in tissue engineering, focusing on the production of ***large-scale libraries of compositionally and spatially-controlled scaffolds that we call "ABCs".*** These ABCs will be built using developmental principles to encode tissue-scale properties including principle A, principle B, and principle C. These efforts will require significant engineering innovation, drawing on a diverse set of disciplines including microfluidics, chemical biology, tissue and cellular engineering.

In parallel, our lab will study and employ intrinsic cellular actuation strategies such as constitutive, microenvironment- and light-responsive cellular contractility to create dynamic tissue scaffolds that mimic specific developmental transitions using cell materials from chicken embryos and differentiated human stem cells. We will then elucidate the sufficient conditions for these transitions, and explore their robustness to structural and compositional perturbations consistent with congenital defects and disease A by building libraries of ABC variants and analyzing their dynamics over time using live imaging and computational modeling. This cross-cutting approach to experimental developmental biology would benefit from close research collaborations at RUK including with name, name, name, name, and name in understanding niche construction in cell type c, imaging and quantifying signaling states in synthetic tissue ABCs, and in modeling ABC structure-function relationships.

At R1 University S (RUS) as a graduate student researcher working with Prof. Jennifer Parker, together with Pa Peabody at RUS and Linda McFly at R1 University T, I led the development of analytical tools for protein immunoblotting at the microscale for applications from protein biophysics to clinical diagnostics. These efforts, with support from a Biff Tannen fellowship, allowed me to contribute ***five first-author publications in journals such as Nature Methods, PNAS and JACS***, one granted patent (3 other applications in progress), and six oral conference presentations. Towards the end of my degree, I focused my research towards single-cell analysis, culminating in a first- in-kind report of massively parallel ***single-cell protein analysis*** to dissect signaling states in neural stem cells to a sensitivity limit of <30,000 protein molecules per cell. These efforts enabled insights into the proteomic state of cells with a specificity that exceeds that of the current state of the art, including flow cytometric methods, and subsequently contributed to an NIH R01 award to Prof. Parker and a startup company recently acquired by Company A.

In addition to my research, I developed my aptitude for the application of engineering principles to biological systems by participating as a student in the ***2015 Course Title Here***, and through positions as a graduate student instructor and guest lecturer in bioengineering courses at R1 University S. Here, I had the opportunity to experiment with and shape my own approach to collaborative and interactive learning. During my undergraduate engineering education in Location Y I was influenced by the indigenous Group Y concept of ***"concept here" (sharing knowledge face -to -face) between collaborators, teachers, mentees, and the wider community*** to bring technology to the fore in an effective and culturally inclusive way. This principle has guided my interactions with 10 mentees at RUS and RUN; and I believe was instrumental in being chosen by the Subject A course directors as the Society of Subject A scholar that year. I also put this spirit of service into practice as an admissions committee member for RUS Bioengineering, and as a ***tutor through the Teaching College Project*** (a 2016 National Award Winning recipient), meeting with and tutoring students face-to-face at Location Z. I intend to further develop my commitment to inclusive, face-to-face instruction in developing a strong teaching and mentorship style that serves RUK's diverse students.

I believe that my research group would directly complement RUK Bioengineering's inter-disciplinary, quantitative biology focus, by integrating microfabrication with an understanding of biological and physical phenomena at small length-scales to engineer biomimetic tissue systems that uncover developmental principles. My research will provide significant opportunities to directly test hypotheses in tissue organization and robustness as relevant to human disease As and congenital disorders.

Sincerely,

Marty McFly

Marty McFly, Ph.D.

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Location, USA 00000

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Cell: 000-000-0000
E-mail: marty.mcfly@email.edu

Education

R1 University S — May 2014

Ph.D. Bioengineering
Thesis: Title here

University of Anywhere, Location Y — May 2009

B.E.(Honors 1st class), Chemical & Materials Engineering
B.Sc., Pharmacology

Research Experience

Postdoctoral Researcher, R1 University N — 2014–Present

Department of Pharmaceutical Chemistry
Advisor: Emmett Brown

- Bringing developmental principles to engineered tissues. Tissue properties encoded at small-scale using cell traction networks to study systems-level cell and microenvironment interactions.
- Developed live confocal imaging to quantify proliferation and spatial position of cells in 1000's of human cell type A-microtissues, an occult disease B model.

This work resulted in one publication in Journal X and one submitted manuscript, and was funded through a Lorraine Baines postdoctoral fellowship.

Graduate Student, R1 University S — 2009–2014

Department of Bioengineering
Advisor: Jennifer Parker

- Developed microscale protein analysis technologies to measure protein expression profiles of 1000's of single cells, clinically relevant fluid samples, and fluorescent protein biophysics.

This work resulted in 7 publications in Journal X, Journal Y, and Journal Z, and was funded through a Biff Tannen fellowship.

Fellowships

Lorraine Baines Medical Research Postdoc. Fellowship, $XXX,XXX — 2016–2019
Clocktower Scholarship, $XX,XXX — 2013–2014
Biff Tannen Fellowship, $XXX,XXX — 2010–2013

Other postdoctoral fellowships awarded (declined): Award 1, Award 2, Award 3.

Honors and Awards

Society of General Subject A scholar, Organization A — 2015
Travel Award, American Society for Subject B — 2015
Travel Award, Subject C Society — 2012
Dave McFly Memorial Prize, University of Anywhere — 2007
Dean's undergraduate honors list (top 5% of students), University of Anywhere — 2004–2007

Publications

In Print

1. Name, name, McFly, M., name, name, name, name, name, name, Brown, E. (2016) Title here. Nat. Methods.
    - Most read article in Nature Methods, September 2016. Featured in R1 University Q Review, C&EN, and Nature Materials.
2. McFly, M., name, name, name, Peabody, P., Parker, J. (2015) Title here. Nat. Methods.
    - Most read article in Nature Methods, June–July 2015. Featured in Journal 1, Journal 2, and Journal 3.
3. name, McFly, M., Parker, J. (2014) Title here. Anal. Chem.
4. McFly, M., Parker, J. (2013) Title here. PNAS.
5. McFly, M., name, McFly, L., Parker, J. (2013) Title here. PNAS.
6. McFly, M., name, Parker, J. (2013) Title here. JACS.
7. name, name, McFly, M., Parker, J. (2012) Title here. Anal. Chem.
8. McFly, M., Parker, J. (2011) Title here. Anal. Chem.

Submitted

1. McFly, M., name, name, name, name, Brown, E. (2017) Title here. Science.

Patents

Granted

Parker, J., McFly, M. (2013) Title here. US, granted 8/18/2016.

Applications at RUN

McFly, M., Brown, E. (2017) Title here. # and #.

Applications at RUS

McFly, M., Parker, J. (2014) Title here. #.

McFly, M., name, Parker, J. (2013) Title here. #.

McFly, M., Parker, J. (2012) Title here. #.

Presentations

Upcoming Talks

1. McFly, M., name, name, name, name, Brown, E. (2017) Title here. American Society for Subject B Meeting, Location, USA.

2. McFly, M., name, name, name, name, Brown, E. (2017) Title here. Organization B Meeting, Location, USA.

Invited Talks

1. McFly, M., Brown, E. Panel Speaker, Workshop title here, Location, USA, March 2017.

2. McFly, M., Brown, E. Title here. RUN Center for Subject D Monthly Meeting, Jan 2016.

3. McFly, M., Parker, J. Title here, RUS, April 2013.

Talks

1. McFly, M., name, name, name, name, Brown, E. (2017) Title here. Subject E Meeting, Location, USA.

2. McFly, M., name, name, name, name, Brown, E. (2017) Title here. Organization C Meeting, Location, USA.

3. McFly, M., name, name, Peabody, P., Parker, J.* (2014) Title here. Organization D, Location. *Speaker.

4. McFly, M., name, name, name, Peabody, P., Parker, J. (2014) Title here. Organization E 2014, Location, USA.

5. McFly, M., Parker, J. (2013) Title here. Organization D, Location.

6. Name*, McFly, M., Brown, K., name, Parker, J. (2013) Title here. Subject E 2013, Location, USA. *Speaker.

7. McFly, M., Parker, J. (2012) Title here. Organization D, Location, USA.

8. McFly, M., Parker, J. (2011) Title here. Organization F, Location, USA.

9. McFly, M., Parker, J. (2011) Title here. Organization G National Meeting, Location, USA.

10. McFly, M., name, name, name. (2007) Title here. Organization H, Anywhere, Location Y.

Posters

1. McFly, M., name, name, name, name, name, name, Brown, E. (2018) Title here. Organization I, Location, USA.

2. McFly, M., name, name, Brown, E. (2015) Title here. Subject B Meeting, Location, USA.

3. McFly, M., Parker, J. (2013) Title here. Organization J, Location, USA.

4. McFly, M., Parker, J. (2012) Title here. Organization K, Location, USA.

5. name*, McFly, M., Parker, J. (2013) Title here. Organization L, Location, USA. *Presenter.

6. Name, McFly*, M., Parker, J. (2012) Title here. Organization M, Location, USA. *Presenter.

7. McFly, M., name, name*, name, and name. (2009) Title here. Organization N, Location, USA. *Presenter.

Courses

Subject A, Organization A, Location, USA	2015
Subject F, Location, USA	2013
Subject G, R1 University U, Location, USA	2012
Teaching Conference for First Time GSIs, RUS, Location, USA	2011
Marvin Berry: Presenting Data and Information, Location, USA	2011

Teaching

Guest Lecturer, RUS Bioengineering 2011, 2013

Courses: Course title here

Responsibilities: Developed and presented course material for lectures on A in microfluidic sensing and engineering prototyping to senior bioengineering undergraduate and graduate students.

Tutor, Teaching College Project, Location Z, USA 2013

Course: Course title here

Responsibilities: Tutoring and mentorship of students in course title here as a member of an independent, non-profit organization enabling education.

Graduate Student Instructor, RUS Bioengineering 2011

Course: Course title here

Responsibilities: Close mentorship of senior bioengineering students as they developed novel devices in partnership with clinical collaborators at RUN, grading and feedback on written assignments and oral presentations.

Mentorship

Goldie Wilson, RUN graduate student 2017
Current status: Graduate student, Brown Lab, RUN

Name, RUS rotation student 2017

Current status: Graduate student, Brown Lab, RUN

Name, RUN rotation student 2017
Current status: Graduate student, Red Lab, RUN

Name, RUS rotation student 2016
Current status: Graduate student, Brown Lab, RUN

Name, RUN rotation student 2016
Current status: Graduate student, GreenLab, RUN

Name, RUS research specialist 2014
Current status: Medical student, R1 University E

Name, RUS rotation student 2014
Current status: Graduate student, Blue Lab, RUS

Name, RUS rotation student 2013
Current status: Company B

Name, RUS rotation student 2012
Current status: Graduate student, Purple Lab, RUS

Name, RUS rotation student 2011
Current status: Researcher, Company C

Service

Ad Hoc Reviewer 2011–2017
Journal 1, 2, 3, 4

Admissions Committee Member 2013–2014
Department of Bioengineering, RUS

Mentor, K-12 Teaching partnership 2012
Parker Lab, RUS

Entrepreneurship

Co-founder, Company D, Location, USA 2016–Project Summary here

Founding Strategist, Company E, Location, USA 2013
Developed a business plan leveraging project A applications for the 2013 RUS Startup Competition. We advanced to the semi-finals.

Forward-engineering of development using tissue type a

Disease A and congenital disorders arise due to a breakdown in tissue function across multiple length-scales. Tissues are hierarchically organized, being built through sequential stages of development in which cellular and XYZ compositions are encoded in space. ***Yet tissue engineering models of disease are not currently built across multiple length-scales to mimic the shape, matrix composition, and cellular arrangement of tissues built by developmental processes.***

The Challenge: Bringing development under engineering control

Human disease operates in complex tissue contexts, where the spatial interaction of cells and XYZ is crucial to understanding the emergence of abnormal function. However, efforts to engineer tissues in the laboratory typically employ strategy A[1], strategy B[2], or strategy C[3,4]. These formats either ***lack the structural organization over multiple length-scales that is characteristic of tissues in vivo, or artificially impose it from the top-down***.

The ability to make developmentally- consistent tissue models at small scale would enable approaches to outstanding questions in human diseases such as disease A and disease B. For example: how are tissue-level cell migration events in process A sculpted and corralled by cell-cell and cell-matrix interactions? How is the stratified cellular organization in the tissue type b spatially encoded by morphogen gradients during embryonic folding of the tissue e lumen? It is crucial that in vitro tissue models capture the feedback of overall tissue shape and local composition on the behavior of individual cells in order to productively address these questions.

Approach: Tissue "ABC" models that mimic, or are sculpted by development.

Overall tissue shape and extracellular architecture are generated *in vivo* through developmental processes. Tissue shape emerges through the interplay between folding at millimeter scale and cell processes such as shape change, traction, and collective migration at millimeter scale. Building on a background in milli-scale quantitative biology innovation, ***my lab will build mesoscale tissue "ABCs" by driving tissue scaffolds through specific developmental transitions*** from the bottom up (Figs. 1,2). These ABCs will contain minimally sufficient sets of primary or engineered vertebrate cells that recapitulate subsequent tissue dynamics. In parallel efforts, we will adapt 2D and 3D tissue models for high-throughput screening efforts using precision tissue assembly techniques such as technique A[5], technique B[6], and technique C[4] to produce ***libraries of ABC variants that mimic a specific developmental stage***. We will study the impact of tissue structure on cell dynamics via engineering "handles" including cellular composition and matrix composition. 3D live imaging[7,8], computational modeling of tissue shape[7] and cell dynamics[9], and genetic perturbation methods including CRISPR/Cas9 will be our core techniques. This multi-faceted approach will provide diverse training opportunities while being firmly rooted in a quantitative, engineering-driven ethic.

Figure 1. Previous Research Highlights

Figure 2. Proposed Research Program

Preliminary Results: Autonomous tissue origamis show structure-function feedbacks.

My postdoctoral research focused on gaining control over the massive-scale reconstitution and analysis of tissues with defined composition across millimeter to small length -scales. We discovered that: 1) transformed cell type a manipulate the growth rates of normal neighboring cells in "occult" mammary tumors, by implementing single-cell tracking in live confocal imaging of thousands of synthetic millitissues[5]. ***2) ABCs consisting of networks of contractile cell type b in XYZ-mimetic collagen gels can be folded with quantitative control at the small-scale***[7]. Moreover, functional passenger cell types self-organized and responded dynamically to fold shapes. These results lay a foundation for building ABC models of human development and disease.

Proposed Research: Sufficient conditions for ABC genesis by forward-engineering.

Aim 1: Mapping cell type c migration stereotypes.

Background & Significance. Cell type Cs (CTCs) are an embryonic cell type d population that exhibits striking behavioral and phenotypic plasticity. A third of all congenital birth defects and several disease As including melanomas are CTC-derived. ***Developing a systems-level framework to understand and control CTC migration dynamics has fundamental importance to human health, but also in engineering strategies to build tissues hierarchically.*** CTCs delaminate from the tissue type c or d, undergo a process A mirroring those in human disease A, migrate collectively over long distances through the embryo and differentiate locally into diverse tissue structures including the bones and cartilage of the face. CTCs travel through embryonic mesoderm in various "migration stereotypes" such as 1, 2, or 3 with significant variation along the anterior-posterior axis. The multiscale collective migration of CTCs is guided by a complex set of XYZ and auto-, para-, and juxtacrine factors that modulate mechanisms including 1) strategy D, 2) strategy E, and 3) strategy F[9,10].

Figure 3. Mapping cell type c migration stereotypes

Rationale. Current loss-of -function and "cut and paste" embryology techniques are limited in their ability to reveal systems-level principles that govern encoding of CTC migration stereotypes. My lab will map CTC migration stereotypes by systematically manipulating 1) overall tissue geometry and 2) cell-cell and cell-matrix interactions in families of reconstituted 3D tissue ABCs (e.g. via the type and concentration of cells/XYZ components within the CTC migratory milieu), Fig. 3.

Design. We will build large families of ABCs from XYZ- mimetic gel substrates with precise cellular compositions and target 3D topologies using microfluidics technology. We will use established and emerging experimental techniques in developmental biology to extract chick embryo cell type c explants by dissection[11], or by flow cytometry on the basis of enhancer-fluorescent reporter constructs[12]. For larger-scale screens, we will derive human CTCs from pluripotent stem cells using established *in vitro* differentiation protocols[13].

Data analysis and interpretation. ABC shapes and CTC dynamics will be read out using live, high-content confocal imaging. We will use established migration metrics such as persistence and dispersion to associate ABCs with CTC migration stereotypes. Phase diagrams delineating transitions between stereotypes will complement Potts models of cell dynamics.

Impact. Mapping CTC migration stereotypes will yield an understanding of the robustness of CTCs to switching between stereotypes in the face of multiple and conflicting microenvironmental cues. Such a map would directly complement studies in ***comparative embryology, state switching in disease A process As***, and the development of new methods for ***building hierarchically organized tissues*** from scratch by guiding CTC-like cell types through migratory and local niche-construction phases.

Aim 2: Spatio-temporal coupling of tissue type d closure and cell type c delamination.

The timing of cell type c departure from the tissue type d relative to its closure is graded along the anterior-posterior axis[10,14]. A diffusionally patterned MNO signaling network regulates both the fold morphology of the tissue type c, as well as Wnt-1-dependent triggering of the cell type c process A[10,15]. Specifically, hook-like dorsolateral hinge points (DLHPs) emerge caudally during tissue type d closure, which radically changes the geometry of the dorsal aspect of the tissue type d. We will approach some fundamental questions here (Fig. 4): how robust is cell type c delamination to variation in the timing of tissue type d closure at a given spinal level? How does the local geometry of the tissue type d at the axis of closure influence the timing or subsequent stereotype of CTC migration? ***The coupling between the shape of folds and paracrine signaling gradients triggering cell type c delamination is not well understood, because loss-of-function experiment techniques cannot quantitatively explore a range of fold shapes and rates of tissue type d closure.*** We will dissect chick tissue type Cs with surrounding dorsal ectoderm and engineer their folding rates and closure profiles using a ABC scaffold underlay.

Figure 4.

Aim 3: Structure A stratification and sorting robustness.

The proliferative, stratified architecture of the structure A enables a remarkable continual turnover of the luminal epithelium[16]. Dysregulation of structure A shape and cellular architecture is a hallmark of disease A and autoimmune disorders of the tissue e. RST/MNO paracrine signaling between cell type e, cell type f, and underlying cell type d regulates fate restriction of stem cells to the base of structure As. This occurs both as a response to mass transfer gradients setup during progressive folding of the embryonic tissue e, but also in adult tissue homeostasis[16,17]. As in CTC migration, a juxtacrine ephrin/Eph "code" enforces cell sorting at the structure A base[16]. ***The coupling between the shape and composition of structure As has not been systematically studied, since methods to place defined cellular communities within specific 3D tissue niches are lacking.*** We will study the establishment and response of synthetic structure As built at the surface of shape- controlled ABCs by live imaging their colonization by sorted DEF+ stem cells from mouse mini-tissue e cultures[16] (Fig. 5). We will also systematically screen cellular compositions in the structure A using programmed cellular assembly methods to study the robustness of structure A homeostasis to perturbations consistent with injury or disease A hyperplasia.

Collaboration. I will lead a multi-disciplinary research group with a focus on quantitative biology approaches to developmental and disease dynamics. Our chemical biology, materials, and engineering-driven efforts would complement the quantitative biology strengths of the RUK environment. For example, my lab could work closely with those of name, name, name, name, and name in understanding niche construction in cell type c and tissue e, in molecular studies of cell type c gene expression and signaling states, in tailoring novel ABC biomaterial scaffolds, and in modeling ABC structure-function relationships.

Figure 5.

Funding. I will seek support for diverse tissue engineering, disease A, and developmental biology research program via government organizations including the NSF (BIO/MC, ENG/CBET), NIH (NCI, NIBIB, NICHD, NIDCR, NINDS, NIGMS; relevant study sections include BMBI, DBD, ICI, DEV2), DARPA (BTO, MTO), and the DOE (BER). I will also pursue funding opportunities from pharmaceutical companies, private foundations including the Burroughs-Wellcome Fund (preterm birth initiative) and non-profit organizations such as the March of Dimes and the American Disease A Society (research scholar and professor grants). Finally, I will aggressively pursue early career awards including the NIH New Innovator, NSF CAREER, Pew Biomedical Scholars, Searle Scholars, Beckman Young Investigator, the Packard Fellowship, and the Coulter Foundation Translational Research Award.

References

1. *Nat Meth* (2015)
2. *Stem Cell* (2016).
3. *Proceedings of the National Academy of Sciences* (2017).
4. *Science Advances* (2016).
5. *Nat Meth* (2017).
6. *of the National Academy of Sciences* **112,** 2287–2292 (2015).
7. McFly, M. *et al.* Title here. *Submitted* (2017).
8. *Science* (2003).
9. *J Cell Biol* (2017).
10. *Developmental Biology* (2013).
11. *Developmental Biology* (1975).
12. *Research* (2015).
13. *Am J Stem Cells* (2014).
14. *Annu. Rev. Neurosci.* (2015).
15. *Development* (2008).
16. *Cell* (2014).
17. *Cell* (2016).

Teaching statement

Guiding students through their intellectual development has been one of the most rewarding aspects of my academic career. I am committed to building a strong teaching aptitude under the overarching principle of "concept here" (sharing knowledge face-to-face), using a collaborative, experiential learning framework to guide students from diverse backgrounds.

Teaching through coursework

I am prepared to teach all core undergraduate and graduate courses and develop new electives, particularly in quantitative biology, tissue engineering, biomaterials, and biological transport phenomena. ***I have a strong academic background in undergraduate and graduate level chemical engineering, bioengineering, cell biology, and evolution coursework.*** I also have extensive and diverse teaching experiences.

As a guest lecturer at RUS, I developed and presented course material for lectures on biomolecular A in microfluidic sensing, and in engineering prototyping for clinical needs to senior bioengineering undergraduate and graduate students. As a graduate student instructor at RUS, I closely mentored senior bioengineering students in the capstone design course, developing their intuition for identifying needs, the engineering design cycle, rapid prototyping, and formal written and oral presentation techniques. This mentorship included three-hour, weekly meetings with design teams, in which I explained and simplified engineering concepts presented in lecturers, and adapted them to suit each team, whose engineering goals were disparate and whose team members spanned a highly diverse range of skillsets. ***This experience honed my approaches to guiding collaborative inquiry, where I led Socratic discussion to navigate complex engineering decision-making.*** This process began from gentle confrontation of approaches identified by the students, and ended by guiding discussions towards cohesive and inclusive identification of the most productive path forward for each team.

I envision developing integrative elective courses based on my research interests and background. Such courses would explore interfaces between microscale biological transport, biomolecular kinetics, non-linear biological dynamics, collective cell behavior, fundamentals in molecular and cell biology for engineers (including experimental techniques, design and data analysis), and quantitative computational methods. These electives would contain a mix of traditional lecturing and coursework supplemented with a survey of classic and current literature to demonstrate how these concepts are applied in research. For final projects, I will guide the exercise of writing small research grants on each student's topic of choice. Students could submit these grants as graduate fellowship applications to funding mechanisms such as the NSF-GRFP, NDSEG, or NIH-F31.

Teaching through research mentorship

Through 10 years of academic research experience, and formative training in communication across academic and cultural bounds in undergraduate courses in Location Y, I have been fortunate to experience many learning and mentoring styles. I have tested and integrated these experiences while closely mentoring 10 graduate students, mainly for semester-long rotation projects at RUS and RUN. Through these relationships, and by observing my own mentors, ***I have learned that enthusiasm and a balance between face-to-face advising and hands-off mentoring are the traits of a successful advisor and mentor.***

Independent pursuit is an important aspect of graduate level research, and I will encourage this in my lab by allowing students to develop their projects as their intellectual curiosity leads them, while providing guidance for research goals and experimental design. When necessary, I will also provide more active advising to ensure that students stay on track for meeting their requirements for PhD candidacy, thesis defense, and publication of their work in peer-reviewed journals.

The specialized nature of academic research also raises the issue of intellectual fragmentation of a research group. ***I will adopt several approaches to encourage cross-cutting, collaborative research within a unifying theme.*** First, my group's research aims will fall within forward-engineering of development from microns-to -millimeters. This theme will provide intellectual and experimental cohesion among group members. Within this larger vision, projects will be diverse, spanning the ranges of fundamental-to-applied, biotechnology-to-biomedical, and theoretical-to-experimental. This will offer trainees with many options to find a project that fits their unique interests and strengths, while also providing exposure to other areas for academic growth. Second, in guiding students as they mature in their PhD candidacy, I will encourage them to diversify risk by expanding their technical and conceptual skill sets. This will provide a balanced training experience that I believe will help prepare students for their future careers. Finally, I will encourage my students to attend and contribute to meetings with other labs that have overlapping research interests. This well expand the intellectual influences of my trainees and bolster opportunities for collaboration.

Broader Community

Academic professors are uniquely empowered to teach, learn, and mentor at multiple levels, from undergraduate and graduate students to postdoctoral fellows to those in the broader community. ***I strongly believe in the advancement and extension of educational opportunities beyond the bounds of traditional college settings.*** As a graduate student, I engaged face-to-face with students at Location Z as a tutor in the Teaching College Project, a 2016 National Award Winning organization enabling education. Here, I learned first- hand about the many social, geographical, and cultural barriers that cripple access of large segments of our broader community to educational opportunities. I hope to continue to engage with outreach programs throughout my career and also promote early interest in research, for example, through summer lab experiences and courses for high school students and teachers.