

To: Professor Mike Nichol  
President, Academic Senate

From: Shri Narayanan  
Chair, University Research Committee

The Joint Senate-Provost University Research Committee of 2008-2009 focused on a number of key items related to advancing research at USC, organized in two major themes: (1) Biomedical and Biological Research: Charting a University-wide Strategy (Subcommittee chaired by Professors Andrea Kovacs and Richard Roberts) and (2) Collaboration (Subcommittee chaired by Professors Steven Goodman and Margaret McLaughlin). In addition the committee undertook activities in support of the Office Research Advancement as well as hosted dialogs with a number of colleagues from across USC throughout the academic year.

The activities of the committee have culminated in two milestones. The first, implemented in terms of a unique "Collaboration Retreat" hosted in March 2009, and summarized in the following pages. The second, a comprehensive document summarizing the opportunities and recommendations to consider in promoting Biomedical and Biological Research at USC.

### **Summary Statement for the Collaboration Retreat**

On March 27, 2009, the Office of the Vice Provost for Research Advancement and the Academic Senate co-sponsored a retreat to take advantage of USC's vast faculty expertise. The goal was to mine these resources by facilitating the introduction of faculty members from varying disciplines and having them develop new and innovative proposals on site. To simplify the process this first retreat of its kind was limited to the topic of health care.

The day-long retreat was held at the Davidson Conference Center on the UPC campus. Although almost 60 faculty members from various schools had signed up, only 24 elected to participate. After opening remarks by Vice Provost for Research Advancement Randy Hall, organizers Margaret McLaughlin (Annenberg) and Steve Goodman (Dentistry) started the proceedings with a round of 'speed dating.' The goal was to take an hour to have each faculty member introduce himself or herself in a 3 minute interview. During this time most of the participants got to meet the other attendees, and in doing so briefly introduced themselves, their professional interests and on-going projects that dealt with health care.

At the end of the speed dating session, attendees self- assembled into teams to build proposals. Four groups were formed and each got down to creating proposals based on their combined areas of expertise.

After several hours and through lunch, each team developed a short presentation on their proposal. Specifically, groups worked out proposals dealing with complications in rural pregnancies, communications amongst HIV patients, clinicians and basic researchers, creating sensor devices to help facilitate care for diabetic patients, and positioning a mobile clinic in needy Los Angeles communities based on their geography and feedback from patients. All the attendees then voted for the best proposal, i.e., the one most likely to succeed in getting external funding. The group that created the HIV Communication Project was voted the winner and received \$17,000 from Randy Hall to facilitate the development of the project. Interestingly this same group, headed by Andrea Kovacs, was able to submit a Challenge Grant in time to take advantage of the US government stimulus package.

At the conclusion of the collaboration retreat, participants were asked to complete a brief evaluation. Twenty-one respondents completed the survey. When asked how they had heard about the retreat, most learned about it from the email from the Vice Provost for Research Advancement or from a colleague. Incorporating the announcement in a Senate email or asking the research deans to promote participation did not seem to have been effective ways to build interest in the retreat. When asked about their purpose in attending, almost everyone responded that they were looking for collaborators for future projects, although about a third of them were interested in the Challenge grants which were due within a few weeks of the retreat date. About half of the respondents were there in part to find out about areas of overlap between their own field and other disciplines. A few were looking for an existing proposal that they could join.

The retreat had separate phases devoted to speed dating, team building, and proposal preparation. Most of the participants thought that the team building and proposal preparation phases were sufficiently long for their purposes, but that additional time should have been allocated to speed dating. One hour was not sufficient for each participant to meet everyone there. Most of the participants thought that there were a sufficient number attending, although about a third thought a larger group would have been desirable. The organizers noted that the desire to meet everyone through speed dating is not entirely compatible with a significantly larger group size. One participant expressed disappointment that there were not more faculty attending from 'key schools' for addressing health care issues including Keck, Social Work, and PPD.

Participants were asked to evaluate whether or not the conference was actually useful to them. About half agreed that they had met people whom they would add to a current project of their own, and a similar number had met others who would be likely to invite them to join a project. Nearly all agreed that they had met people they could collaborate with in the future, and had engaged in useful preliminary conversations with them about a new project. Almost all agreed that they had met people who shared their interests, and that the retreat was a good use of their time. Nearly all agreed that they would attend another similar event next year, and that they would recommend such an event to their colleagues. Participants had a number of suggestions for future retreat topics, including the basic medical sciences, business, arts in society, rehabilitation, and applying for grants. We note that there have been at least two retreats focusing on these or similar topics held during the past year by the Office of the Vice Provost for Research Advancement.

This retreat evolved from the collaboration subcommittee of the University Research Committee (URC). The URC has been committed to identifying approaches that lead to innovation. One way is to simply create and sustain interdisciplinary research groups. This retreat posed the question 'is the most critical step in the initiation of these groups merely the opportunity to be sufficiently introduced?' Given the opportunity to spend the day in search of fellow faculty members that have a common interest (in this case health care), attendees were elated to find that USC has untapped faculty expertise and resources. This retreat vehicle should prove invaluable in tapping into this vast reservoir of talent.

# **Biomedical and Biological Research: Charting a University-wide Strategy**

USC University Research Committee, 2007-2009  
Biomedical and Biological Research Subcommittee

## **I. Background**

We are currently faced with an array of problems that relate to healthcare, education, and our fundamental understanding of biology. In the US, there is an ongoing and inexorable increase in the cost of medical care. From a global perspective, no nation is an island and we must acknowledge that the health problems of one place are both the problem and responsibility of all. Our local community is in fact a microcosm of this larger world. Los Angeles is the second largest and among the most diverse cities in the United States. As such, our clinics treat health problems that occur both in developed and developing countries.

In working to address those problems, the importance of education also becomes clear—in terms of the need to educate patient populations with regard to their treatment, the need to have a scientifically literate population that will understand the problems and opportunities at hand, and the need to educate a new generation of scientists and clinicians that can effectively work across traditional disciplinary boundaries.

Finally, basic science and engineering provide the opportunity to fundamentally change our understanding of biomedical problems and biological systems as well as provide new routes for treatment and diagnosis. There are many aspects of biology that we understand incompletely—neuroscience, virology, immunology, and cancer, to name a few. Importantly, research to address these challenging problems (such as the concerted effort to treat and cure HIV) produces many scientific and societal advances that benefit our community as a whole.

In thinking how to address these complex, interrelated problems, the central and essential role of the University becomes clear. The structure and profit imperatives of modern corporations has resulted in dramatic decreases in fundamental R&D programs. Many problems, such as treating indigent populations, simply cannot be addressed in a corporate setting because there is no business model that would support such work.

Universities are probably the only place that in modern society fosters the environment, the people, and the motive to address and solve these problems. USC has a unique position in the United States and should take advantage of that to play a leading role. We are one of two major academic institutions serving the 10 million people who live and work in Los Angeles County and the nearly 16 million within the Southern California region. As such, it is imperative that USC continue to strengthen its leadership in addressing the major biomedical and biological issues that impact the public health of our community, train a new generation of physicians, scientists, engineers, and technology literate professionals, and provide research and development that improves society and drives the global economy.

## **II. Goals and Objectives**

The URC Biomedical and Biological Research Subcommittee (Committee) was tasked with formulating a University-wide strategy to identify areas of biomedical and biological research in which USC can and should become a leader. Final consensus recommendations are based on a thorough review of objective parameters that identify current strengths and potential untapped opportunities to achieve success in meeting USC's mission of education and research.

The Committee agreed that the following underlying objectives be used in developing final recommendations:

1. **USC's Unique Positions:** Identify biomedical and biological research areas that are unique to USC and that can address societal problems, taking into consideration our unique location (LA) and affiliations (LAC+USC, CHLA, University Hospital and Norris, Los Angeles County Department of Health).
2. **USC's Existing Strengths:** Build on existing strengths at USC and expand to areas of research where USC can and should uniquely contribute in meeting societal needs. Identify factors limiting further expansion in these areas of strength.
3. **USC's Areas of Nascent Strength and Potential Growth:** Determine nascent areas of research with future growth potential in areas of basic science that can integrate with strengths in the clinical arena.
4. **Synergy Across USC:** Determine how to **build bridges** between areas of existing strengths in **cluster** or **thematic** areas of **research, teaching, and outreach** within the University that may enhance biomedical and biological research and education in identified areas.
5. **Enable the Path Forward:** Identify needs for **infrastructure** for enabling technologies and **faculty recruitment** to enhance identified areas of strength that USC has in important growth areas.

### III. Methods

The Committee undertook a three-step process to assess, evaluate and arrive at specific recommendations:

#### 1. **Fact finding and data collection\***

The process included review of the following items:

- A) Two reports prepared by the Battelle Corporation to assess Biological and Biomedical Research at USC entitled "An Assessment of USC Core Competencies and Technology Platforms for Future Development" and "Advancing a Biomedical Research Park at USC's Health Sciences Campus: Feasibility and Assessment of Conceptual Plans"
- B) Survey of high impact publications and labs producing those publications originating from USC or USC investigators.
- C) Survey of the funding expenditures for research at USC, collated by topic and PI.
- D) Responses from individual departments to a survey prepared by the committee. This material included both responses to our questions as well as internal review documents provided by participating departments such as recent UCAR evaluations.
- E) Evaluation of existing NIH, NSF, and other federal and State granting agencies' funding priorities.
- F) Review of other universities' funding directions, initiatives, and departments.

#### 2) **Integration, discussion, and evaluation of data and strategies gathered**

#### 3) **Formulation of specific recommendations**

\*Where it is not confidential, this information is provided as part of the supplemental information.

## IV. RESULTS

### 1. Unique Positions

**USC-affiliated hospitals are uniquely positioned to serve as a resource for Los Angeles.** Los Angeles county is one of the most diverse communities in the world, with large immigrant populations, multiethnic communities, and inner city problems. Indeed, many issues that fall under the penumbra of "global health" are components of our community that must be addressed. These include health disparities, poverty, violence, environmental health issues, maternal, child and women's health, chronic diseases, emerging and reemerging infectious diseases as well as personal health challenges.

The USC-affiliated hospitals are uniquely situated to address these problems, as compared with UCLA locally, or other universities nationwide. Specifically, we have the opportunity to serve a community that desperately needs our help, and where our efforts can play an important role in our educational, service, and research missions. In education and service, we can provide information and clinical care to the patients and the community. This context also represents a novel training and research environment for graduate and professional students. Specifically, the population in Los Angeles affords our clinicians the unique opportunity to conduct long-term, large-scale clinical studies that are simply not possible in other communities.

USC also has a number of areas where we have developed considerable research strength, summarized in the next section. This list is not meant to be exhaustive in its scope but rather to provide a summary regarding the information collected in our surveys and analysis.

### 2. Existing Strengths.

After a careful review of the information described in III, the committee attempted to define areas where USC currently possesses considerable strength. Here, strength is defined by criteria synonymous with academic excellence—a combination of research productivity (publications, impact), funding, personnel, and infrastructure.

Areas of strength within the biological and biomedical sciences at USC can be broken down into two main categories, those related to health and medicine, and those related to basic science (biology, chemistry, physics, engineering, and computer science). Importantly, these divisions are somewhat artificial and there is increasing overlap of these areas. Indeed, one theme emerging from the committee's work was the need for the University to continue providing resources that foster these interdependent collaborative and multidisciplinary relations.

USC already has made major commitments and investments in the several areas that represent cross-cutting multidisciplinary and transdisciplinary programs encompassing basic, clinical and translational sciences. These include:

1. The Norris Cancer Center,
2. The Broad Institute for Integrative Biology and Stem Cell Research,
3. The Zilkha Neurogenetics Institute,
4. The BioMimetic Microelectronic Systems Center (BMES),

5. The Doheny Eye Institute,
6. The Saban Research Institute,
7. The Center for Computational Biology and Bioinformatics and the Center for Excellence in Genomic Science,
8. The Alzheimers Disease Research Center,
9. The Biomedical Simulations Resource (BMSR), and
10. The USC Biomedical Nanoscience Initiative,

This list is not exhaustive but illustrative. For example, the current NIH-funded centers at USC can be found in the NIH CRISP database (e.g., M01, U01, U10, U24, P01, P30, P41, P50 and P60 centers; [http://crisp.cit.nih.gov/crisp/crisp\\_query.generate\\_screen](http://crisp.cit.nih.gov/crisp/crisp_query.generate_screen)) and includes the basic research topics Epigenetics, Epidemiology and Preventive Medicine, Oxidative Stress, DNA Replication and Repair and Computational Biology and the clinical translational research topics, Cancer, Infectious Disease (e.g., HIV, TB, HCV), Autism, Cardiovascular Disease, Psychology, Virology, Alzheimer's Disease, Gerontology (Aging), Diabetes, Obesity, Maternal/Child Health, Environmental Diseases (e.g., Pollution), and Societal Problems (e.g., Violence, Poverty, Alcohol, Drugs).

Rather, this information is illustrative of two important trends developed in later sections of this document: **1) that areas of strength are uniformly led by key individuals or groups** and **2) that many of these centers utilize a model where larger research goals are attacked by intellectually diverse thematic clusters.**

### **3. USC- Areas of Nascent Strength and Potential Growth:**

In addition to the Strength Areas that are represented by Institutes, the committee identified other areas of untapped strength that represent unique opportunities to address major societal problems have also been identified through the objective measures identified above. These strengths represent potential areas of growth because of unique patient populations, existing strong programs with significant national or international recognition for excellence in research (as defined above), and teaching and/or clinical care. They also represent potential for increased grant funding. The areas are divided into **three broad categories that can be and should be integrated.**

**A. Health and Medicine:** This includes Global Health, Infectious Disease (e.g., HIV/AIDS, TB, HCV) and Virology, Maternal/Child Health, Diabetes/Obesity, Environmental Diseases (e.g., Pollution), Rehabilitation Science (Physical Therapy & Occupational Therapy), Developmental Therapy, Violence, Poverty, Alcohol abuse, Drug abuse, and Accidents.

**B. Basic Science:** This includes Microbiology, Chemical Biology, Cellular Transplantation/Gene Therapy, Virology, Neurodevelopment, Neurodegeneration, Epigenetics.

**C. Enabling technologies:** Bioinformatics, Systems Biology, Proteomics, Sensor Networks, Robotics, Nanotechnology and Materials Science, and new Imaging technologies. These approaches are likely to be essential to enable continued leadership and development of our current areas of strength listed above.

## **V. Summary of Findings**

USC should build upon the foundation of its unique position in Los Angeles and the diverse multiethnic communities it serves through new and existing programs that help solve the pressing medical and biologic issues of our times.

USC has a number of areas of existing strength, identified in this document, that have already been recognized. There are areas of strength that the committee believes are potentially high impact for rapid development of transdisciplinary and multidisciplinary research endeavors based on society needs, existing faculty with strength in these areas, and patient populations that can and need to be studied. These are areas identified by the NIH as high priority research areas that have and will continue to have a significant portion of the NIH budget dedicated to it. Furthermore, in some areas there are opportunities for Foundation funding.

## **VI. Final Recommendations**

The recommendations of the committee encompass two themes: some are general recommendations that apply across all of USC, while others relate to specific areas, groups or units identified by the committee. The committee recognized successful areas of strength at USC and identified new and emerging areas of strength. The committee determined that success in new and existing areas of strength will depend on significant investment in infrastructure and faculty.

At the top of the recommendation list is the suggestion that USC implement a change that spans the university—a change in the way we support and promote our three principal missions (research, education, service) by implementing **Research Directed** fundraising. The primacy of this suggestion stems from the facts that 1) the recommendations put forth would benefit from this funding model and 2) this would change the way we view ourselves and the way we are viewed by our community.

**1. Research Directed Fundraising.** The committee recognized the need for funding to expand in these initiatives and suggests that fundraising be implemented for infrastructure development, faculty recruitment, and space. The committee feels that fund raising by thematic cluster area or by area of interest would identify donors who would prefer to support specific areas of research.

Importantly, this approach supports our research, service, and educational missions, and assists in communicating the importance of those missions to our community. The committee felt that many in our community would welcome the goal of assisting research that benefits society as a whole. USC has already explored this model in the context of major research centers at USC, such as the Zilkha Neurogenetics Institute and the Broad Stem Cell Institute. This approach is essential to the implementation and aggressive support of the research plans described here. Overall, investment in infrastructure and faculty will broadly benefit Biological and Biomedical Research at USC.

**2. Bioinformatics directly impacts all aspects of biological and biomedical research and needs to be greatly strengthened.** Importantly, our current infrastructure needs improvement. Bioinformatics spans more than one area of expertise (e.g., sequence information, patient information, imaging). Increasingly, fundamental advances in biology and health care are gated by our abilities to access, integrate, analyze understand and act on diverse types of data. Making connections between data modalities, such as genomics, microarrays, proteomics, imaging studies, and blood chemistry can lead to a better understanding of underlying biology

and more importantly the creation of new approaches to diagnosis and treatment. This infrastructure space must be able to accommodate the complex datatypes that are emerging in the healthcare space, while allowing application of IRB and HIPPA requirements. These requirements fall far outside the boundaries of IT. What is required is that biologists, health care researchers, computer scientists, and systems engineers, create a shared research agenda to address these problems in a comprehensive, robust and scalable manner.

**Next Actions:** Investments must be made in infrastructure and support (both pre- and post-award) needs to be provided to investigators that lead efforts to secure funding to improve bioinformatics at USC.

**3. Enable New Research Areas by Development of Thematic Clusters.** The committee identified areas where Institutes (**Section IV, 2.**) have been established to address societal problems through multidisciplinary and transdisciplinary teams. The committee feels that this kind of structure is essential for future success. The committee suggests that groups of scientists, clinicians and bioinformatics experts be organized in thematic or cluster areas of research in identified growth areas. These are highlighted in items 4-8.

**4. Establish, Develop, and Support Clinical and Translational Research Core Facilities.** The committee felt it was essential that significant investment be made in the 1) establishment, 2) development and 3) ongoing support for University Core Facilities to enable our clinical translational research, clinical service/therapy, and education missions. With the opening of the new hospital at the LAC+USC medical center and the purchase of University Hospital and Norris Cancer Hospital, USC is in a unique position to establish an environment that promotes research, and to play a central role in our community (see **Section IV, 1. USC Unique Positions**). Furthermore, there is an excellent opportunity to establish “point-of-care” data collection systems with patient consent for the purpose of doing real-time research on populations of patients that receive care in these facilities. The committee felt that this was the most important enabling step for leveraging the research potential of the USC-directed hospitals.

**Next Actions:** The committee felt that several features needed to be implemented immediately including: **1) Establishing dedicated space**, including hospital, clinic and community-based space to perform epidemiologic, clinical and translational research. This is especially important given the lack of clinical research space in the new LAC+USC hospital facility. **2) Establishing University-supported Clinical and Laboratory Cores**, including

- i) Epidemiology and Biostatistical core(s)
- ii) Clinical Laboratory and Pathology cores
- iii) Biologic Specimen Repository cores
- iv) Basic Science core laboratories for human studies (e.g., nanoscience)
- v) Imaging core facilities
- vi) Specific core facilities that support each of the thematic clusters

**5. The clinicians at USC are a strength that can and should be tapped for further growth.** However, for the clinician who is charged with the daily activities of seeing patients, teaching residents and interns as well as medical students it is often difficult if not impossible to have dedicated time to perform or participate in research. On the other hand, clinicians have

invaluable expertise that can be fostered in the development of new and innovative ideas in the right setting.

Specifically, thematic clusters could be formed around the following areas identified as major global health challenges with existing strengths at USC: i) Infectious Diseases, ii) Maternal, Child Health, iii) Diabetes and Obesity, iv) Rehabilitative Medicine (including for chronic and acute diseases and trauma), v) Autism, vi) Environmental Health (including respiratory and gastrointestinal diseases impacted by the environment), and vii) Social Diseases that impact health (Health disparities, violence, poverty, alcohol, drug abuse, nutrition)

**Next actions:** The leadership of USC, the Medical School and CHLA need to implement approaches that 1) value clinical research endeavors and 2) give credit to each member of the team involved in the research project. Furthermore, compensation arrangements are needed to offset any reductions in clinical salary due to research activities. This would allow us to better utilize our considerable strength in areas such as cancer research and infectious disease.

**6. Chemical Biology and Systems Biology provide new routes for interdisciplinary research that involve all four USC campuses.** Multi-disciplinary teams with expertise in theoretical, experimental, and computational-modeling could collaborate to study the complex interactions of biological organisms across multiple levels of complexity (molecular, cellular, behavioral, and societal). Using an integrated, as opposed to a reductionist approach, the thematic clusters formed in these areas will foster a fusion of biological, engineering, computer science, chemistry, physics, and clinical disciplines.

This systemic approach will bridge the USC family of schools and hospitals (Keck, VsoE, USC/LAC, ISI) in order to creatively solve global-health challenges. Each USC Campus could emphasize different and complementary strengths, based on their current positioning. KSoM could specialize in medical bioinformatics, epigenetics, and proteomics. CHLA and KSoM could specialize in cellular transplantation and gene therapy. UPC could specialize in basic research at the Chemistry/Biology interface, bridging departments in USC College, VSoE, and Dentistry. ISI/Viterbi has already worked to take the lead in computational approaches (e.g., the Biomedical Informatics Research Network—BIRN NIH center).

**Next Actions:** Dedicated research space and infrastructure on the UPC campus is needed to grow the interface of Biology, Chemistry and the Physical and Engineering Sciences. Programmatic changes are needed to facilitate synergy rather than competition between the existing UPC departments and schools and integrate Ph.D. and M.D. programs across the UPC and HSC campuses (see recommendation 9).

**7. New technology and approaches to meet societal needs.** USC has critical strengths in occupational and physical therapy, biomedical sciences, robotics, computation, and information sciences. These strengths can be effectively combined and leveraged to address pressing societal needs of nearly-epidemic scale, which include the treatment of neurodevelopmental disorders (e.g., autism) and neurodegeneration challenges (e.g., stroke, Alzheimer's, Parkinson's), collectively affecting millions of people throughout the human lifespan, with at present, no existing solutions that can meet the demographic and scale of these growing societal needs.

USC should aggressively promote and invest in interdisciplinary research that works toward addressing these important problems. Routes to address these where we have a unique position include i) human-machine interactions (e.g., robotics), ii) new routes to therapy (e.g., nanotechnology), and iii) new approaches to prostheses (e.g., NSF BMES, NIH BMSR and

AMI). Importantly, these areas are inherently interdisciplinary, bridging clinical and basic research, and would help enable USC's effort to address key problems in our community.

**Next Actions:** Cross-disciplinary efforts (lab space, infrastructure, support, educational programs) are needed to enable scientists and engineers access and interaction with clinical investigators and patients. USC should play a leadership role at the interface of engineering and clinical practice for autism, stroke, and physical therapy.

**8. Broadly, Cell Biology at USC should be Strengthened and Supported.** Neurobiology, Immunology, Cell Biology, and Microbiology represent cross-cutting research areas that must be expanded. In particular, **USC needs to improve its strength in mammalian cellular biology.** This area serves as a key interface between basic research and the clinical sciences in stem cell research, cancer biology, infectious diseases, transplantation research, neurodevelopmental problems (e.g., autism), cardiovascular research, stroke, and gene therapy.

**Next Actions:** USC needs to work to build a core of cellular biologists on both the HSC and UPC campuses through aggressive hiring, creating laboratory space, and supporting essential research cores. This could be done under the mantle of a number of disciplines, including (but not limited to) Chemical Biology, Systems Biology, Neuroscience, Immunology, Microbiology, Stem Cell research, Infectious disease, Oncology, Cardiology, and Pathology.

**9. Establish Transdisciplinary Training Programs** Establish a training program for transdisciplinary research in each of the areas identified in this document, such as establishing a Health Science Technology program (HST) at USC between VSoE and KSoM, and graduate programs in areas such as Global Health, Chemical Biology, or Systems Biology. This approach will create synergy between our research and educational missions.

**10. Establish a University-wide advisory board** to assist in strategic planning and implementation of **biological and biomedical research by Cluster area.** This group could assist the Vice Provost's office, similar to the existing URC.

**11. Support of Existing Stellar Faculty and Targeted Recruitments:**

**a. Existing Faculty:** It is recognized that areas of strength are often centered on a few key individuals, who not only produce high-quality, well-funded research themselves, but who serve as beacons for the recruitment of additional faculty in their respective areas of research. Investment and sufficient attention should be paid to the retention of such key research faculty who currently work in high impact areas identified as strengths.

**b. Recruitment of New Faculty:** Substantial resources should be allocated to highly focused, targeted recruitments of stellar faculty in areas of desired expansion.

**Next actions:** Implement Provost level and School level mechanisms for maintaining and supporting key individuals in identified areas of strength and in expanding these areas through the hiring of new faculty in these areas. The Provost's office will need to coordinate hires that span two or more schools, individual schools need to develop plans to identify talent and the resources (space, equipment, startup) needed to recruit such faculty.

## VIII. Supplemental Materials

### PDF Files Provided

1. Battelle Report "An Assessment of USC Core Competencies and Technology Platforms for Future Development" (July 2006)
2. Battelle Report "Advancing a Biomedical Research Park at USC's Health Sciences Campus: Feasibility and Assessment of Conceptual Plans" (July 2006)

### 3. Summary of Departmental Surveys

- Blank survey questionnaire
- Survey data summary

Academic departments and institutes were surveyed to identify self-reported areas of research investment and strength. A total of 29 departments and institutes from six schools responded to the survey. A copy of the survey is included in the appendix. This survey was intended to capture self-reported areas of strength that may not be reflected in publications or research funding. Identified from departmental surveys in the following broad areas: *Global Health*: Infectious Disease (e.g., HIV, TB, HCV) and Virology, Maternal/Child Health, Environmental Diseases (e.g., Pollution), *Personal Health*: Cardiovascular Disease, Gerontology (Aging), Diabetes/Obesity, and *Public Health*: Societal Problems (e.g., Psychology of Violence, Poverty, Alcohol, Drugs). *Basic Science*: Epigenetics, Oxidative Stress, DNA Replication and Repair, Computational Biology, Robotics, Neuroscience, Chemical Biology, Nanoscience, Rehabilitation Science (Physical Therapy & Occupational Therapy), Transplantation Biology/Gene Therapy, Stem Cell Biology.

### 4. Analysis of Highly cited publications originating from USC

An analysis was conducted in October, 2007 to identify the most highly cited publications originating from USC in the past decade. The source of information was the Thompson Corporation "Web of Knowledge."

### 5. Evaluation of External Sources: National Academy of Sciences, NIH and NSF priorities:

- A) <http://sites.nationalacademies.org/cstb>
- B) National Library of Medicine at [http://www.nlm.nih.gov/pubs/reports/comptech\\_prepub.pdf](http://www.nlm.nih.gov/pubs/reports/comptech_prepub.pdf).
- C) <http://report.nih.gov/>

### Other Data Used

#### 1. Data table on Research Expenditures by PI across USC (2007)

The office of the Vice Provost for Research Advancement provided a list of 100 USC faculty with the highest external funding administered through the USC Department of Contracts and Grants. Additional grant funding information on academic departments was obtained from SCera, the USC Research Portal. Highly funded researchers in the life sciences reflected many of the strengths identified in the publications data. Of particular note is Preventive Medicine and Epidemiology, which includes eight of the top 30 funded faculty at USC. Additional areas identified are Epigenetics, Clinical Research, Cardiovascular Research, Computational Biology, Gerontology, HIV/AIDS and Virology and DNA Replication and Repair