



# COLLEGE OF SCIENCE & LIBERAL ARTS

## 2015 Strategic Plan



COLLEGE OF SCIENCE *and* LIBERAL ARTS

**CSLA Strategic Plan 2015-2020**  
**Missions of Excellence: Education, Research, and Service**

**I. Introduction**

The College of Science and Liberal Arts (CSLA) plays a crucial role in NJIT's development as a comprehensive research university and our goals have been constructed to align with 2020 Vision, NJIT's strategic plan for 2015-2020. CSLA is a diverse community of scientists, scholars, and artists united in a commitment to excellence. This commitment is evident in our three primary missions: education, research, and service. During the 2013-2014 academic year, CSLA had 677 students majoring in our undergraduate programs and 401 students in our graduate programs. 120 students received undergraduate degrees and 109 students received graduate degrees in CSLA programs. Our total research expenditures were just over \$10 million, 72% of our faculty published in peer-reviewed venues, and 52% of our faculty had external research support. As the central provider of NJIT's General University Requirements (GUR), CSLA was responsible for 79,116 undergraduate student credit hours, which is roughly 38% of the total student credit hours at NJIT. Our faculty and staff were extraordinarily active in department, college, university, professional, and community service, ranging from serving on the ethics review committee for a local hospital and acting as editor-in-chief of a scientific journal to chairing NJIT's Institutional Biosafety Committee and the faculty senate.

Over the next five years we aim to grow and diversify our student population, increase faculty research productivity, and continue to hone and innovate our GUR curriculum to

ensure all NJIT students develop the skills necessary to succeed. Faculty mentoring programs will be developed to assist faculty in developing skills to be even more successful in teaching, research, and scholarship. We will also increase CSLA's presence on campus, in the public sphere, and in the higher education community through increased communication and promotion of our students and faculty. By acting in concert with the university's goals and partnering with the other colleges, we aim for shared success in bringing 2020 Vision's goals to fruition and promoting NJIT as a higher education leader in New Jersey, the nation, and the world.

## **II. Faculty and Staff Development**

CSLA will focus on faculty development over the next five years in five research clusters: Life Sciences; Advanced Materials and Processes; Sustainability and Security; Data Science; and Science, Technology, and Society Interactions. These multidisciplinary clusters build on existing strengths within the college, align with university priorities, and will facilitate cross-department and cross-college collaborations to produce innovative research that will position us to provide opportunities for our students and faculty, create new knowledge to benefit society and our professions, and attract valuable external funding. We aim to translate key discoveries into practical applications, and support the development of an interdisciplinary-trained, globally adept, highly skilled workforce. These clusters are also in line with 2020 Vision's goal of multidisciplinary research (objective 3.3) and intersect with NJIT's university-wide research clusters in Life Science and Engineering; Sustainable Systems; Data Science

and Information Technology; Science, Technology, and Society Interactions; and Transdisciplinary Areas.

Faculty development will be supported through mentoring programs aimed at assisting junior faculty in their professional development from the time of arrival at NJIT through tenure and beyond. Senior mentors from within and outside of their home department will work with junior faculty while the college works with departments and the broader university community to develop mentoring programs and workshops. Efforts in faculty development will also include faculty at the associate professor level that have experienced a lapse in research and scholarship to re-engage them in a variety of ways to rejuvenate their research efforts. We understand that a diverse faculty enriches the college experience for students as well as fellow faculty. We are committed to ensuring that our faculty searches are conducted in a manner that maximizes a diverse applicant pool.

Life Sciences research and scholarship are infused in all CSLA departments: Biological Sciences; Mathematical Sciences (applied mathematics, biostatistics, and computational biology); Physics (biophysics), Chemistry and Environmental Science (biochemistry); Humanities (medical and bio-ethics); and History (history of life sciences and medicine). To expand and strengthen our expertise in the area of Life Sciences, we plan to hire 12 faculty members over the next five years.<sup>1</sup>

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<sup>1</sup> See Appendix C for a detailed list of these planned hires.

Advanced Materials and Processes directly involve three of our departments: Physics, Chemistry and Environmental Sciences, and Mathematical Sciences. Thirteen new faculty hires over the next five years will allow us to expand research and education in Advanced Materials and Processes, increase our expertise in instrumentation development, remote sensing, understanding materials properties and processes, optics, discovery of new materials, solar physics, and advanced computational modeling, as well as bolster our research capabilities and ability to compete in a number of emerging national priorities, including the Materials Genome Initiative.<sup>2</sup>

We anticipate the largest faculty increase in CSLA will occur in the area of Sustainability and Security with 20 new hires, some of which will overlap with the other thrust areas.<sup>3</sup> These hires will be distributed over our four science departments and include specialists in remote sensing, genomics and evolutionary community dynamics, solar and terrestrial physics, alternative energy, catalysis, environmental policy, water treatment, wave propagation, statistics and data analysis, optics, and biophysics.

Data science is a rapidly emerging field that cuts across academic programs, disciplines, and business markets. A number of faculty in the Department of Mathematical Sciences have been deeply engaged in data analytics, statistics, and modeling, and are active in multidisciplinary activities in this important field.

Researchers, such as those in the Center for Solar-Terrestrial Research and biological sciences, generate and process large volumes of experimental data and will benefit

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<sup>2</sup> See Appendix C for complete list of these planned hires.

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tremendously by advances in data science and data analytics. The college is poised to be a major contributor on campus in the realm of big data.

The liberal arts in CSLA feature scholars that examine the interactions between the sciences and our larger society. With 11 new faculty hires we will raise the prominence of these disciplines within CSLA and NJIT more generally, and continue to strengthen the area of Science, Technology, and Society Interactions. This research thrust will facilitate broad interdisciplinary research, scholarship, and educational programs involving faculty, students, and programs in the liberal arts and across NJIT's campus. These hires are needed to develop our degree programs in Law, Technology, and Culture; Science, Technology, and Society; History; and Communication and Media as well as provide faculty stewardship of the General University Requirements housed in our History and Humanities departments that impart skills employers indicate they most desire in the students they hire.<sup>4</sup>

CSLA's special role in relation to the General University Requirements also means that we have to increase our cadre of lecturers with ten new hires. Six new lecturers in Mathematical Sciences, three new lecturers in Chemistry and Environmental Science, and one in Physics will allow us to maintain consistent, high quality instruction to first year students, which will have positive impact not only on the students' education but on the university's retention efforts. These increases in instructional staff will allow us to help achieve 2020 Vision's strategic priorities 1 (Students) and 2 (Learning).

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<sup>4</sup> See Appendix C for complete list of these planned hires.

### **III. Students**

Student enrollment in CSLA programs increased 5% over the last five years from 984 in 2010 to 1031 in 2014. Our target enrollment for 2020 for all graduate and undergraduate programs is 1300, which will be a 26% increase from our current enrollment and a 32% increase over our 2010 enrollment. Our strategies for these increases will be outlined in sections IV and V below.

During the past five years women comprised 43% of our student population. Hispanic students have risen from 9% of our population in 2010 to 11% in 2014<sup>5</sup> while African American students represent 9% of our population.<sup>6</sup> We are pleased with our student diversity but recognize a continued need for outreach to traditionally underrepresented groups so that our college can enjoy the rich cultural benefits and educational opportunities that accompany a truly diverse population. CSLA will work with other NJIT entities, such as the Murray Women's Center and the EOP office, to develop and deploy strategies that will further our vision of a college that truly reflects our larger community.

### **IV. Graduate Degree Programs**

CSLA is home to six PhD programs and 14 master's degree programs. Two departments house two PhD programs: Physics (Applied Physics and Material Science and Engineering) and Chemistry and Environmental Science (Chemistry and

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<sup>5</sup> According to the 2010 US Census Hispanic and Latino people (the largest ethnic minority) make up 15% of the American population.

<sup>6</sup> According to the 2010 US Census Black Americans (the largest racial minority) make up 13% of the American population.

Environmental Science). Mathematical Sciences (Mathematical Sciences) and Biological Sciences (Biology) each offer one PhD program. All of our departments offer master's programs that together cover a wide range of fields.<sup>7</sup>

Our current graduate student body consists of 323 students across all programs. To reach our 2020 enrollment target we expect to have an increase of 81 students for a total of 404. Improved support for PhD students at the university level will help us attract high quality students. Working with the office of strategic communications we will increase promotional support for our master's programs that may appeal to working professionals and consider the development of additional master's programs, including Professional Science Masters (PSM) programs.

The Professional and Technical Communication (PTC) program was one of the first completely online degree programs at NJIT nearly twenty years ago. This program has great potential as an online program, but requires a curricular revision to both stay timely and appeal to a new class of student. The curriculum is currently being evaluated and the completely revised program should be ready to launch in September 2015. The program's new key areas will be in instructional and user experience design, corporate communications/social presence/outreach program management, and medical and pharmaceutical documentation. These new foci brings the PTC program in

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<sup>7</sup> Our master's programs are: Applied Mathematics, Applied Physics, Applied Statistics, Biology, Biostatistics, Chemistry, Environmental Science, Environmental and Sustainability Policy, History (MA), History (MAT), Mathematical and Computational Finance, Materials Science and Engineering, Pharmaceutical Chemistry, and Professional and Technical Communication.

line with today's needs and should appeal to individuals in technology startups as well as members of the more traditional industrial and pharmaceutical workforce.

Along with increased targets in already existing programs, CSLA plans to develop two new Professional Science Masters (PSM) degrees by 2020. The possibilities being explored include applied optics, mathematical and computational finance, and biotechnology. Unlike traditional masters degrees, PSM degree programs are designed with specific industry needs in mind. By developing graduate programs that have such an industry focus, we achieve two important goals. First, we fulfill NJIT's mission to serve the community by offering degrees that contribute directly to workforce development and regional economic development. Second, we develop programs that can attract new resources and students to CSLA and NJIT. PSM programs rely on students paying tuition rather than traditional programs that may rely on the use of TA or RA funds. The local private sector need for these programs along with the willingness of students and employers to pay for the value-added advanced training the programs offer will generate revenue that can be used to increase CSLA resources, increase our partnerships with industry, and provide increased opportunities for student internships and employment. These results will further the general research and educational missions of CSLA.

Our success at developing these graduate programs will be partly determined by our recruitment methods. We will employ at least three complementary strategies. First, we will pursue online strategies to target non-traditional students. Our first attempt at

this is being piloted in the PTC program: the program director is offering a free four week course on an open platform designed to introduce potential students to the program in a low risk manner. It is our hope that after completing the short course, participants will want to enroll in the degree program. Second, we will pursue business-facing strategies aimed at partnering with industry to offer select degree programs to their workforce. This strategy will feature our new PSM offerings, but, if successful, could expand to our more traditional programs. Third, we will continue and augment our current recruitment efforts toward traditional students with offers of better support through higher paying teaching assistantships and fellowships.

#### **V. Developing Undergraduate Majors**

Twelve major programs are spread out over our six academics departments. Our two most populous programs—Biology and Mathematical Sciences—are the only undergraduate programs in the departments of Biological Sciences and Mathematical Sciences, respectively. Physics (Applied Physics and Biophysics) and History (History and Law, Technology, and Culture) each offer two undergraduate programs. Chemistry and Environmental Science (Biochemistry, Chemistry, and Environmental Science) and Humanities (Communication and Media; Science, Technology and Society; Theatre Arts and Technology) each offer three programs. Our goals include program improvement through assessment, enhancing opportunities for student engagement, and increasing the number of graduates while exploring development of an additional undergraduate degree program.

There is no doubt that some of CSLA's major programs are popular with students: the major in biology alone accounts for over 44% of our students and mathematics is another 17%. Ten of our programs combined account for only 39% of our student body. These smaller programs have great potential and need to be developed and promoted so that they can achieve greater prominence both within NJIT and beyond our campus. Some of our programs, such as Applied Physics and Chemistry (those likely to be of interest to those that make up NJIT's traditional student body), will benefit from a stronger partnership with the admissions office to identify incoming students appropriate for those programs. Some of our other programs require more concentrated recruitment and promotional efforts, such as Law, Technology, and Culture; Science, Technology, and Society; and Environmental Science. We are currently developing new promotional material aimed at high school students and their parents designed to benefit all of our programs.

Law, Technology, and Culture has been on a steady incline over the last few years and we will undertake measures to maintain and increase that growth. First, we need to educate the Advising Success Center and admissions recruiters on the strengths and appeal of the program for incoming students. We will need to expand the pool of students that NJIT has traditionally drawn from, which will require effort on the part of the college and the admissions department. Second, we need to enhance our partnership with the Albert Dorman Honors College to present the major as a good fit for their students. We need to start marketing and thinking of ourselves as being a first

choice among students interested in the liberal arts, not merely for internal or external transfer students, but for first time students as well.

Science, Technology, and Society (STS) has lacked coherence as a program in recent years and, if we are to promote it, we will need to develop a strong mission and identity for the program. Similar programs are strong at our aspirational universities and STS should play a more prominent role at NJIT. We have a talented and motivated instructional staff for the program; we need to provide them a strong program that can be presented with a clear mission to students. One possibility is to target pre-health students that are looking for a more humanistic approach to a medical career.

With the increased societal recognition of climate influences and the need for sustainable systems, Environmental Science has great potential to increase the number of students in the program while responding to community and professional needs. There is plenty of room to grow this program and key hires are needed to put forth a clear programmatic mission and emphasis to distinguish it from programs at other universities.

Our overall goal for our undergraduate programs is to achieve 1,000 undergraduate students majoring in CSLA by 2020. This is an ambitious goal and represents an increase of 48% over our present student body.

## **VI. Pedagogical Innovation**

CSLA currently offers between 4% (~22) to 6% (~28) of our courses each academic year semester as online courses. One practical strategic goal is to increase the percentage of courses (student credit hours) taught as online courses to between 10% (~52) to 12% (~62) of our semester offerings. There are two main reasons for us to pursue this strategy. First, as NJIT's undergraduate population increases, the introduction of more online courses allows for increased scheduling flexibility for students and faculty. The development of Professional Science Masters degrees—degrees that target a population of people already in the workforce—will benefit from the increased flexibility. Second, the current generation of students increasingly enters college with prior online course experience and expectations. Online and converged learning can increase access to education for students that have competing interests for their time off campus such as part-time employment or internships.

Along with online courses, CSLA will commit to developing converged courses in which students have the choice of attending the lectures in person on campus or viewing and participating in the class via an online connection. While traditional online courses are asynchronous, converged classes are necessarily synchronous. Like other online courses, they increase flexibility for the students and allow a course to have a greater enrollment than might be available if it was held in a traditional face-to-face setting. The first converged course in CSLA was offered in the spring of 2015. CSLA commits to offering converged options in many of our most popular GUR courses by 2020.

Online and converged courses are not without their challenges and CSLA will commit to maintaining and increasing the quality of our digitally-enhanced courses by instituting a college-wide online education committee so that our experienced and successful online educators can oversee the implementation of new online courses to ensure that the courses meet CSLA standards and employ best practices. CSLA will work in concert with the university's instructional design staff to make sure our online offerings are at the forefront of creative, successful online education. We also recognize that to be successful additional university resources and incentives will be needed to train faculty in online instructional technology development and use and for the ongoing deployment of online and converged courses.

We are also committed to improving the instruction and curriculum of our first-year gateway courses that provide the mathematical and scientific foundation for all of NJIT's students. Success in these courses is not only important for our students but for the health of the university. As we strive to improve retention and graduation rates, we need to insure that we are setting our students up for early success from which they can build their academic career. We plan to undertake a comprehensive approach to our first-year courses along the lines of what is offered by programs like Gateways to Completion by the John N. Gardner Institute for Excellence in Undergraduate Education. We will implement a multi-year evidence-based plan to improve student success in those courses that have traditionally resulted in high failure rates with input from faculty, students, and other stakeholder groups. Our goal is to maximize the

likelihood of student success while retaining the high academic standards our courses and programs demand.

Our obligation to our students involves both humanistic as well as scientific education. Employers indicate that communication skills are one of their top priorities in recruiting college students. To ensure NJIT students are able to develop and hone these skills, we will continue to invest in our writing center and first year composition program. Both the center and program are run from our humanities department and we have recently invested in a new director for the writing center and a new faculty coordinator of first year writing. We are committed to providing courses that involve intensive practice of communication skills for each of the four years of a student's education through our GUR offerings.

### **VIII. Research Funding and Development Activities**

Research funding in CSLA totaled over \$10 million during the 2013-2014 academic year. With the recruitment of new faculty, faculty replacements, and more graduate students, our goal is to increase that funding to \$15 million by 2020. We will be aided in this goal by the appointment of a director of research for the college by the Office of Sponsored Research who will work closely with faculty to develop and submit proposals and identify opportunities for funding. Departments will be encouraged to establish target goals for proposal submission and external funding. CSLA is committed to help provide the support structure necessary to achieve these goals. Charts in Appendix A provide details of our department's research funding for the last academic year.

As a college we are also committed to pursuing multidisciplinary grants that engage faculty from across CSLA. There is intellectual and practical benefit to developing such proposals. A broad approach that engages researchers from across the college will require integrating problem-solving approaches from a variety of disciplines and result in projects that are likely to have wider societal impact. Such an approach also brings the college's departments closer together and helps forge a more definitive collegiate identity for CSLA. Such projects require support at the college level and we plan to task our new director of research with promoting and encouraging such projects with our faculty.

CSLA will also undertake a concerted effort to increase donor and alumni support through a sustained partnership with NJIT's Office of Alumni Relations and University Advancement. Working with current CSLA supporters, such as our advisory board, we will pursue active fundraising efforts to provide the college with an endowment that can be used to seed and fund college initiatives. We will work with Alumni Relations to be more active and guarantee CSLA participation and visibility at alumni events. Past efforts in these areas have resulted in modest gains, so we cannot reasonably give monetary projections, but the ultimate goal is to provide CSLA independent funding that can augment our university budget and ensure we can pursue projects important to the college community.

## **IX. Research Centers**

CSLA is currently home to two outstanding research centers: the Center for Solar-Terrestrial Research and the Center for Applied Mathematics and Statistics. We are in the early stages of developing a third research center: the Center for Leadership, Education, and Assessment Research. These centers contribute to the intellectual life of the college and are responsible for bringing important funding to NJIT for our faculty and students.

The Center for Solar-Terrestrial Research is an international leader in ground-based solar physics and studies of the effects of the Sun on Earth's space and terrestrial environment. The Center operates the Big Bear Solar Observatory (BBSO) and the Owens Valley Solar Array (OVSA) in California. Both BBSO and OVSA have strong instrumentation programs including successful efforts in high order adaptive optics, visible light and near infrared polarimetry, and radio imaging spectroscopy. Presently, the group is engaged in building the world's most capable solar telescopes, the New Solar Telescope and the Frequency Agile Solar Radiotelescope. The Center is also heavily involved in several space and ground-based experimental investigations of the heliosphere, the magnetosphere, and the ionosphere, is central to CSLA's research mission.

The Center for Applied Mathematics and Statistics (CAMS) plays a prominent research role in CSLA, and has an outstanding track record of engaging researchers from academia, industry, government, and other institutions by organizing interdisciplinary workshops for researchers whose strengths and goals are complementary. CAMS activities include support for the submission of research proposals, which is done

through dissemination of information, organization of group projects, collegial advice and assistance with application documents. Graduate student research is encouraged through the CAMS Summer Research Program and with support for students to attend conferences.

Our proposal for the Center for Leadership, Education, and Assessment Research (CLEAR) is based on the work of Dr. Jim Lipuma and Professor Bruce Bukiet that has already secured nearly \$1.5 million for NJIT in a partnership with the New Jersey Department of Education. This proposed center would serve to coordinate activities connected with online learning, including online education, converged learning, and assessment. The center would engage in investigating and developing tools, materials, and resources to support educational research, professional learning, and best practices to foster K-16 educational effectiveness and student success. Some initiatives include the Online Professional Learning Exchange (OPLE), the NJIT platform for delivering ongoing professional learning experiences in a blended learning environment, NJIT's Curriculum, Learning and Assessment Studies (CLAS) Network (our open resource repository), and tools for adaptive and blended learning.

The college expects to play central roles developing additional interdisciplinary centers such as in neuroscience and big data analytics.

## **X. Developing CSLA's Public Image**

We are embarking on an ambitious plan to increase the public profile of CSLA both on campus and in the wider community. We believe our efforts in this regard will pay off in attracting more and better qualified undergraduate and graduate students, help foster development and increase the pool of potential CSLA donors, and help increase NJIT's overall profile and overall standing in key rankings.

We will increase the visibility of the several departmental and program colloquia and seminar series already underway in CSLA. We have already started to feature them on the CSLA website and communicate about them with NJIT's strategic communications office to increase their presence in the NJIT newsfeed. We aim to develop a series of public lectures devoted to issues of interest to the entire CSLA community with the objective of attracting large parts of the CSLA community as well as the greater NJIT community so the mission and ideals of CSLA are better understood on campus. The college will have a greater presence in social media to significantly increase the visibility and name recognition of our programs, and highlight student and faculty accomplishments.

Following the lead of independent groups such as Cafe Scientifique, CSLA will work to partner with public libraries and community organizations in the New Jersey/New York area to offer key members of the CSLA community as lecturers and discussion leaders for issues that will be of interest to a lay audience. We will invite appropriate students and faculty of local high schools to these programs and offer to meet with their students and teachers before the public lecture. By appealing to a lay audience we hope both to

educate the public about CSLA's and NJIT's mission, serve the community, help with student recruiting, and to identify potential donors or supporters for our programs. With the inclusion of high school students we hope to increase our applicant pool and especially to target the very best students in these communities that may not be considering NJIT.

As we build and expand CSLA it will be important for the dean and his staff to become involved with national organizations related to the administration of a college of arts and sciences. This involvement will ensure that CSLA is aware of and can implement best practices for colleges of our kind. Active involvement on our part will also ensure that CSLA, and through us NJIT, becomes a noted contributor to discussions about the administration of colleges of arts and sciences. Increasing our profile among these groups will help not only with efficient management of the college, but, as these deans are often the people called on to evaluate other colleges of arts and sciences, will likely help our ratings as well. As a start, the decanal staff has already joined The Council of Colleges of Arts and Sciences.

We will partner closely with the Albert Dorman Honors College to nominate students for prestigious scholarships and professional recognition and to nominate faculty as fellows in professional organizations and awards. We need to begin to identify students that we believe may be competitive for undergraduate awards (e.g. Beinecke or Goldwater Scholarships), international graduate study awards (e.g. Churchill or Marshall Scholarships) and domestic graduate study (e.g. James Madison Fellowships or Paul

and Daisy Soros Fellowship for New Americans) and commit to guiding them through the demanding application processes. Similarly, we will encourage faculty to become fellows in their professional organizations and support them in pursuing high-profile prestigious awards.

## **XI. Conclusion**

CSLA will expand in a number of engaging directions over the next five years while reaffirming our commitment to excellence. We will develop our five key research clusters (Life Sciences; Advanced Materials and Processes; Sustainability and Security; Data Science; and Science and Society Interactions) by expanding our faculty to 120 tenured/tenure-earning faculty, increasing our externally funded research by 50%, and increasing published scholarship to 85% of TT faculty. We aim to increase the number of graduate and undergraduate students while attracting students that are highly motivated and well prepared for their chosen courses of study. CSLA will develop two new professional science masters degrees and explore additional graduate, certificate, and undergraduate programs aimed at both serving the local workforce and increasing our enrollment. We will put renewed emphasis on undergraduate programs we believe have great growth potential while enhancing all programs in the college. We will increase our faculty ranks to contribute to our research enterprise and steward our academic programs along with hiring ten new lecturers to contribute to our first and second year curriculum, which will help increase university retention, graduation rates, and better ensure the quality of our lower division courses. To better serve our students we will increase the online and converged offerings in CSLA.

To complement the academic and research expansions in CSLA we will also enhance our public image, expand alumni outreach, and make fundraising a fundamental part of our college's mission. We will begin community programs and engage in higher education associations to trumpet the hard work of our faculty and students and to make the CSLA administrative officers noted contributors to professional discussions. We will engage with alumni and potential donors to raise funds necessary to transform CSLA into a more competitive and well-rounded college of sciences and liberal arts.

Working within the university framework set out in 2020 Vision, CSLA will continue the central role our college plays on campus while expanding our academic offerings and broadening our public mission and image. We will rely on the momentum imparted to us from the previous CSLA administration and continue the college's upward trajectory. Our vision is clear, our goals are extraordinary, and our commitment profound.

Appendix A  
CSLA Productivity Charts for AY 2013-2014

UNIVERSITY REPORTED	Total
SCH – undergraduate (Ttl)	79116.0
SCH – graduate (Ttl)	4487.0
SCH – dept. Total	83603.0
Total SCH per faculty (tenure/tenure track/lecturers)	561.1
Headcount – undergraduate majors	677.0
Headcount – masters	278
Headcount – doctoral	123
Research funding (FY13- 14)	\$10,112,355.00
Research funding per FTE (tenured/tenure track/ research faculty)	\$104,251.1
FTE – tenured and tenure- earning	94.00
FTE – instructors and lecturers	55.00
FTE – research faculty	3
Total FTE	152.00

SELF-REPORTED	Total
Number Of T/TE Faculty	94
Scholarly Books Authored	4
Scholarly Books Edited	3
Refereed Journal Articles	188
Refereed Book Chapters	18
Conference Proceedings	30
Other Publications	46
% Faculty Who Published	72%
Percentage With Research Funding	52%
Invited Presentations	130
Refereed Conference Presentations	63
Other Conference Presentations	61
Patents	4

Appendix A  
Departmental University-Reported Productivity Chart for AY 2013-2014

<b>UNIVERSITY REPORTED</b>	<b>Bio</b>	<b>Chem &amp; Env Sci</b>	<b>Hist</b>	<b>Hum</b>	<b>Math</b>	<b>Phys</b>
SCH – Undergraduate (Ttl)	4428	10753	1434	22440	26782	13279
SCH – Graduate (Ttl)	162	1218	17	336	2034	720
<b>SCH – Dept. Total</b>	<b>4590</b>	<b>11971</b>	<b>1451</b>	<b>22776</b>	<b>28816</b>	<b>13999</b>
Total SCH Per Faculty (Tenure/Tenure Track/Lecturers)	383	704	207	690	686	467
Headcount – Undergraduate Majors	301	99	36	57	133	51
Headcount – Masters	6	79	56*	21	71	22 (AP)/19 (MtSE)
Headcount – Doctoral	14	24			39	9 (AP)/31 (MtSE)
<b>Research Funding (FY13-14)</b>	<b>\$539,212</b>	<b>\$599,842</b>	<b>\$53,000</b>	<b>\$49,031</b>	<b>\$1,743,353.00</b>	<b>\$7,127,917</b>
Research Funding Per FTE (Tenured/Tenure Track/ Research Faculty)	\$67,402	\$59,984	\$10,600	\$4,086	\$44,701	\$323,996
FTE – Tenured And Tenure-earning	8	10	6	12	39	19
FTE – Instructors And Lecturers	4	7	2	21	13	8
FTE – Research Faculty						3
<b>Total FTE</b>	<b>12</b>	<b>17</b>	<b>8</b>	<b>33</b>	<b>52</b>	<b>30</b>

Appendix A  
Departmental Self-Reported Productivity Chart for AY 2013-2014

<b>SELF – REPORTED</b>	<b>Bio</b>	<b>Chem &amp; Env Sci</b>	<b>Hist</b>	<b>Hum</b>	<b>Math</b>	<b>Phys</b>
Number Of T/TE Faculty	8	10	6	12	39	19
Scholarly Books Authored	0	0	0	3	0	1
Scholarly Books Edited	2	0	0	1	0	0
Refereed Journal Articles	18	28	2	5	64	71
Refereed Book Chapters	6	2	2	8	1	1
Conference Proceedings	15	3	0	2	3	10
Other Publications	2	2	6	17	21	0
<b>% Faculty Who Published</b>	<b>100%</b>	<b>70%</b>	<b>83%</b>	<b>75%</b>	<b>64%</b>	<b>75%</b>
<b>Percentage With Research Funding</b>	<b>88%</b>	<b>44%</b>	<b>33%</b>	<b>33%</b>	<b>46%</b>	<b>75%</b>
Invited Presentations	28		2	11	89	
Refereed Conference Presentations	24		4	25		10
Other Conference Presentations	12	16	4	29		
Patents						3 issued-5 filed

Appendix B  
Departmental Strategic Plans

**Five-Year Strategic Plan for the Department of Biological Sciences**

**Summary**

By 2020, the Federated Department of Biological Sciences at NJIT aims to be running at its full operational capacity: a research faculty of fifteen, an instructional faculty of four, and a full-time staff of three, housed on the third and fourth floors of the newly renovated Central King Building. Based on past growth we expect to have over 400 undergraduate students enrolled per semester by that time.

**Background**

NJIT's embrace of biology has always been hand in hand with our sister Department at Rutgers, through the 1997 agreement known as Federation. It is this agreement that allowed NJIT to begin offering Biology degrees and hiring faculty members who perform biological research. And it is the accelerating demand for biological education that has allowed for our steady growth since then, including the founding of the Department of Biological Sciences in 2005, and the investment of the State of New Jersey in our new research and teaching facilities in the Central King Building, which opened in 2014

**Current status: A vertically integrated department.**

In part by design and in part because of past hiring opportunities, the DBS has unusually strong *vertical integration*. By this we mean that our research faculty works at a wide variety of scales of biological organization, from cells to ecosystems, but *the specific topics allow for linkages between these scales*. Risking over-simplification, the 'stack' looks something like this:

Ecology and conservation  
(emphasis on movement and spatial distribution)  
*Russell, Bunker*

Behavioral and morphological adaptations  
(emphasis on communication and navigation)  
*Garnier, Flammang, Soares*

System neuroscience  
(emphasis on locomotion and sensing)  
*Haspel, Fortune, Soares*

Cellular neuroscience  
(emphasis on motor systems)  
*Nadim, Golowasch, Bucher*

The thread linking these levels is perception/navigation/communication.

### **Priority 1: Bring our research faculty up to planned capacity**

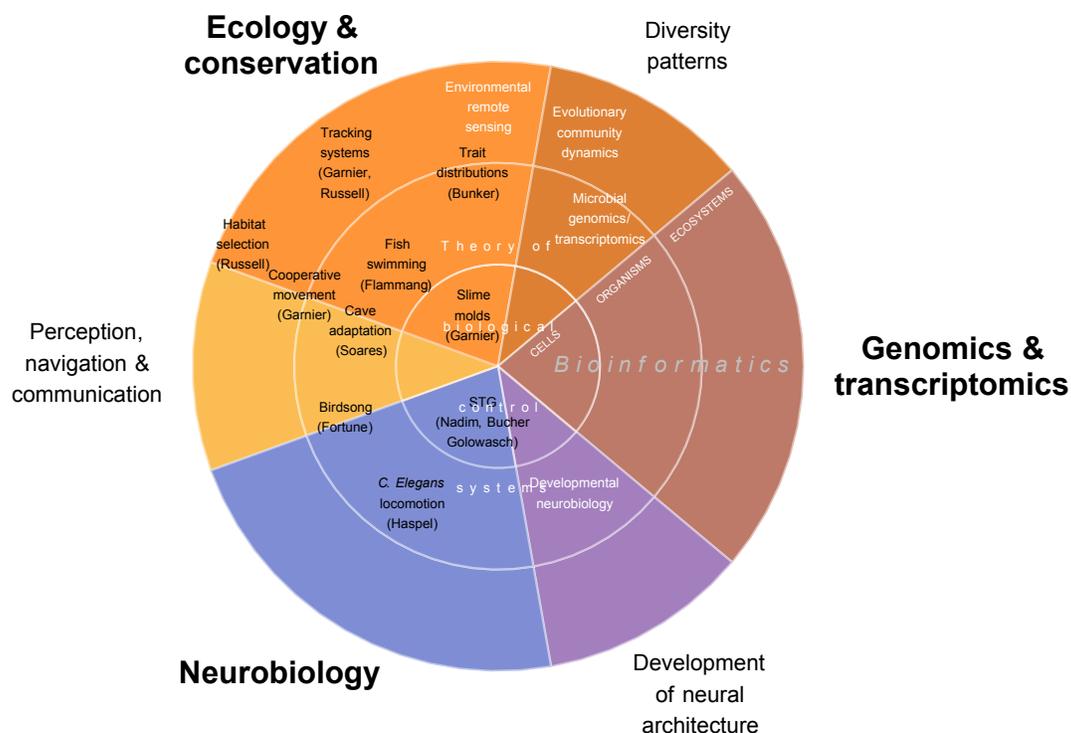
Our new home in the Central King Building is designed to host the activities of 15 research faculty. We currently have 10. There is one 'empty' lab space intended for future hires, large enough to potentially host the activities of three faculty, assuming that they share equipment to some extent. Our proposal therefore involves hiring three researchers in a related area that will occupy this space, and two with a more computational/theory focus that will need less in the way of traditional 'bench' space and can be integrated into the rest of our facility.

As described above, research in the DBS currently spans a number of scales of organization between two 'poles': neurobiology and ecology. Our plan is to create a third pole, but maintain the kind of integration we already have.

#### **The third pole: genomics/transcriptomics**

The figure below outlines a schema with three overlapping disciplinary areas: Ecology & Conservation, Neurobiology, and Genomics & Transcriptomics. Each region of overlap is characterized by a set of related research questions. In addition, the concentric rings from the center outwards represent different levels of organization: Cells, Organisms and Ecosystems.

A number of our existing research projects are shown in black. The left half of the figure thus represents the Department as it is now, with Genomics on the right being the new 'pole.' Our proposed hires are shown in white. All of the genomics-related proposals fall in the overlap zones, to allow for collaborations between new hires and existing faculty and to maintain an integrated research program. The environmental remote sensing proposal fills a gap in the ecology and conservation side, with links to existing research on large-scale movement patterns and habitat selection, and to proposed new research on multi-species co-evolution. Finally, the control systems proposal is for a mathematical/computational researcher who might work at any, or more than one, spatial scale and system, from gene regulatory networks to neural sensor/action feedback loops to distributed decision networks.



Most existing faculty have research links to colleagues in other Departments and Colleges. The proposed push into genomics should generate new interactions with the bioinformatics program in the College of Computer Science. The remote sensing position will find affinities in the Departments of Physics, Chemistry and Environmental Science, and Civil and Environmental Engineering. The control systems position will find common ground in a number of Departments in the Colleges of Engineering and Computer Science, as well as in the Department of Mathematical Sciences.

### The genomics lab (3 positions)

We request the addition of three faculty whose research will involve genetics/genomics/transcriptomics, working in areas that will interface with other faculty in both the NJIT and Federated Department, and with other Departments at NJIT. As well as bringing cutting-edge, highly-fundable science to NJIT, the common thread in these proposed hires will allow us to offer comprehensive training in extremely marketable skills at both the graduate and undergraduate levels. The specific search areas below are presented in no particular order (see 'timing' note below for discussion of equipment sharing).

- **Microbial Genomics/Transcriptomics and Community Dynamics.** The dynamics and diversity of microbial communities is a hot topic in areas as diverse as agriculture, conservation, medicine and dentistry. New genomic tools allow for rapid surveying in a wide range of systems. **NJIT focus groups: Life Science and Engineering; Sustainable Systems.** Links: ecologists in DBS; CEES; BME; NRDP. (Note CEES recently filled a position in environmental biology that will include microbial systems as a research area, but with an emphasis on more functional roles such as biofuel production or contaminant mitigation. This will complement the position proposed here.) Example job description: *A full-time tenure track position is available in the Department of Biological Sciences, NJIT. We are interested in candidates who conduct research in microbial ecology and evolution using genomics, transcriptomics and related tools, focusing on the functional attributes and dynamics of diverse microbial communities in soils, aquatic systems, biological systems, etc. and their role in ecosystem functioning.*
- **Evolutionary Community Dynamics.** This is the study of the long-term dynamics of ecological systems by comparing the evolutionary histories of multiple taxa, especially key mutualists/symbionts (e.g., plants and their pollinators, trees and mycorrhizal fungi). Such study allows us to determine the stability of such systems under changing environmental conditions, and thus is relevant to assessing current resilience in the face of climate change and other disturbances. **NJIT focus groups: Sustainable Systems.** Links: ecologists in DBS; CHEM, NRDP; CoAD (landscape design). Example job description: *A full-time tenure track position is available in the Department of Biological Sciences, NJIT. We are interested in candidates who conduct research in evolutionary community dynamics, focusing on understanding the resilience and adaptability of key ecosystem relationships under changing environmental conditions.*
- **Evolutionary Developmental Biology.** Also known as 'evo-devo', this is the integration of traditional research on organismal evolutionary biology (systematics, paleontology, and comparative anatomy) with molecular embryology, genetics and genomics. It is used to study morphological and/or physiological adaptation, symbiosis, response to a changing environment, stress/tolerance, invasiveness, behavior/signaling, or speciation/extinction. **NJIT focus groups: Life Science and Engineering;** Links: most researchers DBS. Example job description: *A full-time tenure track position is available in the Department of Biological Sciences, NJIT. Candidates should conduct research in evolutionary developmental (evo-devo) and/or ecological developmental (eco-devo) biology, focusing on the genetic, genomic, developmental and ecological mechanisms that mediate the origins and diversification of novel complex traits in (non-model) animals.*

### **Landscape remote sensing (1 position)**

This request is driven by an equal balance of research and pedagogical considerations. In terms of research, the acquisition and use of diverse remote sensing data crosses many disciplines, and at NJIT there is research being carried out in Biology, CEES,

Physics, NCE, CoAD. In terms of curriculum, students planning on moving into the ecological/environmental industry *must* have training in the tools of Geographical Information Systems (GIS) and Remote Sensing (RS) to be competitive. While NJIT does offer some training in these disciplines, it is with a strong focus on technical aspects and engineering applications. This hire would be expected to develop a parallel training program in environmental/biological applications, likely in cooperation with CEES, where such courses are already on the books but are not offered due to lack of resources. **NJIT focus groups: Sustainable Systems; Data Science and Information Technology.** Links: ecologists in DBS; CEES; Physics; NCE; CoAD (landscape design). This hire would not occupy traditional bench space, but we might request that one of the smaller CKB third floor classrooms be converted into a dedicated computer facility for GIS/RS instruction. Example job description: *A full-time tenure track position is available in the Department of Biological Sciences, NJIT. Candidates should conduct research in landscape remote sensing, especially the integration of data from diverse sensing modalities to address applied environmental problems. NJIT has a long history of development of sensor technologies, and there are opportunities for collaboration across multiple departments.*

### **Biological control systems (1 position)**

This discipline brings a mathematical and systems approach to biological, and bio-inspired, feedback and control systems. The majority of existing research faculty in the DBS are working on one or more components of such systems, from individual neurons and pattern generators through sensory adaptations and the achievement of coordinated movements and vocalizations to collective behaviors and responses to environmental stimuli. This position will therefore provide a 'glue' that unites the majority of the DBS, and provides links to engineering and mathematics via the use of systems modeling and applications to robotics. **NJIT focus groups: Life Science and Engineering; Sustainable Systems.** Example job description: *A full-time tenure track position is available in the Department of Biological Sciences, NJIT. Candidates should conduct theoretical and/or modeling research in biological control systems. A diverse faculty in the Department study a number of different systems, including individual neurons and pattern generator networks, unusual sensory adaptations, the achievement of coordinated movements and vocalizations, collective behaviors, and high-level behavioral responses to environmental stimuli. There are also opportunities to collaborate outside the Department in areas such as robotics and neuromuscular rehabilitation.*

### **A note about timing and start-up**

It is our intention to make the best possible use of the new CKB facility, and part of that involves coordinating the hires of 'bench' scientists to use the same open lab space, and to share equipment. The common thread of the hires proposed for that space is genomics. By splitting the cost of larger items of equipment across three faculty members, start-up costs per individual can be kept reasonable. For example, a current sequencing set-up (e.g., an illumina MiSeq, and its supplies, thermal cyclers,

electrophoresis gel rigs, etc.) currently costs ~\$200,000, which works out at only \$67,000 per user. A number of other equipment items (centrifuges, etc.) can also be shared. This does, however, make the timing of hiring more complicated. We propose that we be allowed to hire at least two of the three proposed genomics researchers in the same hiring round, so that they can coordinate the specification and acquisition of such larger items.

Our suggested sequence, then, is as follows: 1) remote sensing position, 2) *two* of the genomics 'bench research' positions, 3) control systems position, 4) third genomics 'bench research' position. This will give us time to assess the space/equipment needs of the genomics work and adjust our plan if it seems a tight fit to add a third into the same space.

### **Priority 2(a): Further develop undergraduate teaching with an emphasis on practical training**

The Federated Department currently offers a large selection of courses that satisfies most of the needs of the different concentrations/majors in the program. As new faculty are recruited, new courses will be developed in their area of expertise at both the graduate and undergraduate levels. One of the deficits, at NJIT in particular, is the reduced offering of courses with practical training, i.e. labs. One course currently being developed is a Neurophysiology lab course. Additional courses will be needed, such as in the areas of genomics, microbial biology, and ecology field courses. During this period, specific courses and investments will be proposed to satisfy these needs.

### **Priority 2(b): Promote our undergraduate program as a training ground for top-rank biological researchers**

At the moment, NJIT is perceived as a good place for pre-medical education, and approximately  $\frac{3}{4}$  of our undergraduate students intend to pursue health-related professions, mostly on the clinical side. Without compromising this important career pathway, and following priority 2(a) and NJIT's renewed focus on undergraduate research experiences, we intend to put additional effort into recruiting undergraduate students with aspirations toward research careers, whether in medically related fields or one of the areas outlined on the earlier Figure. This will not only benefit NJIT's recruitment and reputation, it will help our research faculty by providing enthusiastic research assistants interested in a broad spectrum of topics.

### **Priority 3: Improve our ability to recruit and support high-quality graduate students**

In cooperation with Rutgers, four major overhauls of our graduate programs are in the process of being implemented, and will continue to be a priority over the next few years:

- 1) We are restructuring the administration of the graduate programs to improve operations and transparency, enforce more consistent academic standards, and promote cooperation across the Federated Department. Over the past year we established an 'Executive Committee' consisting of the two Chairs and two additional faculty members, one from each side of the Federated Department. The goal was to provide more balanced oversight of the program and other committees: a) Recruitment, b) Standards (oversight of PhD students before qualifying exams), and c) Program assessment/curriculum. (Previously, this oversight rested entirely with a single Program Director, who is the Chair of the Rutgers Department.) Further changes may come about as the Federation agreement itself evolves (see below).
- 2) We are in the process of improving our recruitment strategies for PhD students, with the goal of attracting the best possible candidates. Strategies include: a) Faster processing of applications to avoid losing good students to other programs that make offers earlier in the season, b) On-campus interviews of the top domestic candidates to establish a stronger rapport and personal connections, c) Improvement of the web presence of the programs and other avenues of advertising. A first round of recruitment with some of these changes already implemented showed great promise.
- 3) We are in the process of restructuring the academic tracks within the PhD program. The existing tracks represent to some degree historical research strengths of the department, which have changed over the last number of years.
- 4) We are exploring a change our approach to graduate education at the Master's student level. Our current Master's program does not have a particular direction, other than general biology. As this is not geared toward any specific job market, it mainly attracts students not yet competitive for PhD or MD programs. While keeping a general biology option, we will explore the addition of one or two tracks that are geared toward training students in specific areas of biology relevant for the industry and government job market. Our plan is to first seek advice from New Jersey companies in the respective fields, and develop connections for possible industry internships and job placement. Possible tracks include biotechnology and environmental biology.

One area of concern for us is the support of PhD students through NJIT. We have been very successful in supporting students from external sources, either from research grants or from programmatic support found outside of NJIT (for example Rutgers Biology and CMBN). Support from the Rutgers side will likely not continue at the levels of the past, particularly not for students recruited through NJIT. We doubled our number of faculty in the last four years (and will triple it within five years according to this strategic plan), while the TA budget for early PhD student support has not increased significantly. In addition, the recent and future growth of the department means that we have a disproportionate number of junior faculty members not yet funded by grants, but in dire need of students. We will therefore be asking for an increase in the TA support commensurate with the growth and development of the department.

#### **Priority 4: Consolidate our place on the NJIT campus**

At the time of writing, the research activities of the Department have been physically located on the NJIT campus for less than one year. Our new presence brings with it an opportunity to forge ties with other elements of NJIT. This process has already begun, with cooperative activities of different kinds being discussed with faculty from the College of Computing Science, the Newark College of Engineering and the College of Art and Design (the latter resulting in a cross-disciplinary course in ‘Visualizing Biology’). Still, the existence and activities of the DBS remain a mystery to many, so the outreach process will continue.

#### **Priority 5: Redefine a strong and balanced Federation partnership with Rutgers-Newark**

Over the years, Federation has clearly benefitted both partners enormously, and continues to do so. At the same time, the circumstances faced by each of the partners have changed considerably, so that the original agreement, while still operating in spirit, is no longer very useful in guiding many of the practicalities. It is time for a new version of the agreement. This is not a call for weakening or eliminating Federation. The underlying principle — that a uniting of the two Departments increases educational and research opportunities for the students and faculty of both — remains intact. Rather, it is a call to put in place mechanisms that will maintain and even strengthen that cooperation as NJIT develops a presence on its own campus. Obviously, this will be a cooperative process between NJIT and Rutgers-Newark.

#### **Priority 6: Restructure administrative operations**

We are fortunate to have been able to recently hire a third full-time member to our administrative team: Ms. Shamay Carty. Once she is in place we will be overhauling the administrative operations of the Department, especially purchasing, with an eye towards robustness, efficiency and transparency. The system we desire is one that can be shared between different administrators and, where appropriate, faculty, allowing loads to be shared and activities to continue through individual staff absences.

#### **Priority 7: Establish an advisory board**

While our Department remains small compared to others, it is growing rapidly and we feel the time right is to seek out the help of an advisory board to help guide our future and provide a useful external perspective.

#### **Development project: A Field Station for NJIT (a real-world test bed for environmental and ecological technology)**

NJIT suffers from not having a suitable site for environmental field research and education. Given NJIT's strengths in the use of technology in environmental contexts (chemical and other kinds of sensor technology, animal monitoring and tracking via video, audio and attached devices, distributed networks, etc.), we have developed a proposal for a unique field site: one that deploys such devices to create a 'wired and wireless' ecosystem that provides real-time data on diverse aspects of the environment. Preliminary discussions for a site have centered on a property adjacent to, and owned by, the Six Flags complex in Jackson, NJ. The owners have indicated a willingness to donate this land in perpetuity as a conservation and research center. Discussions are ongoing, but other site options could still be considered. Russ Furnari, Director of Environmental Operations at PSE&G and a member of the CSLA Advisory Board, as been helpful with suggestions in this regard.

### Assessment (goals)

Our goals are ambitious but relatively simple to assess. By 2020...

- We should have hired five new tenured or tenure-track faculty members, and fitted out the remaining space in CKB for active research.
- At least two of the faculty members already in our department should be in the process of review for promotion, or already promoted. We are confident that they are on the right track at this time.
- Two additional faculty members will have gone through their third year review. We expect them also to be successful.
- Our Federated PhD program will have undergone a through review.
- An enhanced and successful graduate recruitment plan will have been put in place and be ready for evaluation.
- An evaluation of our MS program will have been completed, with recommendations for or against expansion.
- A number of new lab courses should be up and running and evaluations will be analyzed to assess their success and future.
- We should be seeing an increase in recruitment of undergraduates who are interested in research-related careers.
- A new Federation agreement with Rutgers will have been drawn up and ratified by both institutions.
- We will see increasing numbers of joint activities (research proposals, course offerings, infrastructure and equipment sharing) with members of other Departments and Colleges at NJIT.

### Assessment (notes on process)

- 1) Assessing the performance of the NJIT 'half' of the Federated Department of Biological Sciences can be a challenge, nowhere more so than in the area of graduate student training. For example, students regularly 'cross the street,' in both directions, and a student that is recruited into one institution, and supported

by that institution in her early years, may switch. This gives students a greater range of options, but means that advising and mentoring activities are somewhat decoupled from institutional support (in the form of TA awards). We are working with the Office of Graduate Studies at NJIT to develop a proper record and accounting of our contributions to the Federated graduate program.

- 2) Acquisition of an advisory board (Priority 7) will provide a new avenue for broad-scale, external assessment via regular review of our programs and other activities.

## Timeline

### Hiring

As described above, our suggested sequence for hiring is as follows (years are start years):

2016 — Remote sensing position

2017 — *Two* of the genomics 'bench research' positions (sharing equipment and startup)

2018 — Control systems position

2019 — Third genomics 'bench research' position. This will give us time to assess the space/equipment needs of the genomics work and adjust our plan if it seems a tight fit to add a third into the same space.

### Other priorities

**Priority 2: Undergraduate recruitment and training.** This is a progressive activity, with new lab courses to be developed over the next five years as we hire new faculty and as recruitment increases.

**Priority 3: Graduate recruitment and support.** The development of a proper accounting of our contributions within the context of Federation is in progress and will be completed this academic year. We will then make a case for enhanced TA support to support our past and projected expansion, and continue to do so as that expansion proceeds.

**Priority 4: Campus consolidation.** This is also a gradual process, and as described above, has already begun.

**Priority 5: Federation agreement.** This discussion has started and will likely be concluded by Summer 2016 with a proposal generated by the Federated Department and submitted to the administrations of NJIT and Rutgers Newark for review and ratification.

**Priority 6: Administrative operations restructuring.** Will be completed by Summer 2016.

**Priority 7: Advisory Board.** Discussion will start this year, and if the concept is approved, the goal will be to appoint a board for the start of the 2016-2017 academic year.

**Field station.** Open ended, but a decision of whether to continue to pursue the Six Flags option will be made before the end of this academic year.

## **Five-Year Strategic Plan for the Department of Chemistry and Environmental Science**

### **History**

The Department of Chemistry and Environmental Science was founded in 2001 in NJIT's College of Science and Liberal Arts. The founding faculty had been in the Otto F. York Department of Chemical, Biological and Pharmaceutical Engineering in the Newark College of Engineering. A group of three faculty members that specialized in environmental policy subsequently joined the new department in 2004 from their original home in the Department of Humanities. Subsequently, a biochemistry BS program was started in 2012. The department now offers BS, MS, and PhD degrees in chemistry, BS, MS, and PhD in environmental science, BS in biochemistry, MS in pharmaceutical chemistry, and MS in environmental and sustainability policy, along with minors in chemistry, economics, and environmental science and policy.

In its early stages, the department was quite small, with a limited infrastructure. The department has strived to strengthen its faculty, increase service to the university in teaching and research, and improve its infrastructure. Graduate and undergraduate enrollments have remained steady, and we recognize that further increase of enrollment is required on both undergraduate and graduate levels. New faculty and staff were hired in steady procession with the support from the CSLA administration. Faculty members within the department are active in seeking and receiving external research funding. Numerous faculty members sustain internationally recognized research, publishing in the top scientific journals in their fields, and are funded by federal agencies such as the

National Institutes of Health, National Science Foundation, and Department of Energy

### **A Vision of Excellence in Chemistry and Environmental Science**

New Jersey Institute of Technology and the Department of Chemistry and Environmental Science's mission is to provide excellent education and research experiences for students at the undergraduate and graduate level. The department's emphasis in chemistry is based on a solid grounding in the sciences, mathematics, and engineering. Extensive hands-on laboratory experience allows students to apply theories to practical areas of chemistry, with special emphasis on analytical, organic, physical, and biological chemistry, as well as energy, pharmaceuticals, materials, and environmental chemistry. Students in the environmental science program draw on chemistry, geology, and biological sciences to understand complex aspects of the environment. Students gain expertise in computer modeling, data analysis, and digital mapping, with specializations in environmental policy, sustainable earth paradigms, biocomplexity, and environmental chemistry.

The BS chemistry and biochemistry degree programs are certified by the American Chemical Society (ACS). The ACS provides guidelines and evaluation procedures for approved chemistry programs and indicates that the faculty should have a collective expertise that reflects the breath of the major areas of modern chemistry. The major areas are analytical chemistry, biochemistry, inorganic chemistry, organic chemistry and physical chemistry. Thus, the department is intent on maintaining expertise in these areas and developing a national and international reputation for conducting cutting edge

research. In addition, the department serves as a resource to support interdisciplinary research and education in complementary scientific and technical areas at NJIT.

The department's faculty are frequent recipients of teaching and research awards. In addition, undergraduate students are engaged in scientific research and co-author peer reviewed publications with faculty mentors, present research at conferences and symposia, and receive awards and scholarships based on their research.

The department has strong relationships with secondary-school students and teachers. Faculty actively participates in the Summer Research Internship Program for Economically Disadvantaged High School Students sponsored by the American Chemical Society. In addition, faculty conduct extensive community outreach and present their research to regional high schools.

### **Fields of Study**

Within a disciplinary framework, the department has strengths in the following areas: thermodynamics and kinetics, combustion and atmospheric chemistry, protein engineering, computational chemistry, materials science, biochemistry, organic chemistry, environmental science and policy, analytical chemistry, and photonic materials. However, research has become multidisciplinary in nature and traditional boundaries have become blurred. The focus at NJIT includes, but is not limited to, life science and healthcare, sustainable systems, manufacturing systems, advanced materials and engineered particulates, and nanotechnology. A multidisciplinary

approach is needed to solve important problems in these areas. Thus, the faculty has a keen interest in most of these multidisciplinary areas with bio-related fields as one of the major directions for development in the department.

From a multidisciplinary perspective, environmental science and environmental policy and materials science represent major interdisciplinary fields active in the department; they have been, are, and will be important components of the department. “Energy science” and “energy policy” refer to a set of issues relevant to energy mining, storage, transportation, utilization, and prevention of negative impacts. These issues require a multidisciplinary approach in which a number of faculty from the department participate. For example, faculty conduct grant-funded research in water resource and ecosystem management, natural resource conservation and environmental planning. They actively apply expertise in environmental planning and management toward designing sustainable rural housing and communities in China. Such involvement will involve the development of innovative principles and applied technologies. As is the case with all multidisciplinary work, participation of specialists from any field represented in the department is encouraged.

### **Indicators of Success**

Metrics for our undergraduate students focus on job placement, participation in research, conference presentations, and co-authoring of peer reviewed publications. Students with research experience have better chances for successful employment, typically receiving offers before graduation. Moreover, such students often elect to

continue studies at the graduate level. Our students have continued on to successful careers in industry, been accepted to medical and dental schools, and pursue doctorate degrees at leading research universities. For our graduate students, conference presentations and peer-reviewed publications are indicators of success. In addition, PhD graduates continue postdoctoral training in prominent research laboratories and lead research and development groups in industry.

Our faculty are evaluated on peer-reviewed journal publications of high impact, as well as conference and symposia presentations. Research funding continues to be a key factor associated with successful and sustainable research programs. Student evaluations are important to judgments of teaching effectiveness. Finally, faculty service is important to the university and to the profession. For example, they serve on proposal review panels, evaluate submitted manuscripts, organize conferences, and serve on numerous departmental, college, and university committees.

We are considering new outcomes procedures, and the department will consider the American Chemical Society subject exams for assessing undergraduate student learning. On the graduate level, the department will consider using the GRE subject test in chemistry as an admission requirement and explore developing a Professional Science Masters program, possibly in the biotechnology field.

### **Projection 2020**

By 2020, the Department of Chemistry and Environmental Science set the following

goals:

- Double the total undergraduate enrollment in the department's degree programs.
- Double the graduate enrollment in the department.
- Hire at least six tenure/tenure track faculty members, in support of our new programmatic initiatives, while retaining existing lines. Hire a university lecturer to support undergraduate instruction due to increased university enrollment.
- Double the research funding with the emphasis on competitive agencies.
- Develop strong research and teaching in the department's biochemistry and bio-related fields.
- Improve, adapt, and implement various teaching and learning pedagogies directed, in large measure, to improve student success and learning in first year chemistry gateway courses.

## **Five-Year Strategic Plan for the Federated Department of History**

During the next five years, the NJIT Department of History will build on its tradition of excellence in two key areas: (1) the history of technology, environment and medicine/health (HisTEM), including the history of science and the history of media—with special attention to increasing its support for the development of bio-related and medical education at NJIT; and (2) the history of law and the undergraduate degree program in law, technology and culture (LTC). Federation with Rutgers-Newark provides the NJIT history faculty with the flexibility and depth to maintain their focus on these two areas of excellence, as well as the intersections between them, without sacrificing either the quality or the range of their historical coverage. By means of strategic hiring in these areas, supplemented by appropriate increases in material resources, the department seeks to raise its national profile for research in the field of HisTEM and to attain increased recognition for research in the history of law, especially in relation to HisTEM. At the same time, the department remains committed to the success of its undergraduate majors in history and LTC, and its M.A. concentration in HisTEM. Finally, as part of its ongoing service function, the department will continue to serve large numbers of undergraduate NJIT students who seek to fulfill their General University Requirements with history courses.

### **Federation with Rutgers-Newark and HisTEM**

The NJIT Department of History was founded in the mid-1990s, when history faculty members in the NJIT Department of Humanities joined with their colleagues in history at

Rutgers-Newark to found the Federated Department of History. Their goal was to forge a professional department on the model of history departments at leading comprehensive technological universities such as Carnegie Mellon, Georgia Tech, and MIT. Because of the federation with Rutgers-Newark, the NJIT department was able to begin granting joint B.A. and M.A. degrees in history while focusing on developing its research profile in a focused area central to NJIT's mission: the history of technology, environment and medicine/health (HisTEM). On the research side, NJIT faculty in the federated department have published books in the area of HisTEM and related fields with leading publishers, such as Johns Hopkins University Press, Cambridge University Press, Oxford University Press, University of Chicago Press, Duke University Press, and University of California Press. Over the past decade, Prof. Neil Maher and Prof. Stephen Pemberton have established themselves as nationally recognized figures in their respective fields of environmental history and history of medicine, and M.A. students whom they have mentored in these areas have been accepted into prestigious Ph.D. programs at Princeton, University of Pennsylvania, Carnegie Mellon, University of Oregon, Rutgers-New Brunswick, and University of California Davis and Santa Barbara, among others—a sign of growing national respect for our HisTEM graduate program. Our HisTEM faculty are also active in advising graduate students in the Urban Systems Ph.D. program of NJIT-Rutgers, Newark, and are also affiliated with the Ph.D. program in History of Technology, Environment and Health at Rutgers-New Brunswick.

### **Bio- and Pre-Medical Initiatives**

As part of its commitment to excellence in HisTEM, the department has begun to play a major role in the move of CSLA and the university generally toward national excellence in bio-related fields and in pre-medical education. Prof. Stephen Pemberton's undergraduate course offerings in the history of medicine—including Hist 378: Medicine and Health Law, Hist 379: History of Medicine, and Hist 381: Science and Technology in Modern Medicine—have been useful in exposing NJIT undergraduates to the social, cultural, political, and ethical aspects of contemporary medical and public health practice. These courses are not only popular with biology and biomedical engineering majors, but they also have been identified by many of NJIT's best students as both relevant and valuable preparation for their careers in medicine and the health professions. As founding co-chair of the university's prehealth committee, Prof. Pemberton has also been in the forefront of activities related to the university's increased investments in pre-medical and health education.

### **Law, Technology, and Culture (LTC)**

In 2009 the department defined a second, related area of specialization when it launched a new honors-level undergraduate major in law, technology and culture (LTC). Unique in the country, this major was designed to become the centerpiece of pre-law education at NJIT. Students in the major take both standard pre-law courses and special core courses and electives that focus on legal aspects of technology, medicine, media, and related fields. In 2012, Prof. Alison Lefkovitz joined the history faculty as the new director of LTC, and she has ably elevated LTC as the primary site at NJIT for

comprehensive prelaw education and advisement. In Fall 2014, Prof. Elizabeth Petrick joined our faculty as core addition to our HisTEM concentration, and has supported our prelaw initiatives by serving as LTC's associate director. The major now has nineteen students. There are also approximately 20 minors. The department has also expanded the LTC curriculum by adding a professional development in law 1-credit course and double majors in patent law with the biology, chemistry, and physics departments.

The department supports a vibrant, formally constituted Pre-Law Society and a stimulating program of LTC events and activities. These activities have included overnight enrichment trips (including a trip to University of Pennsylvania Law School in 2013 and to American University Law School with a visit with Cory Booker's staff in 2014); eminent guest speakers; practical workshops and forums on law school admissions including panels with lawyers and law students at the annual 3D Day event, an all-day LSAT prep course, and a bi-weekly workshop on skills necessary for gaining admission to law school; social events; and peer-mentoring with upper-class students in the Pre-Law Society providing guidance to less advanced students on courses and assignments. These efforts have led to many of our students enrolling in prominent local law schools (including Seton Hall, Villanova, Fordham, Rutgers-Newark, Northeastern, and others) and working in local courts and law firms. It is now clear that the LTC major and the pre-law program that is linked to it are not only succeeding but *could* – contingent on additional resources from the university – take pre-law education to a new level at NJIT.

## **Challenges and Opportunities**

In order to continue its development in the areas discussed above, the department must respond effectively to several challenges. The biggest challenge relates to the diminished size of the department. In the early 2000s, the history faculty numbered nine faculty (five of them women) while administering only the history B.A. and M.A. and the legal studies minor. The department currently has only six faculty (two of them women) and two lecturers (one woman), but has added the LTC undergraduate program and taken on more advisement with pre-professional programs (prelaw and prehealth) as well as serving on dissertation committees with NJIT-Rutgers' affiliated Ph.D. programs. Our faculty's active and accomplished records of university service – particularly in faculty governance – also hinges on having enough faculty to serve these programs as well as the university at large.

The HisTEM field currently has only three dedicated faculty members (Profs. Maher, Pemberton, and Petrick) and one senior university lecturer (Dr. Lisa Nocks), as well as two faculty members (Profs. Karl Schweizer and Richard Sher) who have teaching, rather than research, interests in this area. Prof. Pemberton is currently the only faculty member who specializes in bio- and medical-related fields, and our LTC director (Prof. Lefkovitz) is the only faculty member with a primary interest in the history of law. We have an additional university lecturer (Dr. Kyle Riismandel) whose teaching excellence supports prelaw, history, and communications programs in CSLA. At least one of our six faculty members plan to retire in the next few years, another could possibly retire by 2020. The silver lining here is that every projected faculty departure represents an

opportunity for the department to build up its defined areas of research excellence during the next five years.

The department's biggest challenge apart from its limited number of faculty and instructional staff is its ability to support its pre-professional programming in the legal and medical/health areas while continuing its record of excellence in history/HisTEM. Even beyond hiring, our material resources have remained limited (shrunk in real terms), as our programs and responsibilities have grown. The challenge has been experienced most acutely in relation to our new, but growing and vibrant LTC program. NJIT's expansion into bio and healthcare education and research presents another side of this challenge/opportunity. For in addition to pre-medical courses, the department is positioned to expand its offerings to include history of life sciences as well as history of medicine and health elective courses to NJIT students. The recent enrollment expansion in biological sciences, biomedical engineering, and the new bio-related majors, such as biochemistry and biophysics, has also resulted in a large increase in the number of students pursuing pre-health tracks. This, in turn, creates a demand as well as need for a strong humanities component to complement the growth in scientific and medical areas.

Another challenge faced by the department, and NJIT generally, is to hire more qualified women faculty. Ten years ago history was the only NJIT department with a majority of women faculty and teaching staff. But one woman faculty member retired, and most of the others have moved to more prestigious universities, such as Princeton, NYU,

Rutgers-New Brunswick and most recently the University of California at Irvine. Currently the women in our department number two among the faculty (both assistant professors) and another as a senior university lecturer. This is a challenge that the department should be able to meet because history is a discipline in which qualified women faculty are far more plentiful than they are in most technical disciplines.

### **Plan for Excellence I: Hiring**

The key to the department's plans to meet these challenges during the next five years is strategic hiring. The department needs to make a substantial number of hires, and each hire it makes has to strengthen at least one of our targeted areas of excellence, as well as contribute to the broader missions of CSLA and the university. It is also necessary to take steps to attract and retain outstanding women faculty, by hiring in particular areas of history in which women faculty are well represented, such as law, history of life sciences, and history of medicine/health; including at least one woman faculty member from the Rutgers-Newark side of the Federated Department of History on faculty search committees and on the NJIT department's promotion and tenure committee; and making sure that women faculty feel comfortable in the department, and at NJIT generally, once they have been hired. Although hiring a woman cannot be mandated in any particular search, it seems reasonable, through these methods, to project that for every five new hires in history, at least two should be women, and if possible more than that. Our last two faculty hires have, in fact, been women. It is also preferred that at least one of these future hires, preferably, the one supporting LTC be made at the associate professor level.

With these ends in mind, the Department has defined the following five positions as our main hiring priorities over the next five years:

1. History of Life Sciences/Biology

This person will teach undergraduate and graduate courses in the history of biology and the life sciences, with close connections to the history of health and environmental history. The addition of a historian of biology and/or the life sciences will not only contribute to our undergraduate and graduate concentrations in HisTEM but will also support other bio-related programs on campus (e.g., biology, biochemistry, bioinformatics, and biomedical engineering) as well as pre-professional education for those seeking careers in medicine, dentistry, and allied health professions. For example, elective courses in the history of biology will attract biology majors fulfilling their GUR in Lit/Hist/Phil/STS, and the new hire in this area may be able to contribute a historical segment to Biol 200: Concepts in Biology. This position has the enthusiastic support of the NJIT's Federated Department of Biological Sciences, and the search committee for it will include an interested member of that department.

2. History of Law/LTC

This person will teach core and elective courses in the history of law/legal history and will be capable of administering the LTC major program, the legal studies minor, and the NJIT Pre-Law Society, as well as in conducting university-wide

pre-law advising. Leaving the field of specialization open will increase the chances of attracting candidates whose area of expertise complements that of Prof. Lefkovitz. However, preference will be given among qualified candidates to those with specialties in the history of law in relation to a field in HisTEM. The growth of the LTC program, the need to another legal historian who can administer LTC when Prof. Lefkovitz is on research leave, the limited number of history faculty to support pre-law program while covering our HisTEM commitments, as well as the Rutgers-Newark policy of restricting the access of NJIT students to law-related courses at Rutgers (such as courses in the criminal justice program) have combined to make this hire a high priority.

### 3. History of Media/Communication and Law

This person will teach a core course in the LTC program (Hist 370: Legal Issues in the History of Media) as well as other undergraduate and graduate courses related to the history of media, communication, and law. This position will support both HisTEM and LTC, as well as the communication and media major in the Department of Humanities and other communication-related programs on campus. The department is looking particularly for someone who specializes in the historical development of twentieth-century media (e.g., television and film) and/or recent digital media (e.g., the Internet, computer multimedia, wireless communication devices, etc.) in relation to legal issues (copyright, piracy, etc.). The department previously had a faculty member, Prof. Allison Perlman, who ably filled this role. Her resignation in 2011 led to the hire of a lecturer, Dr. Kyle

Riismandel, rather than a tenure-track faculty member. Having this faculty line would create great flexibility for us in terms of supporting HisTEM, LTC, and our GUR teaching commitments (particularly if we retain the lecturer line and dedicate the teaching there to NJIT students interested in fulfilling their cultural history and senior seminar GUR requirements).

#### 4. History of Technology

Although the history of technology is a core area of HisTEM and an important field for the general mission of any technological university, NJIT has only recently hired a faculty member with a dedicated research field in this area: Professor Elizabeth Petrick, who specializes in the history of computing in the United States. The hire of Prof. Petrick was an enormous gain for the department in the wake of our last history faculty retirement in 2012. However, the department preferably needs more than one faculty member who can give it a research presence in the history of technology on a par with the contributions of Neil Maher in environmental history and Stephen Pemberton in history of medicine. The research and teaching focus of this second specialist in the history of technology would cover different areas of technology, time period, or geographic focus than Prof. Petrick. For example, she or he could teach undergraduate course such as Hist 385: Technology and Society in European and World History, which have been popular with NJIT students for many years and are also taken as core courses by students in other majors, such as science, technology and society. This person will also teach graduate courses in the

history of technology, which constitute an essential component in the graduate HisTEM concentration.

5. History of Medicine/Health

This person will complement the teaching and research of Prof. Pemberton, by specializing in an area of medical history or the history of health that is thematically and geographically different from his area of expertise in late twentieth- and twenty-first-century America. The demand for undergraduate and graduate courses in the history of medicine and public health is already large and growing steadily, and we anticipate substantial increases in demand as NJIT moves forward in medical and prehealth education.

**Plan for Excellence II: Resources**

As a “chalk-and-talk” discipline, history is an inexpensive investment for the university, without laboratories, studios, and other special facilities, technical assistants, expensive equipment, or large amounts of seed money. The starting salaries of history faculty are relatively low, and the department operates without an associate chair. At present, the department has enough office space to accommodate three or four of the five hires cited above, assuming anticipated attrition from retirements. And because virtually every undergraduate class offered by the NJIT history faculty fulfills a dual function as both a course for history and/or LTC majors/minors and a GUR course for all NJIT students, history courses (including senior seminars and honors senior seminars that history faculty teach under HSS course numbers) nearly always run at full capacity. For

example, in most academic years since 2011, the department has taught more than 1400 undergraduate students with six faculty members, two university lecturers, and several adjunct instructors.

In order to implement its development plan effectively, the department requires increased funding in the following two critical areas: support for LTC and prelaw programming and support for travel and research.

Since the founding of LTC six years ago, the director of the LTC program has always operated with limited resources. Only in the last two academic years has LTC had a small operating budget of \$3000, but such monies have yet to be converted into a permanent budget line for the department. In many years, LTC has not only had little to no budget, and its director (who has always been an assistant professor) has administered the program with little to no release time from teaching due to the small number of faculty and instructional staff in our unit. Moreover, the co-op and advising components of LTC that have made our prelaw programming so successful with students are not being adequately supported or recognized by other academic units whose students utilize the services provided by our department. For the LTC program to be successful, the burdens on the LTC director must be recognized by forms of support to the department that either align with our de facto status as the only academic unit at NJIT providing comprehensive prelaw advising. For these advising services to continue or expand, NJIT will either need to support the department's record of accomplishment in this area or these services will need to be shifted to the Albert Dorman Honors College or other academic units who have greater resources to administer them. The

NJIT history faculty has learned over the past five years that our growth of the LTC program cannot be sustained in the current resource environment without undermining the history department's primary commitments to History/HisTEM.

The LTC Director has received one-course reduction per academic years since 2012, but should receive a one-course reduction per semester to cover her administrative work. The ability to secure both course reductions as well as opportunities for research leaves hinge in the long-term on being able to hire faculty and/or lecturers to support LTC and history.

Finally, LTC needs a dedicated annual program budget of at least \$10,000 to truly succeed. This budget will cover a part-time student assistant for networking/outreach activities, funding for speakers, Prof. Lefkovitz's travel expenses on student trips (some of which has been paid out of pocket), recruiting expenses such as posters and mailing materials, necessary equipment (such as a printer capable of producing brochures), and annually updated law school admissions and LSAT materials. Combined with the hire of a second legal historian and HiSTEM faculty who can teach law-related courses in the coming years, these improvements will ensure that the LTC program has the necessary resources to reach its full potential while supplementing NJIT's previously successful investments in history and HisTEM.

Since History faculty at NJIT are research-active, they are encouraged to present papers at major conferences and to do research in archives that are sometimes located far away from the Newark area. Unlike faculty in scientific and technical areas, history faculty cannot normally obtain grants to cover their conference and research travel. Yet the amounts of money supplied for conference and research travel have not kept up with our transformation into a major research department, let alone with increased travel costs, and the entire department budget is so low that there is little money to spare for this purpose. It is also important that travel funds be a permanent budget line because it takes up to 18 months for our faculty to gain entry onto national and international conference programs. Without knowing that some funds are available, faculty participation in conferences has been unwittingly diminished. This situation is particularly unfair for assistant professors who are expected to engage such activities for their promotion and tenure, but who are paid the lowest salaries. It is therefore proposed that the department budget be augmented by at least \$10,000 per year, specifically for the purpose of conference and research travel.

## Five-Year Strategic Plan for the Department of Humanities

Over the next five years New Jersey Institute of Technology needs to commit resources to build up and re-vitalize the Department of Humanities, a severely depleted academic unit. The department is not only responsible for four degree programs and the bulk of the GUR, but also for the university's ESL instruction (graduate and undergraduate) and the NJIT Writing Center, which is devoted to tutoring. Because of the first-year composition courses and other required humanities electives, the department maintains the largest percentage of the GUR, far greater than any other department or school; it also provides several courses that NCE and other colleges require for their majors.

The Department of Humanities is indispensable for the achievement of the mission of the university: the education of technological and scientific professionals who are also well-informed citizens of a complex world. The department's core programs and courses provide the university's primary source of liberal arts education. Why is this important? The liberal arts education provided by the Department of Humanities fosters the skills that employers value most--especially the ability to collaborate with and communicate with colleagues from diverse cultural backgrounds. As Dean Deborah Fitzgerald of MIT stated last year,

the challenges of our age are unwaveringly human in nature and scale, and engineering and science issues are always embedded in broader human realities, from deeply felt cultural traditions to building codes to political tensions. So our students also need an in-depth understanding of human complexities — the political, cultural, and economic realities that shape our existence — as well as fluency in the powerful forms of thinking and creativity cultivated by the humanities, arts, and social sciences. [*Boston Globe*, 30 April 2014]

This five-year plan anticipates the need for ten additional tenure track positions at the level of assistant professor, exclusive of any potential retirements of senior faculty. The positions proposed here are necessary to achieve the teaching, scholarship, and otherwise educational mission of the department and the university. Faculty research, which will be increased by the addition of tenure track faculty (replacing university lecturers who primarily teach), redounds to the benefit of the university—in money, visibility, and enhanced reputation. The plan also anticipates the immediate need for an increase in departmental staff of one high level administrator with the title assistant to the chair.

All of the positions are connected to the ongoing research needs of the various departmental programs, as well as to the several service commitments of the department to other colleges and schools in the university. All of the proposed positions build on existing strengths of the department and have the potential for highly successful interdisciplinary research. All of the positions support the goals of the 2020 Vision plan.

### **Goals**

Over the next five years, the Department of Humanities embraces the following major goals:

(1) Maintain and expand the four degree programs: the undergraduate majors in science, technology, and society (STS); communication and media; theatre arts and technology; and the master's degree program in professional and technical communication (MSPTC);

(2) Re-focus and re-structure the graduate degree program in professional and technical communication with a forward-looking curriculum incorporating content strategy, instructional design, social network analysis, computational media, and data science;

(3) Strengthen and grow the GUR to emphasize the development of skills in critical thinking, oral communication, and writing and communication in a digital environment; as well as to provide oversight and assessment for the educational objectives of the GUR as part of a liberal arts education that is relevant for a technological university;

(4) Expand the social sciences as part of a re-configured (and possibly re-named) department, so that sociology, psychology, anthropology, and policy innovation will be represented in the broad liberal arts education of NJIT students;

(5) Develop an academic framework within both the degree programs and the GUR would meet the new standards of the 2020 Vision plan to provide students with a “connected academic community;”

(6) Expand the scope of the NJIT Writing Center and its tutoring program by creating more formalized relationships with other departments and schools within the university, hiring more tutors, and developing and maintaining ongoing sessions for students deemed at-risk;

(7) Explore the possibility of creating new graduate programs: an M.S. in STS and/or an M.F.A. in communication and media (or possibly an M.A. or Ph.D.). This goal depends on a preliminary market analysis of any need or interest for these degrees;

(8) Develop new initiatives and research opportunities in all principal areas of the department, emphasizing collaboration and interdisciplinary research within the department and across the college and university.

These goals are interrelated and interdependent. The Department of Humanities is committed to expanding its courses, programs, and research faculty in areas exploring cultural, philosophical, artistic, and social science discourses dealing with (1) computational and digital media, (2) big data as the basis for knowledge in the modern world, (3) technology and science policy, (4) environmental sustainability, and (5) the arts and culture generally, but especially as created, expressed and understood through science and technology. Students in humanities courses develop skills in communication, verbal reasoning, presentation and media use, research skills, as well as a socio-historical understanding of contemporary culture in its relationship to science and technology.

### **Overview of the Faculty Positions**

The new faculty positions being proposed are listed below. They are essential to the completion of the goals described above.

#### **I. Specialists in Humanities and the Liberal Arts (number: 2)**

For the last twenty years, all new hires in the Department of Humanities have been directly connected to one of the degree programs. We now have a critical need for scholars in the humanities who serve a more general purpose in fulfilling the educational needs of the university. We require intellectual leaders to transform and guide the overall four-year structure of the GUR liberal arts education, especially as concerns rhetoric, communication, and critical thinking across the curriculum. These positions require active researchers in many different disciplines, but all would support the GUR and the overall research goals of the department. The possible specializations for this position include literary studies, philosophy and ethics (specifically engineering ethics and ethics of technology), and art and music history.

## II. STS: Science, Technology, and Society (number: 2)

Specializations might vary but there is a need for faculty to develop courses and research in:

Political Theory of Science and Technology  
 Science and Technology Policy Innovation  
 Environmental and Sustainability Studies  
 Psychology and Sociology of Science and Technology  
 Ethics and Technology and Scientific Research  
 STS Methodology: Quantitative and Qualitative Research Methods

## III. Communication and Media and MSPTC (number: 3)

Faculty are required to explore the connections among computation, communication and media. There is a need for specific positions in computational media, digital rhetoric, instructional design, social network/data mining analysis, and visual media and art.

#### IV. Theatre Arts and Technology (number: 1)

Theatre arts and technology is the only degree program in the Department of Humanities that does not have a tenure track professor (of any rank). The program requires an academic and intellectual leader (not necessarily the program director) who combines teaching, performance, research, and scholarship.

#### V. Social Science (number: 2)

NJIT currently lacks any organized core group of social science researchers and professors. As a top rated university, we require a social science unit or organized working group. The social sciences are an indispensable part of three of the major degree programs in the Department of Humanities (STS, communication and media, and MSPTC), and comprise six credits of the lower-level GUR. Specialists in psychology and sociology, especially connected to research areas in emerging technologies, are needed to support both the GUR and core courses in the undergraduate and graduate degree programs.

#### **Overview of Staff Position**

The Department of Humanities currently has two staff positions, a departmental administrator and an administrative assistant. This is inadequate for a department of our size. Note that the Federated Department of History (roughly one-fifth the size of Humanities) also has two staff positions; the Department of Mathematical Sciences, which is roughly the same size, has five staff positions. The department requires an assistant to

the chair who would take on some of the duties of the current departmental administrator.

## **Five-Year Strategic Plan of the Department of Mathematical Sciences**

The Department of Mathematical Sciences (DMS) at NJIT has long had a deep sense of its research and educational mission. Over the past three decades this self-understanding has permitted highly effective planning and implementation that has transformed DMS from a service department with the narrow purpose of teaching engineering calculus into a complete department of mathematical sciences that offers multiple degree programs, engages in research mentoring at all levels, conducts internationally recognized research in mathematics and its applications, builds infrastructure to support this mission, and serves the mathematical needs of the full range of disciplines now represented at NJIT. The environment in which DMS considers the future has many uncertainties. The State of New Jersey faces fiscal pressures making robust support of education in general and higher education in particular difficult. Budgetary concerns at the national level portend a challenging funding environment for the sciences including the mathematical sciences. DMS joins with the larger NJIT community in planning for and succeeding in this future through the implementation of the 2020 Vision strategic plan. Happily, the capacities and interests of the department align well with the major ambitions of 2020 Vision towards which DMS hopes its efforts will be a major contribution.

### **History**

The last three decades makes clear the overall trajectory of the department as a leading

department on the national and international stages in mathematical sciences and towards excellence in fulfilling the mathematical needs of all NJIT students. A review of this history reveals the enormous progress that has been made in these directions and brings into focus the immediate steps needed to continue our upward trajectory. In the early 1980s DMS had only two small degree programs, the M.S. in applied mathematics (1975) and the B.S. in statistics and actuarial science (1984); the primary function of the department was instruction of the engineering calculus sequence<sup>8</sup>. At that time a small group of faculty harbored much greater ambitions for the department and in 1986, Daljit S. Ahluwalia arrived from NYU's Courant Institute of Mathematical Sciences with the mission of bringing these ambitions to life. Among his earliest actions was to develop a hiring policy to build a research active faculty. Significant developments in all aspects of the department's mission have continued at a steady rate since; some essential milestones are catalogued in the table below.

#### Milestones in the Mathematical Sciences at NJIT since 1986

1986: Center for Applied Mathematics and Statistics (CAMS) founded.  
 1986: Seminar in Applied Mathematics initiated.  
 1986: Department has 24 tenured and tenure-track faculty members.  
 1988: B.S. in Applied Mathematics begins.  
 1988: Department moves into renovated space on 5th and 6th floors of Cullimore Hall.  
 1990: Gregory Kriegsmann joined NJIT as Foundation Chair in Mathematical Sciences.  
 1992: First two NSF SCREMS grants received to develop computational servers.  
 1994: Doctoral Program in Mathematical Sciences inaugurated with a track in Applied Mathematics.

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<sup>8</sup> The 1981 assessment report of the department states the department's primary mission is "to provide excellent undergraduate education in applied mathematics which is relevant to the engineering student."

- 1994: CAMS Summer Research Program for Graduate Students founded.
- 1994: Department ranked 85th in the nation by research expenditure--first time better than 100th.
- 1996: The CAMS Statistical Consulting Laboratory founded.
- 1997: CAPSTONE Laboratory established with NSF grant.
- 1998: Department name changed from "Mathematics" to "Mathematical Sciences."
- 1999: NJIT Pi Mu Epsilon chapter (Mathematics honor society) established.
- 1999: CAMS Reading Room (first established in 1993) is renovated.
- 1999: M.S. in Applied Statistics established.
- 2000: Applied Statistics and Probability track added to the Doctoral Program in Mathematical Sciences.
- 2003: B.S. in Mathematical Sciences consolidates undergraduate math majors.
- 2003: DMS selected as one of three units for Strategic Initiative funding.
- 2004: Frontiers in Applied and Computational Mathematics (FACM) initiated.
- 2004: Undergraduate Biology and Mathematics Training Program grant received from NSF.
- 2004: Division of Biological Sciences formed in DMS.
- 2005: DMS computation cluster developed with an NSF Major Research Instrumentation (MRI) grant.
- 2006: Robert Miura received the Leroy P. Steele Prize for Seminal Contribution to Research.
- 2006: Department has 48 tenured and tenure-track faculty members.
- 2006: Registration in NJIT math courses for AY 06-07 reached 5,658.
- 2007: C2PRISM grant for infusing computational science into high schools received.
- 2007: DMS ranked 10th in the nation for faculty productivity by Academic Analytics.
- 2007: Department of Biological Sciences established from the DMS Division of Biological Sciences.
- 2008: M.S. in Biostatistics initiated.
- 2009: Gregory Kriegsmann and Robert Miura named to the inaugural class of SIAM Fellows.
- 2009: M.S. in Mathematical and Computational Finance established.
- 2009: Department ranked 36th in the nation by research expenditure--best ranking to date.
- 2011: Mathematical Problems in Industry (MPI) workshop held at NJIT for the first time.
- 2015: An all-time high of 8,351 registrations in NJIT math courses in AY 14-15.
- 2015: The Northeast Complex Fluids and Soft Matter Workshop held at NJIT for the first time.
- 2015: Department has 36 tenured and tenure-track faculty members.

## **Mission**

The department's thorough understanding of its mission enables it to coordinate its activities, effectively utilize the talents of its members, and distribute governance throughout the department. The department has long understood its mission to produce high quality research in mathematics and its applications and to provide a high quality, appropriate mathematical education to all NJIT students (<http://math.njit.edu/about/mission.php>). The maintenance of this mission as a contemporary instrument enabling self-governance requires periodic department-wide review and refinement. Towards this end, DMS will conduct a yearlong review in AY 15-16 towards adoption of an updated mission statement at the beginning of AY 16-17. Two issues in particular deserve discussion and refinement at this juncture: the highly interdisciplinary applied mathematics found in DMS and the integration of research and education.

### **Research**

The faculty of DMS will develop and implement robust research programs that are fully competitive on the national and international stages and fully integrated into its instructional programs. Our ambition is for our faculty to gain, within the appropriate international communities, recognition of their leadership in their areas of research. The most fundamental evidence of such leadership is frequent publication in the leading journals of their discipline. Our goal is to increase the production of refereed journal publications per faculty member by 25% by 2020. Combined with DMS hiring plans, this increase would bring the department to 100 referred journal publications in AY 19-20.

This important goal is nonetheless secondary to the goal of improving the quality and recognition of the publication of DMS faculty. Indicators of the quality of faculty publication include external awards such as grants wherein a community identifies its leaders. DMS plans to increase the fraction of the faculty with major external grant support (PIs and Co-PIs) from 55% in AY 14-15 to 70% in AY 19-20. Combined with the DMS hiring plan, this increase would bring DMS to 32 members with major external grant support. In overall research funding, the department seeks to regain its 2009 NSF ranking of 36<sup>th</sup> in the nation. To promote the DMS for recognition beyond grant awards, we will establish a recognitions and awards committee to assist faculty in establishing and publicizing records of accomplishment appropriate for recognition from their academic communities.

In addition to being an affirmation of the work of researchers, research grants provide essential support for research efforts. Securing such support for travel, students and other research associates, and essential equipment is necessary to the health of the research enterprise in DMS. The current funding environment presents significant challenges. Some have seen in NSF's recent sunseting of the funding for the Institute for Mathematics and Its Applications (IMA) and the Mathematical Biosciences Institute (MBI) a particularly difficult future for the interdisciplinary work on which DMS has built its reputation. Our response must be continued efforts to demonstrate the value of interdisciplinary research to the larger community and, where appropriate, seek out a wider range of funding sources.

## **Mentorship**

The supervision of research is the point at which the research mission and the educational mission of the university are most profoundly in harmony both philosophically and practically. The cost associated with the low mentor-protégé ratio inherent in the authentic supervision of research dictates that it must be used with care, but its potential to give students life changing educational experiences and to achieve the 2020 Vision goals for milestone experiences makes evident the need for DMS to continue and deepen the use of this model.

DMS has a significant history of implementing and encouraging supervision of research for undergraduate students. The proclivity of DMS faculty to guide undergraduate research was formalized in the course structure for undergraduates in Applied Mathematics in 1997 with the establishment of the capstone laboratory through an NSF CCLI grant and the association of Math 450 and Math 451 with that laboratory. A second NSF CCLI grant awarded in 2005 provided a substantial update for the lab. DMS has implemented four major training programs funded by NSF (UBM 2004-2010, CSUMS 2007-2010, UBM 2009-2013, EXTREEMS-QED 2013-2018). In academic advising, DMS has always encouraged students to pursue internships and REUs appropriate to their interests whether at NJIT, another university, a government laboratory or in industry. To maintain and expands the department's undergraduate research mentorship, DMS will explore the following:

- To allow for more extensive and in depth research projects, consider extending options for students to extend the yearlong capstone experience to include the summer and/or spring semesters before the senior year.

- To increase the availability of mentors, consider bringing graduate students regularly into roles as mentors for undergraduate research projects.
- To provide undergraduate students local access to local research programs, grant opportunities for these will be periodically reviewed and proposals organized when appropriate.
- To help undergraduate majors understand the research and internship opportunities that are available, major advisors will discuss these with advisees from their arrival in the department and annual events will be held to publicize current opportunities.
- To provide further research opportunities to undergraduates, DMS faculty will utilize funding sources including REU supplements and the Provost's Undergraduate Summer Research Awards.
- To serve high school students and enhance the recruiting of high performing students to NJIT, consider integrating high school students into research programs in the department.

At the graduate level the guiding of the thesis has long been the pinnacle of research mentorship. However, the thesis is by no means the only instance of research mentorship in the graduate programs. The CAMS summer program for graduate students has long been a mainstay for DMS faculty to assist graduate students make the transition from habits and methods of effective classroom learner to the habits and methods of the effective researcher working at the frontiers of knowledge. Courses such as statistical consulting and the mathematical and computational finance forum serve important mentoring functions. To continue this tradition, the department will:

- Continue to review and revise the transition of graduate students from the classroom to research--mindful of the rationales for the approaches used in the various sub-disciplines represented in the department.
- Continue to review and revise the needs and structure of thesis advisement to allow effective mentorship and timely completion.
- Consider expansion of application focused forum courses to areas, particularly M.S. programs, where they may be appropriate.
- Consider seeking out and developing external opportunities for graduate students at other universities as well as industrial and government laboratories.

The importance of mentorship extends beyond the doctorate to postdoctoral fellows.

To maintain and extend this tradition, an *ad hoc* committee on the professional development of postdoctoral associates will be appointed with charges to review the needs of postdoctoral associates for professional development and recommend formal processes to support their development in the areas of research, publication, proposal writing, teaching, mentoring, written and oral communication, and computing.

Mentoring is also crucial to the development of the junior faculty in DMS. Timely progress of faculty members from the rank of Assistant Professor to the rank of Professor is an important objective the department. DMS will initiate a new departmental committee for the faculty mentoring led by the department chair to undertake the following tasks:

- Formulate and present to the departmental P&T promotion plans for all members below the rank of professor who desire to participate.
- Provide individual mentors to guide candidates in the implementation of her/his promotion plan, assist candidates in the construction of P&T cases, and present the cases to the P&T Committee.
- Provide professional development opportunities in the areas of research, publication, proposal writing, teaching, mentoring, written and oral communication, and computing.

### **Curriculum and Instruction**

NJIT's 2020 Vision includes a major effort to improve curriculum and instruction. The intensity and diversity of the department's involvement in instruction ensures that DMS will play a significant role in these efforts. The department has the following plans to support undergraduate and graduate education:

### Undergraduate curriculum and instruction

- Improve the curriculum for undergraduate math majors to enhance computing skills.
- Improve the curriculum for undergraduate math majors to include new opportunities to improve theorem-proving skills—particularly for students planning to attend graduate school.
- Develop improved understandings of the mathematical needs of students in client departments to better serve these students.
- Develop within the system of faculty mentorship active assistance with issues in instruction.
- Increase the availability of full-time instructors—particularly in first-year courses and statistics GUR courses.
- Increase (from one) the number of full-time instructors involved in the delivery the courses in the actuarial science track of the B.S. in Mathematical Sciences.
- Develop methods to effectively introduce the services of the Math Tutoring Center as early as possible to new students.
- Perform an annual review of placement to maximize student success in the calculus sequence.

### Graduate curriculum and instruction

- Undertake a review aimed at refining the core curriculum appropriate for the DMS doctoral degree.
- Facilitate the transition of graduate students from classroom learner to researcher.
- Improve program elements and expectations to enhance computing skills.
- Expand opportunities for graduate students to develop skills as mentors and instructors.
- Encourage graduate student contacts, such as internships and the MPI workshop, with industry.
- Consider the development of online/hybrid courses as a remotely accessible introduction to M.S. programs.

### Management tools

- Develop automated tools to analyze and manage the flow of students through course sequences (including placement).

- Develop automated tools to analyze course performance in terms of prerequisite grades of students entering the course and grades of students in downstream courses.

### **Service and Infrastructure**

Service is the activity required to build and maintain the essential infrastructure of DMS and CAMS. Some critical service and infrastructure items include:

- Maintain and enhance the organization of seminar, colloquia and meeting activities that bring scientific colleagues from around the world to NJIT.
- Maintain and develop appropriately the computational facilities of DMS and CAMS.
- Strengthen the DMS student advising systems at all levels to enhance timely graduation and the intellectual and professional development of students.
- Work towards a more effective merit system for DMS faculty through the appointment of a Merit and Compensation Committee.
- Work towards gaining recognition of the accomplishments of DMS members through the appointment of a Recognition and Awards Committee.
- Enhance graduate student offices and other departmental facilities.
- Consider development of events for high school students in support of recruitment.
- Consider expansion of the activities of the CAMS Statistical Consulting Laboratory to create more connections to research both inside and outside NJIT.

## **Five-Year Strategic Plan for The Department of Physics**

Research within the Physics Department at NJIT is carried out within several themes, mainly:

- Solar-terrestrial physics
- Optics, imaging, and remote sensors
- Biophysics
- Condensed matter, materials, and device physics

Twenty faculty members and a similar number of research professors and postdocs supervise several dozen undergraduate and graduate students (20 PhD students and 13 master students in the program in applied physics). The materials science and engineering program, with another 25 graduate students, is also centered within the Department of Physics. Every year about eight graduate students receive their PhD degrees. Tight collaboration with industry, various solar and terrestrial observatories, and national labs is a distinct feature of our department. Among recently hired faculty members are experts in computational biophysics and helioseismology. Most of the graduate and some undergraduate students affiliated with the department work at the intersection between the traditional academic environment and state-of-the-art national facilities and industrial labs.

The goal of the department is to educate the next generation of scientists, engineers, and scientifically informed citizenry through research-intensive education in the physical sciences and related technologies. In these days of rapid changes in science and technology we are also faced with the fact that progress requires interdisciplinary

approaches. Many advances in science and technology are not within one discipline but occur at the boundaries of several disciplines, which is evident by the collaborative research activities at Physics Department.

## **SOLAR-TERRESTRIAL PHYSICS**

### Center for Solar-Terrestrial Research (CSTR)

The Center for Solar-Terrestrial Research (CSTR) at NJIT is an international leader in ground- and space-based solar and terrestrial physics, with an interest in understanding the effects of the Sun on the geospace environment. CSTR operates the Big Bear Solar Observatory (BBSO) and Owens Valley Solar Array (OVSA) in California, the Jeffer Observatory at Jenny Jump State Forrest in New Jersey, and the Automated Geophysical Observatories (AGOs) distributed across the Antarctic iceshelf. The center also manages a large number of instruments at South Pole Station, McMurdo Station, across South America, and across the United States. CSTR is also a PI organization in the NASA Van Allen Probes mission and houses the Space Weather Research Laboratory (SWRL), which does scientific research in the area of space weather with the mission to understand and forecast the magnetic activity of the Sun and its potential influence on Earth. Such instrumentation and data resources enable scientific studies spanning from the Sun's surface, into the Sun's extended atmosphere, and onwards into the Earth's atmosphere. CSTR makes NJIT the only university in the U.S. with a group whose studies span the entire and complete system stemming from the Sun to the Earth.

CSTR assets have grown enormously since it was founded in 1997 as the Center for Solar Research, without any corresponding change in the size of the affiliated faculty. For the current fiscal year (FY15), center members are PIs on about \$6.6 M in federal and international collaborative grants. The CSTR is currently comprised of six senior members including four regular faculty (Cao, Gary, Gerrard, and Wang) and two senior research faculty members (Goode and Lanzerotti). In addition to the senior faculty, there are ten research professors, eleven research engineers, and three administrative staff members. Currently there are two postdocs and 13 Ph.D./MS graduate students. Our recent postdoctoral associates and graduate students have gone on to make their marks in universities, NASA, national centers, and industry. Our successes have made NJIT one of the most significant universities in the U.S. in geospace sciences.

In addition to the CSTR activities, the recently proposed computational heliophysics research program will be housed within our department under leadership of Professor Kosovichev. This center was proposed with the primary goal to develop data analysis and modeling tools in the area of heliophysics by combining the expertise of the College of Computing Sciences (Computer Science Department) and College of Science and Liberal Arts (Departments of Physics and Mathematical Sciences), and establishing a partnership with the NASA Advanced Supercomputing (NAS) Division at the NASA Ames Research Center. The Center will focus on new innovative approaches, including development of intelligent databases, automatic feature identification and classification, realistic numeric simulations based on first physics principles, and observational data

modeling. The center will develop a synergy of these approaches and will make substantial advances in heliophysics and computer science.

### **OPTICS, IMAGING, AND REMOTE SENSORS**

In the area of optics, imaging, and remote sensors, there are four faculty members (Federici, Gatley, Sirenko, and Zhou) whose primary research emphasis is photonics and optical characterization of materials. This group strongly collaborates with both the biophysics group as well as the condensed matter physics group. To expand the research specialties of the optical science and photonics— and to further collaboration within physics and interdisciplinary research with other departments—we plan to establish strategic research in the areas related to imaging, remote sensing, and far-infrared/THz ellipsometry.

The short-term goal in this group is to establish an interdisciplinary research center in the area of remote sensing. The field is ripe with funding opportunities distinct from the research activities based in the Center for Solar-Terrestrial Research. Specifically, the research center in remote sensing will emphasize optical techniques for remote sensing in industrial, agricultural, military, medical and forensic science applications. As examples, the department's optical remote sensing group has a pending approved proposal with the US Army Night Vision Lab at Fort Belvoir and recently won a \$356,039 grant from the Department of Justice to build a "Hand-Held Multispectral Camera for Crime Scene Investigation". Potential funding sources for imaging sciences and remote sensing include DARPA, NASA, Jet Propulsion Lab, US Geological Survey,

DOE, Department of Agriculture, US Forest Service, USAF, National Ecological Observatory Network (NEON), NSF, NGIA, NSA, CIA, NIJ, as well as public and private companies. The development of a core research expertise in multispectral imaging and remote sensing will open up a variety of funding opportunities for NJIT for which we would otherwise not be competitive. In addition to new sources of funding, this research initiative will also attract graduate and undergraduate students who normally would not consider NJIT as their university of choice. The inherent governmental/commercial interest in the technologies resulting from NJIT's investment in this area also suggests a realistic expectation of Intellectual Property revenue from faculty inventions.

Another direction of research in our department is THz spectroscopy with applications in materials, health, and defense areas. In particular, the field of far-infrared/THz ellipsometry is the main priority for our optics group. Far-IR /THz ellipsometry instrumentation and software development have a number of applications: from studies of magnetic phase transitions in multiferroic crystals to the measurements of the film thickness and carrier mobility/concentration in metallic and superconducting samples. Our faculty developed a unique far-IR full-Mueller matrix ellipsometer that has been installed at the National Synchrotron Light Source, Brookhaven National Lab. This research and development effort is supported by funding from NSF and DOE in a total amount over \$1M. One of our future goals is to build a multiuser ellipsometry facility at the most advanced synchrotron source, NSLS-II, where it will be open for national and international users. The main theoretical challenge in this project is development of

analytical models for fitting and simulation of the light propagation in bi-anisotropic media and in materials with the negative index of refraction

## **BIOPHYSICS**

The primary goal of the biophysics group is excellence in teaching students through connections to research. It is our philosophy that creative researchers are inspiring teachers, and that the students should be our central focus at NJIT. In the next five years we will create a reputation for our biophysics program that will recruit enough new biophysics students to double the number of physics majors. Already under way is the Biophysics Summer Research Program in which outstanding high school students and undergraduates collaborate with our faculty in exciting research projects. The program has grown from 14 students in 2013 to 25 students last year. These student researchers produced results that were presented in the NJIT Summer Research Symposium. Some of the top undergraduates continued their work during the school year. The projects on which they worked included a smart shunt to prevent brain damage that was then tested in sheep, a personal tonometer to prevent blindness that was tested in patients, computer models of proteins, the dynamics of microtubules growth and an impact recorder that powers itself and helps protect people who handle explosives. The students and faculty also collaborated in nano-scale bio-devices to measure the health of living cells, implantable nanotube fuel cells with the highest power density ever measured and an artificial pancreas to prevent the complications of diabetes. This work on the molecular scale has received recognition in the journal *Biosensors and Bioelectronics*, in the ABC News program "This Could Be Big," and in a

nationally televised TED talk. The biophysics group is also exploring the theory of protein thermodynamics in a wide range of ambient pressures and temperatures. The goal here is to secure research funding from NSF and NIH.

Our five-year goal also includes raising the retention rate in biophysics courses to 85%, while at the same time doubling the number of biophysics courses. We have started this process by introducing a new course called the Physics 204: Biophysics of Life. In its second year the number of students has more than doubled up to two complete sections. The retention rate last semester was 90%. The student evaluations were enthusiastic and numerically the highest in the physics department at the lower division. The course is demanding as it requires four research reports and three verbal presentations, each involving quantitative graphical analysis. These courses are our model for the new courses we envision. Our other courses, Biophysics I and II (Physics 350 and 451) are also increasing in number of students. They have an emphasis on mathematical analysis of data trends and statistical variations. Again, the student evaluations put these courses among the top in the physics department. We are also improving the long-standing biophotonics course, OPSE 410, to make the student's learning more creative.

Recently a BS program in biophysics has been found with the goal of growing the number of students involved in research projects. Students are an integral part of our biophysics research. In 2015 we have three graduate students and seven undergraduates. In the area of biophysics we have three faculty (Thomas, Prodan, and

Dias) and two research professors (Farrow and Kanwal). For our goals of improving and increasing the number of biophysics students and courses, the concomitant goal follows of adding two faculty members to cover the new courses and the integrated research. We need these faculty to be committed to our philosophy of a fruitful combination of research with students and enthusiastic teaching. Our additional five-year goal is to create a biophysics undergraduate laboratory like the OPSE lab so that each of our courses can increase the opportunity for the students to carry out hands-on learning. We will plan the new lab and then seek funding. We believe we can achieve these student-centered goals because of our success in teaching and related research. Members of the biophysics group have won the NJIT Award for Excellence in Lower Level Undergraduate Teaching, the Albert Dorman Honors College Award for Faculty Service, and the NJIT Award and Medal for Excellence in Research.

In the next five years we plan to increase our work to bring out the talents of students to create intellectual property. A patent for a nano-scale biofuel cell using carbon nanotube technology will be issued in the fall of this year. This breakthrough was featured by NBCNews.com in 2014 as part of its Science of Innovation Series in collaboration with the US Patent Office and the National Science Foundation. The smart shunt program led by several biophysicists has received continued NIH funding to develop and test an implantable device that helps in the treatment of hydrocephalus. Our work with students on these new biosensors has been recognized by the National Academy of Inventors, which inducted Professor Gordon Thomas, one of the members of our group, this spring.

## **CONDENSED MATTER/MATERIALS/DEVICE PHYSICS**

Two main thrusts of research within condensed matter/materials/device physics group are synchrotron-related research on materials properties and research on materials and devices for renewable energy. These two research areas cover largely the current research activities within the group. The goal for 2015-2020 is to strengthen these two main research areas. This goal should be achieved through concerted efforts to increase the funding levels, the number of graduate students, publications (including publication in high impact journals), and patents.

For the synchrotron-related research on material properties, the proximity to the newly built National Synchrotron Light Source II at the Brookhaven National Laboratory (BNL) is a unique advantage to NJIT. In the area of condensed matter research, the focus of the Department of Physics is on structure-transport correlations and critical behavior in transition-metal oxide systems. Our faculty members are working in the following overlapping areas: spin and lattice dynamics in complex functional materials; methods to calculate spectrum from resonant inelastic X-ray spectroscopy; correlation effects in atomic and molecular systems; and investigation of the origin of magnetic properties of thin films. We will expand our efforts to investigate new materials synthesized in collaboration with the Rutgers Center for Emergent Materials, studied with advanced synchrotron-based probes and elaborate theoretical approaches. We will increase the funding level, number of graduate students (including number of available RA positions), and number of papers by 50 percent by 2020.

Second, as for the research on materials and devices for renewable energy, sustainability is one of the thrust areas in NJIT strategic plan. The condensed matter/materials/devices group in the department should lead the efforts. Research on materials for solar cells and research on design of novel wind mills will be the main research topics, which also includes the synthesis and characterization of thin films for micro- and nano-electronic, photonic, and solar applications. We will strengthen the existing and seek new collaborations with national labs and companies. Ongoing research activities at Apollo CdTe Solar Energy Research Center will be focused on improving the applications of CdTe semiconductor materials for use in thin-film solar modules. Again, we aim 50 percent increase of the funding level, numbers of graduate students, publications, and patents by 2020.

By working very closely with industry including start-ups and national labs (e.g., IBM, PPM Inc., PSS Inc., Orycon Inc., New ETD, Princeton Optronics, National Renewable Energy Laboratory, Brookhaven National Laboratory, Argonne National Laboratory, and Los Alamos National Laboratory), the condensed matter/materials/device group expects to enhance its research focus. Some of the new research activities include design of: new turbines for applications in windmills; graded bandgap structures for solar cell applications, novel approaches for production of hydrogen, transition metal oxide thermoelectric etc. Device studies also include uncooled bolometers, imagers and light emitting diodes. The research focus will continue to be along the lines of materials, devices and device integration. Device integration will include 3-D printing, magnetic

field assisted assembly and pick and place approaches. In addition to the students in the PhD program, students enrolled in the Masters' program are being encouraged to participate in research. Their participation will include attendance and presentation of their research at international research meetings as well as publishing their results in peer-reviewed journals. Efforts are in progress to provide partial support for students enrolled in the masters program, in addition to the full support for PhD program. This will increase the enrollment of students in the masters and PhD program. Particularly, for the masters program, in addition to providing enhanced research opportunities for students, this will also enable the students to be introduced to research at NJIT, resulting, thereby, in their continuing to pursue their PhD either at NJIT or at other universities.

In addition to providing a strong infrastructure, including laboratories, which will supplement courses such as PHYS 687, PHYS 789, MTSE 719, the program will continue to work towards assisting/guiding students to obtain internships and jobs. Efforts are already underway and companies including Intel, Princeton Optronics, Thorlabs, Edmond Scientific and BOSE have made commitments to our graduating students. This will not only result in increase in enrollment in graduate programs in physics but will also contribute to a strong alumni base.

Appendix C  
Planned Hires by Research Cluster

**Life Sciences**

Microbial Genomics (DBS)  
Evolutionary Developmental Biology/Genetics (DBS)  
Biological Control Systems (DBS)  
Biophysics (PD)  
Imaging of Nano-structured Materials (PD)  
Time-resolved X-ray (PD)  
Biomaterials (CES)  
Bio-organic Synthesis (CES)  
Bio-analytical Chemistry (CES)  
Structural Biology (CES)  
Statistics and Data Analysis (DMS)  
Positions in the History of Biology/Life Sciences and History of Medicine (History)

**Advanced Materials and Processes**

Multispectral Imaging (PD)  
Instrumentation Development (PD)  
Computational Condensed Matter Physics (PD)  
Complex Oxide Synthesis (PD)  
Imaging of Nanostructured Materials (PD)  
Time resolved Pump-probe X-ray (PD)  
Data Analysis/Modeling in Solar-Terrestrial Plasma Physics (PD)  
Biomaterials/Nanotechnology (CES)  
Bio-organic Materials (CES)  
Solid State Materials Chemistry (CES)  
Organometallic Chemistry/Catalysis (CES)  
Wave Propagation (DMS)  
Applied Stochastic Modeling (DMS)

Appendix C  
Planned Hires by Research Cluster

**Sustainability and Security**

Landscape and Remote Sensing (DBS)  
 Microbial Genomics (DBS)  
 Biological Control Systems (DBS)  
 Evolutionary Community Dynamics (DBS)  
 Bio-organic Synthesis/Green Manufacturing (CES)  
 Environmental Policy and Management (CES)  
 Bioanalytical Chemistry (CES)  
 Organometallic Chemistry/Catalysis (CES)  
 Water Treatment (CES)  
 Wave Propagation (DMS)  
 Applied Stochastic Modeling and Analysis (DMS)  
 Statistics and Data Analysis (DMS)  
 Terrestrial Physics (PD)  
 Data Analysis/Modeling in Solar-terrestrial Plasma Physics (PD)  
 Solar Radio Physics (PD)  
 Optics/Remote Sensing (PD)  
 Optics/Instrumentation Development (PD)  
 Biophysics (PD)  
 Computational Condensed Matter Physics (PD)  
 Time-resolved X-ray Measurement (PD)

**Data Science**

Applied Stochastic Modeling and Analysis (DMS)  
 Statistics and Data Analysis (DMS)  
 Terrestrial Physics (PD)  
 Data Analysis/Modeling in Solar-terrestrial Plasma Physics (PD)  
 Solar Radio Physics (PD)  
 Optics/Landscape/Remote Sensing (DBS and PD)

**Science/Society Interactions**

Two historians of law (at least one specializing in issues relating to media and communication)  
 An historian of technology  
 Two humanities faculty to steward the GUR (specialties may include literary studies, professional ethics, or art history)  
 Two specialists in Science, Technology, and Society (specialties may include psychology, sociology of science, philosophy of science, or environmental studies)

Three specialists in communication and media (specialties may include computational media, social networks, or visual media)  
A specialist in environmental policy and management