Theme Area: Integrative Quantitative Biology and Biodesign (IQB^2)

Research: 21st century biological research requires integrative approaches across all STEM disciplines. As a result, Integrative Quantitative Biology and Biodesign (IQB^2) is emerging as a new transformative field of life-science. IQB^2 aims to uncover fundamental design principles of biological systems and leverage these discoveries to engineer solutions to challenges associated with human health and global sustainability. Over the past decade, Rice has excelled in hiring IQB^2 faculty across eight departments in Engineering and Natural Sciences (BIOE, BIOS, CHEM, CHBE, CS, ECE, PHYS, STAT). This growth has established a network of IQB^2 researchers with complementary approaches across Rice campus with a potential to make Rice a global leader in this field.

Education: The Systems, Synthetic, and Physical Biology (SSPB) Ph.D. program was created in 2012 as a mechanism to leverage Rice's newfound strength in IQB^2. Google ranks SSPB highly when searching graduate programs in either synthetic (4th link), physical (1st link) or systems (18th link) biology. Our colleagues across the U.S. have consistently remarked that they view Rice as a leader in this area. SSPB-affiliated faculty have garnered support for targeted summer undergraduate (REU) and graduate (NRT) programs and are poised to develop additional innovative training programs, such as a professional masters and undergraduate minor/major.

Existing Strengths:

- Faculty collaborate across department boundaries and established a PhD program with innovative curriculum
- Critical mass of faculty across campus with potential to be competitive for training and programmatic grants
- Synergistic with existing centers and training programs (CTBP, Neuroengineering NRT, Bionetworks REU)
- Uniquely positioned within TMC to take leadership role, engage in synergistic collaborations, and leverage the technology innovation resources of the Texas Medical Center accelerator and JLabs
- IQB^2 is poised to grow connections with industries related to human health and sustainability
- IQB^2 is poised to connect with other areas and departments at Rice: materials and nano strengths at Rice (as occurs at MIT and Wyss Institute), Environmental and Earth science (efforts underway) and new data-science initiative
- Faculty benefit from a traditionally strong computing facilities at Rice and have been participating in K2I efforts to expand and upgrade these with NIH/NSF equipment/infrastructure proposals
- Top IQB^2 researchers regularly visit Rice for seminars
- Rice graduates at the BA/BS and Ph.D. levels are sought after by field leaders

Investments needed to achieve pre-eminence:

Simple investments	Moderate investments	Grand investments
1. Improve support for graduate student recruiting 2. Support training and center grant preparation and administration 3. Support education activities that yield visibility(e.g. IGEM) and infrastructure for summer programs 4. Establish matching funds for postdoctoral hiring 5. Productively connect faculty with development and technology transfer 6. Support and catalyze international connections, *e.g.*, visitor housing and funding strategic faculty travel	1. Establish transitional post-doc fellowship positions combining independent research and teaching 2. Hire new faculty in IQB^2 areas that are synergistic with existing faculty and bring national visibility 3. Build research (*e.g.*, IQB^2 foundry) and training (e.g. wet design kitchen) infrastructure 4. Provide competitive funding to catalyze interdepartmental collaborations 5. Cultivate vibrant microcosms for science and innovation by strategically locating IQB^2 faculty	1. Recruit several senior field leaders to Rice(NAS, HHMI-scholar level or rising stars) 2. Create an IQB^2 Institute with mission is to create new biological knowledge and to clinically/ commercially translate new bio-technologies (similar to Harvard's Wyss or UWs MSI) 3. Provide meaningful seed funding (raised by development) to support high-risk/high-payoff research directions by institute members 4. Endow graduate and post-doctoral scholarships to enable recruitment of the best scholars

Potential 2025 Impact

I. Internationally recognized institute that addresses rapidly evolving societal needs by creating new biological knowledge and transferring new biotechnologies to the clinic and industry with alacrity
II. Center and training grants as well as increased funding from industry/governmental agencies to support development and translation of fundamental knowledge and transformative technologies
III. Graduated students become thought leaders in academics and industry, enriching the alumni network
IV. Institute competes for the best scholars in the world (undergraduate, graduate, and post-doctoral)