WHOLE SYSTEMS GENOMICS
FOR IMPROVED HUMAN, ANIMAL, AND ENVIRONMENTAL WELL-BEING

Submitters

Name	Department	College
Garry Adams	Veterinary Pathobiology	Vet. Medicine & Biomedical Sciences
Nancy Amato	Computer Science and Engineering	Engineering
Rodolfo Aramayo	Biology	Science
Christian Brannstrom	Geography	Geosciences
Robert Chapkin	Nutrition & Food Science	Agriculture and Life Sciences
Bhanu Chowdhary	Veterinary Integrative Biosciences	Vet. Medicine & Biomedical Sciences
Jeffrey Cirillo	Microbial & Molecular Pathogenesis	Texas A&M Health Science Center
Craig Coates	Entomology	Agriculture and Life Sciences
Clare Gill	Animal Science	Agriculture and Life Sciences
Patricia Goodson	Health & Kinesiology	Education and Human Development
Juergen Hahn	Chemical Engineering	Engineering
Tim Hall	Biology	Science
Jim Hu	Biochemistry & Biophysics	Agriculture and Life Sciences
Janie Hurley	Office of Technology Commercialization	Texas A&M University System
Nancy Ing	Animal Science	Agriculture and Life Sciences
Heather Lench	Psychology	Liberal Arts
Michael Massett	Health & Kinesiology	Education and Human Development
David McIntyre	Integrative Center for Homeland Security	Bush School of Government & Public Service
John Mullet	Biochemistry & Biophysics	Agriculture and Life Sciences
Penny Riggs	Animal Science	Agriculture and Life Sciences
Deborah Siegele	Biology	Science
David Stelly	Soil & Crop Sciences	Agriculture and Life Sciences
Thomas Welsh	Animal Science	Agriculture and Life Sciences
James Womack	Veterinary Pathobiology	Vet. Medicine and Biomedical Science

Invited Colleges/Schools:

College of Agriculture and Life Sciences
College of Education & Human Development
Dwight Look College of Engineering
College of Geosciences
College of Liberal Arts
Mays Business School
College of Veterinary Medicine and Biomedical Sciences
Texas A&M Health Science Center
Texas AgriLife Research
Texas Engineering Extension Service
Bush School of Government & Public Service

Summary

The Genomics Revolution is fundamentally reshaping the world, and genomics pioneers at Texas A&M University are helping to lead the way. Contributions by these world-renowned scientists in genomics have advanced agricultural productivity, human and animal health, and have influenced economics, policy, ethics, geography and business. A vibrant integrated institute brings together talented individuals conducting genomics research in diverse organisms, facilitates synergism, maximizes efficient utilization of infrastructure, and strengthens international competitiveness. An umbrella that unites leading faculty with promising junior scientists and emerging technologies in whole systems genomics will continue to contribute to human and animal well-being and improved environmental stewardship.

1. MERIT AND IMPACT

1.1. Global Merit and Impact

Technological innovation and scientific progress drive great societal advancement. Dramatic changes in human lifestyles resulted from development and widespread use of the printing press, cell theory, electricity, and automotives. These breakthroughs planted seeds for further innovation that propagated entire industries. For example, the invention of transistors led to integrated circuits, microprocessors, personal computers, the internet, and global electronic commerce. Similarly **profound and sustained impacts are arising from *genomics***, the study of an organism's entire genetic material (or genome) by high-throughput molecular and computational approaches. Genomics, too, promises to be one of the most profound areas of sustained revolutionary development, exploration, global utilization, commercialization and socio-economic consequence. By any measure, including publications, job opportunities, educational resources, social ramifications or economic impact, genomics is already central to contemporary society.

Texas A&M University and the Texas A&M University System currently lead, or are well positioned to lead, integrative and applied genomics across many fields of endeavor. To maintain and bolster this position of excellence, **vigorous, well-placed investments must be applied**. Our capacities in genomics and genomic applications are diverse. Thus, one institutional challenge is how best to facilitate and encourage synergistic and interdisciplinary research interactions that drive innovation and continued advancement in the field. On behalf of hundreds of TAMUS faculty, staff and students, **we propose formation of an Institute to coordinate and advance the common elements of genomics research.**

The Institute will be organized around 6 foci of vast societal impact (Figure 1), to which both TAMU and TAMUS are already heavily committed:

- **Food, Nutrition & Security:** An adequate and safe food supply is one of the most basic human needs for survival and overall well-being. Genomic technologies are key genetic tools used for improving food production, food security, and nutrition, reducing exposure to pathogens, toxins and carcinogens, and contending with competition for resources. Although genomic technologies have already profoundly and positively changed the availability and quality of food worldwide, continued improvement is still required, pointing to the need for better understanding of how genomics may improve livelihoods more generally.

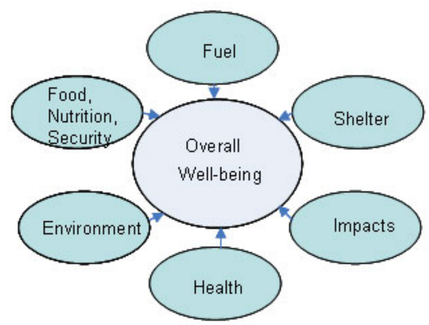

Figure 1. Societal Impact Foci

- **Health:** Genomics has already greatly influenced the pharmaceutical industry, especially in the areas of human and animal health and reproductive fertility. Development of personalized medicine, nutrition, and fertility is invaluable because an individual's unique genome largely determines predisposition to various diseases, responses to toxins or drugs, and sensitivity or resistance to potential allergens, pathogens and chemicals. We can expect affordable personal genome sequencing, predictive medicine, and treatment regimens tailored to our respective genotype.
- **Legal, Ethical, Educational, Economic and Social Impact:** Collection of personal data and utilization of genomic technologies have significant medical, social, ethical, and legal ramifications. Assuring that products derived from genomics research do not exacerbate existing socio-economic inequalities represents a major challenge, especially in developing countries. Issues arising from advances in genomics demand an interdisciplinary approach for enlightened governance in the numerous settings that genomics will continue to influence.
- **Fuel:** Production of bioenergy has emerged as critically important for national and international economic and environmental interests. Genome tools are necessary for modification and selection of microbes, plants, and algae essential for efficient bioenergy production.

- **Shelter:** Humans depend on plants and animals for materials used in textiles and construction of clothing, shelter, and protection against the elements. Advances in genomics enhance the qualities and production efficiency of these materials.
- **Environment:** As both the world population and affluence grow, competition for resources increases. Genomics offers important tools for conservation-minded stewardship of biological resources and efficient use of land, crops, animals, and chemicals, while also challenging policymakers to distribute the benefits of genomics equitably and democratically to a variety of stakeholders.

Ultimately, all these efforts increase human health, well-being, and prosperity.

The effectiveness and growth of the Institute will be amenable to conventional metrics. Basic research impact will be apparent in grant dollars received, publications, publication acknowledgement, records of facilitated meetings and conferences, formal discussions with administration, patents and licensing revenue, corporate investments and partnerships, and prestigious appointments of faculty to legislative policy, state, national and international advisory committees. Conventional educational metrics will also be applicable, e.g., numbers of undergraduate and graduate students, post-doctoral trainees, short courses, outreach, and extension. Effectiveness of teaching can be assessed with Likert-scale or comparable surveys to measure pre- and post-training knowledge and anticipated behavioral changes. The Mays Business School might incorporate such metric assessments into MBA student projects. Additional measures could include web-site traffic statistics, web surveys, and short course quizzes to survey public knowledge, perception, and beliefs.

1.2. Building Intellectual Capacity at Texas A&M

The Institute will function as a hub for diverse genomics activities at TAMU and TAMUS components to facilitate intra- and interdisciplinary interactions that would not otherwise occur. External, world-renowned scientists will be invited to join the Institute in an advisory capacity. These intellectual exchanges will create a nurturing environment for mentoring by encouraging collaboration among faculty and students at all levels. Additionally, by ensuring that state-of-the-art infrastructure, instrumentation and computational resources are available to genomics researchers, the Institute will be especially conducive to recruitment, retention and success of nationally and internationally recognized faculty, and outstanding staff and students. Coordinated investments in shared multi-user resources or core facilities associated with the Institute will elevate competiveness for multi-user equipment grants, large-scale genomic research grants, and will increase the resources and thus, productivities of existing and incoming faculty, staff and students. Success of the Institute and its many users will greatly increase international recognition of Texas A&M University and the Texas A&M System.

2. MULTIDISCIPLINARY ASPECTS AND ORGANIZATION

1.3. 2.1. Multidisciplinary Aspects

Because genomes provide the blueprints for the development and function of all living organisms, most Institute projects will be multidisciplinary collaborations and will prospectively engage nearly every TAMU College and all TAMUS institutions at some level. More than 110 faculty identify themselves on the TAMU website as undertaking genomics research. These researchers are in the Colleges of Agriculture and Life Sciences, Veterinary Medicine and Biomedical Sciences, Engineering, Science, Education & Human Development, and several departments within the Texas A&M Health Science Center (TAMHSC). Additional faculty in the Colleges of Liberal Arts, Geosciences, the Mays Business School, and The Bush School have expertise in areas related to translation and application of genomics discoveries, and have expressed interest in participating in the Institute. Participants from other system components including Texas AgriLife Research, Texas Engineering Extension Service (TEEX), and external institutions have also been identified. The Integrative Center for Homeland Security can contribute a unique national connectivity for the security aspects of this interdisciplinary effort. For example, the areas addressed as social impact foci are also identified as areas of "critical infrastructure" by the federal government. Advances in genomics will also lead to opportunity for patented and licensed products resulting in corporate partnerships and associations. Numerous commercial entities already cooperate and interact with TAMU Genomics faculty, and organization of the Institute will strengthen corporate relationships.

During preparation of this expanded white paper multiple town hall-style meetings were held to clarify goals and new opportunities provided by formation of the Institute. The resulting conversations stimulated discussion among faculty from diverse departments, and enthusiasm for the concept of a truly multidisciplinary Institute continues to grow. The number of individuals who have opted to join this initiative has increased by 270% to 123 participants since the concept was first presented in the preliminary white paper. The affiliations of these participants are shown in Figure 2. These members participate in a variety of interdisciplinary graduate research programs, and many have joint appointments with one or more system components. A significant number of participants have leadership roles in international organizations. Because of these affiliations among such a large group, external linkages are extensive and have international reach. Involvement by this diverse group of participants in the Institute will stimulate additional intellectual linkages among researchers and educators across disciplines and will create a unique multidisciplinary environment that fosters innovation and success.

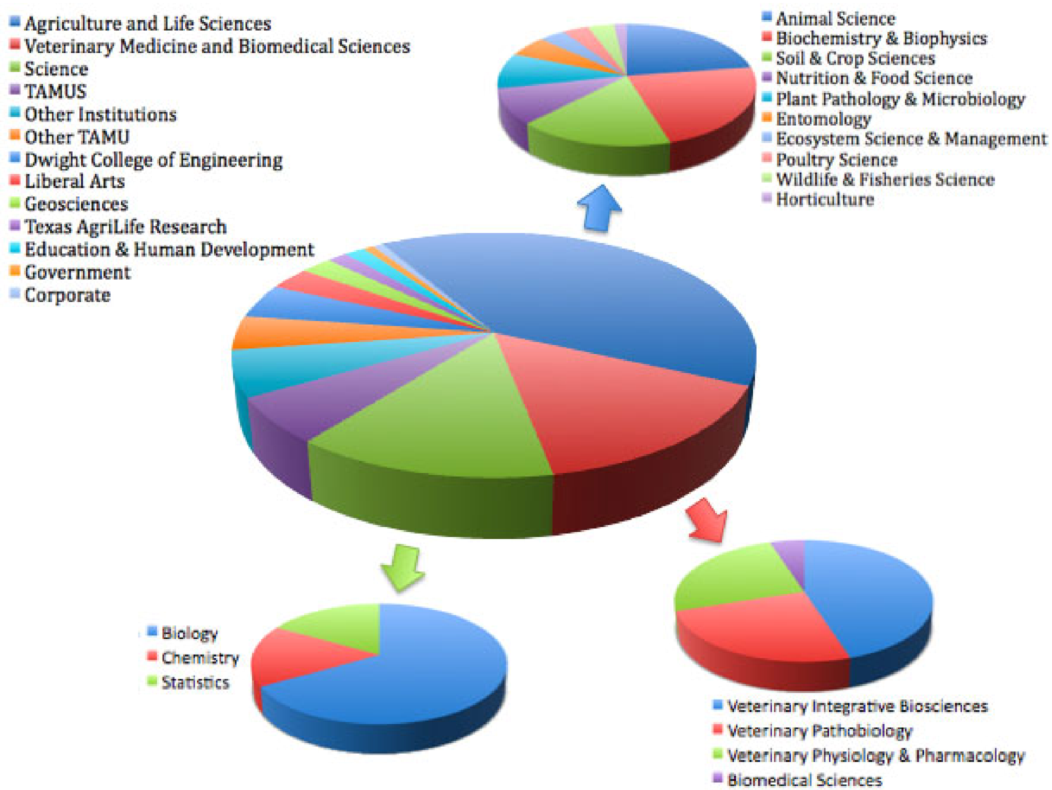

Figure 2. Affiliations of Participants. A total of 26 TAMU departments are represented, along with external and TAMU system members. Further detail for the Colleges of Agriculture and Life Sciences (40% of total), Veterinary Medicine & Biomedical Sciences (15%), and Science (13%) is shown in the smaller charts.

Effectively functioning centers and institutes leverage resources on a grand-tiered scale. At the University level, the Institute will provide a structure that brings people (intellectual resources) and equipment (infrastructure resources) together. Resources will be utilized more efficiently because coordination promotes complementary rather than redundant acquisition of instrumentation, maximizing gain for dollars invested. Moreover, existence of a cohesive Institute will strengthen external grant applications resulting in returns that may be orders of magnitude above dollars invested. Prospective donors to the University will be greatly encouraged when they can see an organized collection of tangible assets, and a clear vision of how their contribution will have an important positive impact. Justifications of multi-user grants that serve the entire TAMU/TAMUS community will be much more compelling than those requests submitted by individual laboratories, departments, or even colleges.

1.4.2.2. Suggested Organization

We propose the formation of a campus Institute that functions at several levels: [1] organization of resources (people, expertise, technologies, and facilities), [2] facilities (a network of shared core facilities), [3] shared governance, and [4] a combination of internal and external advising. A visionary director with a holistic view of genomics research and its enormous influence on society will be recruited to lead the Institute. This individual will be internationally renowned with an established track record and demonstrated excellence in genomics and bioinformatics, multi-user facilities management, grantsmanship, and collegiality. The director will lead the Institute with the assistance of associate or deputy directors. A senior administrative assistant with proven management skills will provide necessary support for the Institute. Increased clerical assistance for grant submission and metric record keeping will free research scientists from clerical duties and improve their scientific productivity.

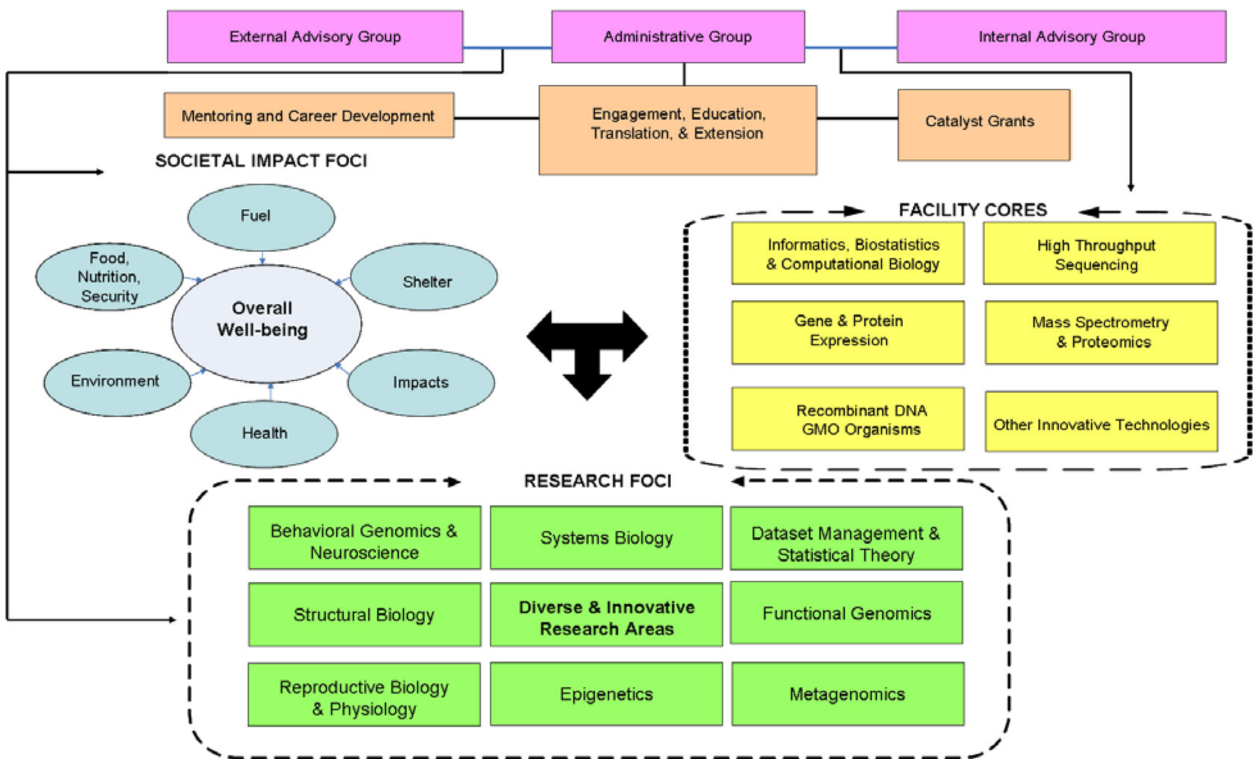

Figure 3. Proposed Institute Organization. The Institute is organized on one level into Social Impact foci. A second tier is organized according to Resarch Foci. Numerous potential research areas are possible and will be finalized by the research community as the Institute forms. "Place-holders" shown in the diagram are not intended to limit or exclude research topics. Both foci strata will be supported by core facilities.

Two concepts are critically important for success of the Institute. First, although TAMU has tremendous existing resources and strengths, the ultimate goal for this Institute is the formation of a world-leading, multidisciplinary Institute that takes advantage of the breadth of TAMU's expertise in genomics and builds upon existing resources and strengths. To achieve success, the Institute leadership must embrace a broad, holistic, and far-reaching vision to surpass the best TAMU institutes, centers, and organizations that have formed previously. Second, and particularly during leaner economic times, we must design an Institute that could be built "if money were no object," yet develop an economically sound and efficient means to build this Institute ***even if*** funding becomes a limiting factor in its development.

Such goals can be accomplished by structuring development of the Institute in a tiered fashion. At the first level, an organizational vision will be defined and initiated. At this level, an initial set of faculty "members" of the institute will be assembled, along with a catalog of available instrumentation and list of significant infrastructure needs. Communication among member faculty and laboratory personnel will be facilitated by formation of an Institute website and listserv. This level of development has been largely completed during preparation of this white paper, and the Institute has a virtual presence and a home for more than 120 participants at http://genomics.tamu.edu. This team of faculty is expected to grow significantly as the Institute matures and blossoms on campus.

At the second level, commitment to core facility instrumentation upgrades, dedicated support staff, and necessary computational and informatics infrastructure will be essential for recruitment of a director and subsequent faculty hires. At this stage, the Institute will be driven initially by an internal implementation board with significant input from the submission team who conceived the vision for this proposal. The charge of the board will be to initiate a search for director candidates who have demonstrated prior expertise in establishing innovative, multidisciplinary research efforts. The board will also oversee hiring of support personnel and establishment of new core facilities or improvement of existing facilities. Priority will be assigned to establishment of data management and informatics support with the cooperation of the Institute for Applied Mathematical, Statistical, and Computational Sciences as well as the Laboratory for Genome Bioinformatics. Additional priority will focus on much needed high-throughput sequencing instrumentation, and assembly of related core facilities. There must also be an allowance for future instrumentation needs due to rapid improvements in emerging technologies.

Leadership and direction of the Institute will be enhanced by an external advisory board. The initial board has been assembled to include leading research scientists with demonstrated expertise in international and multidisciplinary efforts (see brief biographies in Appendix B2). Confirmed external advisors are: Ronald Phillips who is a National Academy of Sciences member, Wolf Prize Recipient, and former Director of the University of Minnesota Microbial and Plant Genomics Institute. David Threadgill is head of the Department of Genetics at North Carolina State University and leads an international effort based on the mouse Collaborative Cross population. Michelle Le Beau is Director of the University of Chicago Cancer Research Center; she has extensive experience building interdisciplinary research programs, and developed a strategic plan for reorganization of the center to optimize use of its talent and resources. Babatunde Ogunnaike is a Professor of Chemical Engineering and Systems Biology at the University of Delaware, and was Texas A&M's inaugural McFerrin Lecturer in 2008. Harris Lewin directs the Institute for Genome Biology at the University of Illinois and is a Fellow of the American Association for the Advancement of Science. Debora Hamernik is the Associate Dean and Associate Director of the Agricultural Experiment Station at the University of Nebraska; she has also served as a National Program Leader and as acting director of the competitive programs unit of USDA-CSREES. The external board also includes Michel Georges, who has received the elite Francqui Prize in Biological and Medical Sciences, as well as the Wolf Prize and other awards, and is a renowned animal genomics leader at the University of Liege, Belgium.

Creation of the Institute will enhance competitiveness for Center grant funding opportunities, shared instrumentation funds, and training grants (e.g. IGERT funds). Historically, TAMU has been underrepresented in such funding, and one important function of the Institute will be to facilitate cooperation in these types of proposals to increase local prominence and competitiveness. The Institute's mission and Director's mandate must specify the importance of advancing the 6 Societal Impact Foci. In addition to the Societal Impact Foci, the Institute will be organized on another level into Research Foci that will create intellectual vitality by generating synergism among faculty who would not otherwise cross paths professionally. The final set of Research Foci will be chosen with input from the genomics research community. Potential Research Foci and associated core facilities, which are complementary to this vision, have been highlighted by many of the other white paper proposals that have substantial overlap with this proposal. Examples of complementary Research Foci include, but are not limited to, Neuroscience, Phage Technology, bioinformatics, Statistics, & Computational Biology, Social Science and Business Applications of Genomics, Epigenetics, Physiology & Reproduction, Systems Biology, Health, Drug Discovery, Genetically Modified Organisms, and Mass Spectrometry & Proteomics.

A strong mentoring component of the Institute will encourage collaboration and interaction between senior faculty leaders and promising junior scientists and students to ensure their success. An engagement component of the Institute will coordinate extension, education and outreach activities to translate research findings to the public, as well as serve advertising and public relations needs. This portion of the Institute could play an important role in supporting annual multidisciplinary symposia, as well as graduate- and undergraduate-level team-taught courses and seminar series. Another unit of the Institute will provide a mechanism for internal catalyst grants. These grants would fund pilot projects or provide matching funds for equipment and high-risk ventures because, for an institute to lead innovation, the existence of mavericks taking risks and traveling on unorthodox paths is vital.

The core facility components will be supervised by faculty directors and will employ talented genomics and bioinformatics support personnel with excellent research and teaching skills. Facility cores will have a centralized web presence to help faculty members find and utilize needed equipment and resources. The internal advisory board will have representation from the research foci and core facility directors, and will interact with the external advisory board to lead the Institute.

In short, **the implementation plan for the Institute** will be to 1) assemble existing faculty participants and foster multidisciplinary conversation and research interaction, 2) improve instrumentation and research infrastructure, 3) identify a visionary director to lead the institute, and 4) encourage collaborative and innovative research. Accomplishment of these initial implementation goals will drive further advancement and funding of the Institute as the members take advantage of collective strength to improve funding competitiveness.

3. SYNERGIES AND COMPETITIVE ADVANTAGE

3.1. Synergies with University and College Plans

This Institute plan contributes to and enhances research efforts compatible with all 12 imperatives of Vision 2020. The Institute will be founded on the principle of Vision 2020 to achieve a culture of excellence. Successes achieved through the Institute outlined above will continue to elevate the entire University. Aims are consistent with goals and strengths of multiple colleges, notably Agriculture and Life Sciences, Veterinary Medicine and Biomedical Science, Science, Engineering, Business, Liberal Arts, Geosciences, and the Bush School.

The first 5 imperatives focus on elevation of faculty, strengthening of graduate, undergraduate, and professional programs, and improvements in the letters, arts, and sciences core. By improving research infrastructure and enabling multidisciplinary scientific discourse, this proposal supports the aim of Vision 2020 to establish an environment in which a community of scholars can produce creative and intellectual work at the highest level. TAMU genomics scientists already lead the world in their specific disciplines, and the collective power of the center will illuminate the prominence of existing work while harnessing synergy to enable even greater research leadership. The presence of appropriate infrastructure that makes resources and expertise readily available to TAMU's existing faculty will encourage scholarship and collegiality. The Institute will provide unity, help increase the visibility of the faculty, and lend power and coordination to funding proposals. Because genomics research permeates life as we know it, interaction between research scientists and faculty in social science, letters, and arts disciplines will bring additional attention and resources to these fields, further driving TAMU's international prominence. Multidisciplinary interaction and state-of-the-art resources will continue to attract and facilitate recruitment of outstanding faculty and students. Establishment of team-taught interdisciplinary symposia and seminars will enhance graduate, undergraduate, and professional education. In particular, professional programs must include education in the application and implications of knowledge about the genome. For example, how society deals with topics including management of personal genomic information, personalized medicine, and distribution of genetically modified organisms, represents issues that will continue to grow in importance in the coming years.

The remaining imperatives for TAMU address diversification, globalization, and cooperation with local, national, and international communities, along with increased access to resources and elevated stature among peer institutions. The genomics faculty is already internationally recognized within individual programs, and as a collective, will exhibit even greater prominence. This prominence can be used to drive recruitment of the best faculty and student candidates from a diverse national and international population. Improvements in knowledge resources can be facilitated by web-assembled common resources, and this effort has already begun. At TAMU's large campus, improved directories of where resources and instrumentation exist, along with pertinent contact information, will motivate students and faculty to physically interact with each other across campus. This approach can establish a culture of interactivity that will reduce the effects of physical barriers on campus. Centralization of certain instrumentation and resources will also make equipment usage more accessible. This unified assembly of various types of resources could also improve interaction with the local metropolitan community, as well as facilitate public distribution of genomics-related "news" and translation of research findings to the community. In short, TAMU must continue its strong genomics tradition to remain competitive with other research institutions. TAMU must also remain known as the place where students become leaders, particularly in agriculture and science, and strength in genomics will continue to benefit the state of Texas.

Finally, Imperative 10 demands enlightened governance and leadership. More than 120 faculty participated in this bottom-up effort in Whole System Genomics to articulate a vision for long range goals in genomics and related efforts. A series of town hall-like meetings and email exchanges brought together faculty from nearly every College to identify common needs and vision. These meetings have already contributed to the functional establishment of the Institute, and have already enabled multidisciplinary interaction.

In addition to synergy with Vision 2020, the proposed institute supports several college plans. Genomics has obvious overlap with the Colleges of Agriculture & Life Sciences, Science, and Veterinary Medicine and Biomedical Sciences, but also complements research foci in the Colleges of Education, Engineering, Geosciences, The Bush School and Mays Business School, and the University Libraries. In brief, the Institute will complement and enhance Agriculture's mission and goals to elevate quality of life through cutting-edge efforts in Signature Areas of fundamental biology, food security, safety, nutrition, & health, prosperity of agricultural systems, healthy ecosystems & conservation of natural resources, bioenergy, and communities, families & youth. Synergy with the Institute exists with Science's strategic goals focusing on areas related to grand challenge problems in health, energy, security, and the environment, along with Veterinary Medicine's Signature Areas in biomedical genomics, infectious disease & biodefense, neuroscience, reproductive biology, toxicology, environmental health science, and veterinary clinical research. As a result of numerous white paper efforts, Engineering added a Signature Area focused on Informatics as a transformative research area. Certainly, forward progress in genomics and genomics-related research is heavily dependent upon informatics and improvements in biostatistical methods. The Institute has relevant overlap with the goals of the Mays Business School, particularly with the Department of Marketing's priorities toward wellness of individuals, better healthcare outcomes for society, and wellness and sustainability of both the environment and society. Additionally, the Department of Information and Operations Management research foci on improved health care supply chain, enhanced environmental sustainability, and methods to meet worldwide food demand can all be complemented by the goals of the Institute. In Geosciences, one prominent research theme relates to research in interaction of coupled natural-human systems; Education focuses on research strengths in health & wellness and elimination of educational & health disparities; Liberal Arts has identified a research strength area in health, human wellness and healthcare. These programs will all be strengthened by multidisciplinary overlap with genomics research. Finally, the TAMU Digital Libraries are essential for research support and facilitation of intellectual access to digital objects, research reports, and management of datasets.

3.2. Potential Texas A&M Competitive Advantage

Leading genomics-related institutes include the genome sequencing centers at Baylor College of Medicine ($114 million in federal grants), Washington University in St. Louis (WUSTL; total university endowment $5 billion), and the Broad Institute of MIT and Harvard ($600 million endowment), as well as the Duke Institute for Genome Sciences & Policy and the Translational Genomics Research Institute (TGEN). Due in part to focused advertising and public relations efforts, as well as substantial resources focused specifically on genome information, the Broad Institute is perhaps the most well-known and recognized genomics center in the world. However, TAMU is specially poised to do something that the Broad Institute cannot do, because their mandate is to work solely on human health issues. Agriculture, veterinary medicine, microbiology, physiology, and other fields in which TAMU scientists excel, could benefit remarkably from formation of the Institute. In turn, these advances would ultimately also have a positive impact on overall human and animal health and well-being.

In comparison to the peer institutions defined in Vision 2020, and to peer land-grant institutions, the combined genomics expertise at TAMU is arguably among the top ten. (Appendix D lists URLs from which information for institutional comparisons was gathered.) Two notable peer institutions are The University of North Carolina (UNC) and the University of Illinois at Urbana-Champaign (UIUC). Through state and donor resources, UNC has created a world-class genomics center with $245 million for the next decade, four new buildings costing $600+ million and $50 million in recurring funds for 40 new faculty positions. Currently, the UNC genomics program identifies 51 faculty participants, and a Center for Genomics and Society exists within the large Genomics initiative. The Institute for Genomic Biology (IGB) at UIUC represents another peer institution that exceeds TAMU's current strength, particularly because of focused investments in genomics and related topics, and donor funding from the W.M. Keck foundation to assemble a $75 million facility. UIUC's IGB is composed of 130 genomics faculty organized under 3 broad program areas of Systems Biology, Cellular & Metabolic Engineering, and Genome Technology. Within the program areas are themes ranging from Business, Economics, and Law of Genomic Biology to Proteomics and Genomic Ecology of Global Change. Personal communications with founders of UIUC's IGB emphasized the synergy generated by formation of the IGB, and the IGB's current director, Harris Lewin, has agreed to serve as an external advisor to the TAMU Institute.

Georgia Institute of Technology has established a significant bioinformatics program that includes genome scientists. The University of California (UC) – Berkeley created a Center for Integrative Genomics that consists of 16 research scientists and bioinformaticians, and supports a graduate program in computational and genomic biology. A $162.3 million building was also constructed to encourage multidisciplinary interaction as part of a Health Sciences Initiative. UC – Davis has a recently formed a genome center specifically focused on phenotypic consequences of genetic variation. The Davis program currently has 14 research faculty, but continues to actively recruit faculty for genomics, next-generation proteomics, and statistical genomics applied to animal, plant, and microbial systems. The center is characterized by excellent core facilities. The director of the Davis Center, Richard Michelmore, is a leader in plant genomics and has been suggested by numerous faculty as a potential external advisor for the TAMU Institute. A third member of the University of California system, UCLA, has a Department of Energy Institute for Genomics and Proteomics composed of 12 principal investigators.

The University of Michigan hosts 3 centers with related research areas. A Center for Integrative Genomics is focused on the complex and adaptive interactions in animals due to genetic variables. The Center for Chemical Genomics supports chemical screens and houses RNAi libraries, and a Center for Public Health and Community Genomics emphasizes ethical, legal, and social impacts associated with application of genomics and public health. However, it does not appear that the Michigan centers are closely linked with each other. A cluster hiring effort in genomics has been established at the University of Wisconsin. This effort assembled a genome center containing 42 faculty (16 members and 26 affiliates) in a variety of scientific disciplines. The University of Minnesota established a Biomedical Genomics Center that contains 10 program research areas with core facilities and 45 affiliated faculty. A separate Microbial and Plant Genomics Institute houses 66 faculty members. A Center for Comparative Genomics and Bioinformatics located within the Huck Life Sciences Institute at Penn State University, has 11 faculty labs and supports a graduate program in Bioinformatics and Genomics. University of Florida created an Interdisciplinary Center for Biotechnology Research with divisions in bioinformatics, cellomics, genomics, and proteomics. This Center is essentially a research support center that provides core facility services and trained staff in the areas described. Additional peer genomics efforts exist at the University of Missouri, Clemson University, Cornell University, and Iowa State University.

Assembly of the TAMU Institute of Whole Systems Genomics for Human, Animal, and Environmental Well-Being will bring together TAMU's world-leading scientists in a collective fashion to drive synergistic progress in broad areas of genomics and genomics-related research. Because of TAMU's unique combination of faculty expertise and resources, the Institute could readily put TAMU in the #2 position of peer institutions behind UNC. Improved visibility and publicity of Institute success, to reveal TAMU's well-kept secret of existing genomics expertise, would attract funding donors, recruit prestigious faculty, and enhance research funding to enable progress toward becoming the #1 public genomics program.

4. CRITICAL MASS AND GROWTH NEEDS AND POTENTIAL

4.1. Existing Critical Mass

At least 123 participants have opted to join this multidisciplinary initiative in Whole Systems Genomics. The number of participants has increased 270% since submission of the preliminary white paper, and includes Distinguished professors, Regents' professors, National Academy of Science members, Wolf Prize recipients, and developers of patented and licensed technologies. Of the 78 new participants, 21 are submitters and 19 are participants on other finalist white papers, and represent 14 of 18 finalist papers. This broad representation across all the white papers emphasizes the integral role genomics plays across many disciplines.

Prior to the emergence of the proposed Instititute, faculty in genomics and genomics-related research areas have typically worked in small groups that could be described as islands of excellence. Figure 4 illustrates some of the diverse species investigated by TAMU genomics scientists. Notably, TAMU's greatest strengths lie in the areas of plant, animal, and microbial genomics. Our scientists include recognized world leaders in the genomics of cattle, horse, cat, bison, marsupials, guinea pigs, turkey, pine, cotton, rice, sorghum, *E. coli* and other microbial species. TAMU scientists have international prominence in numerous areas of genomics. For example, the first three elected Chairs of the International Cotton Genome Initiative are TAMU-affiliated faculty. TAMU scientists have also drafted genome white papers that resulted in funded genome sequencing projects for cattle, honeybee, guinea pig, horse, cat, opossum, and sorghum and have played critical leadership roles in these sequence and annotation projects. Leaders in genomics interact domestically and internationally with leaders in closely related areas including systems biology, structural biology, ecology, conservation, evolution, developmental biology, reproduction, cancer, nutrition, epigenetics, immunogenetics, genomic signal processing, biostatistics, and bioinformatics. Diverse TAMU faculty also have interests in addressing social, economic, environmental, and other indirect impacts of genomic technologies. Areas of interest include future land-use and land-cover dynamics, governance systems that regulate genomic technologies in crop and livestock production, human health effects on the livelihoods of rural poor people, and social ramifications and human reaction to health information or genomics-related topics.

Figure 4. Diverse organisms studied. Illustration represents a portion of the diversity of organisms investigated by TAMU genomics scientists.

From 2006-2009, participants in this white paper published at least 997 peer-reviewed journal articles. This estimate of an average of 312 publications per year is based on the PubMed and Web of Knowledge databases (and excludes meeting abstracts and journals not indexed by these databases). Of these publications, 281 (28%) resulted from collaborations among participating scientists (shown in red in Figure 5). Names of white paper participants were placed into a network generated at http://biomedexperts.com. The resulting figure illustrated nearly 59,000 third-level connections (interactions between participant scientists with additional colleagues, and their subsequent interactions), indicating the vast influence of participants on research across the world (Figure 6). Furthermore, participants have been cited more than 8,000 times in the last 5 years, demonstrating great scientific productivity and further evidence of influence on the scientific community.

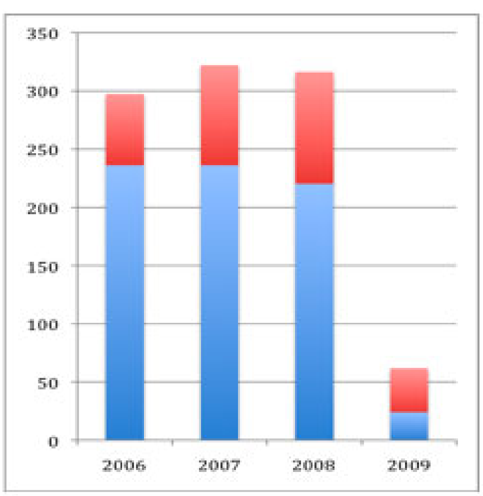

Figure 5. Number of publications since 2006 for participants in the Institute. Red indicates papers published collaboratively with other Institute members. (Source: PubMed and ISI Web of Knowledge, accessed March 2009).

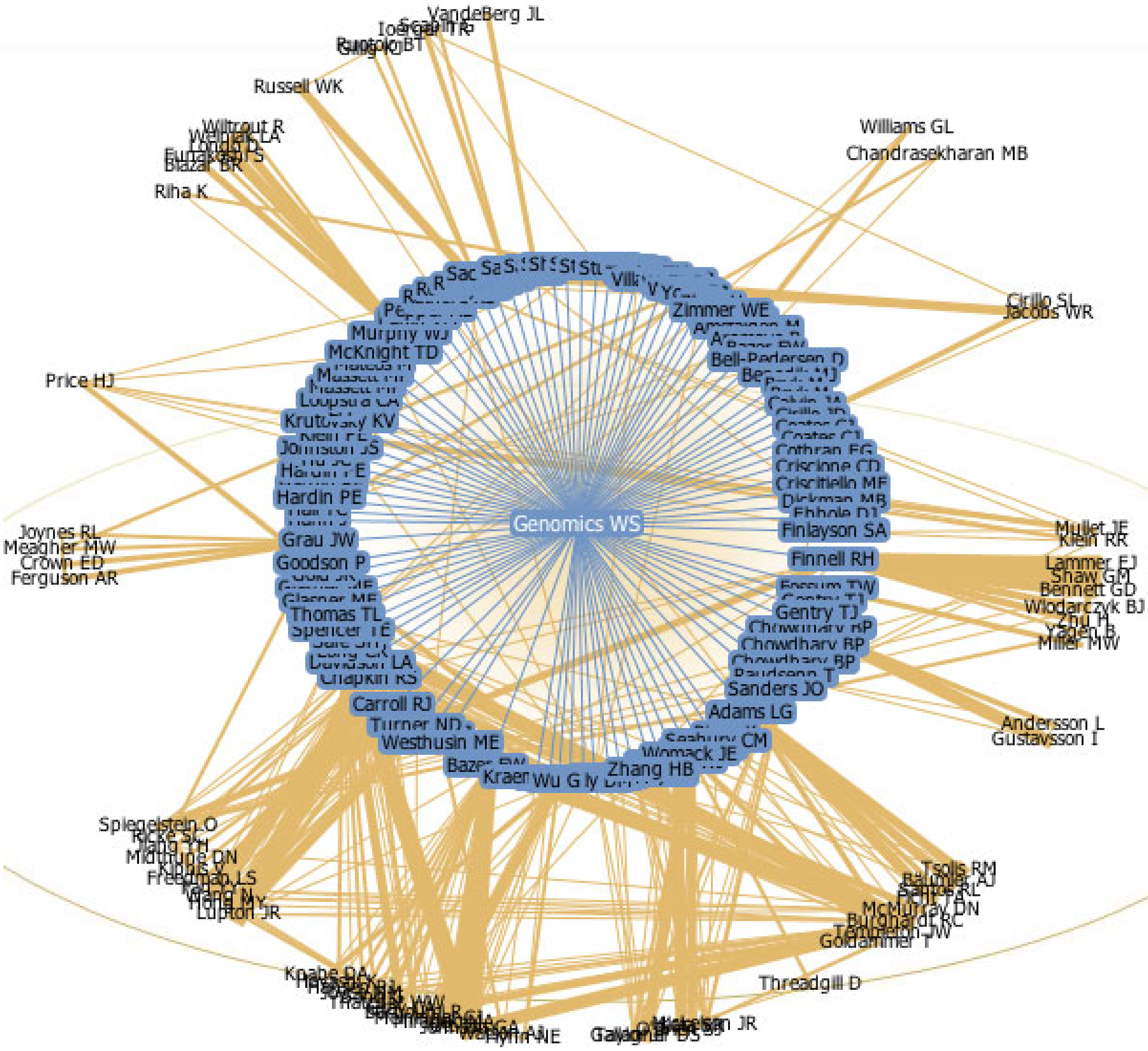

Figure 6. Interaction network. Genomics participants (blue) were entered into a network at biomedexperts.com. Interactions among participants are shown in light brown inside the center circle. Interactions with other authors are shown outside the blue circle. The outer connections demonstrate the impact of TAMU research and represent nearly 59,000 connections. Because of density, most of the names are not legible in the figure, but the overall patterns illustrate network interactions.

4.2. Needs for and Availability of Candidates for Building Excellence

As described in Suggested Organization Section 2.2, the Institute will require leadership from a director, an administrative assistant and clerical staff who will form the administrative core in conjunction with deputy directors and internal and external boards. The director will have documented experience in assembling an Institute with a mission of far-reaching vision. To attract suitable candidates for this position, the first two tiers of the organization plan must be completed, with commitment to sufficient infrastructure suitable for this type of Institute.

Existing faculty who are members of the Institute have immediate need for bioinformatics and data management support. A faculty appointment and skilled support staff (PhD level) who have experience in biological research programming and a good track record of interaction with genomics clients will be required. Bioinformatics is a common theme within several proposals. To develop a leveraged approach to bioinformatics and ensure a consistent vision, the participants of Applied Mathematics, Statistics, & Computational Sciences (AMSCS), the Systems Biology & Bioinformatics (SB&B), and the Whole Systems Genomics white paper authors are working together to formulate a single plan to create an integrated bioinformatics research community. This cooperation is aimed at establishing both the research community and the support structure needed to fulfill the campus-wide need for bioinformatics support, and AMSCS will hire a senior enabling faculty member in this area. To build the infrastructure necessary for the Genomics Institute, we will continue to work with AMSCS leadership, selected landmark areas, and other existing campus efforts such as the Alliance for Bioinformatics, Computational Biology, & Systems Biology (ABCS), and the Laboratory for Genome Bioinformatics, to coordinate growth and personnel hiring in bioinformatics, statistics, and computational biology.

Because several colleges previously, and independently, identified Genomics as a signature program area for faculty reinvestment, a broad base of faculty exists on campus and includes many newly-recruited hires. These faculty have immediate needs for appropriate infrastructure and instrumentation. Once sufficient commitment to infrastructure is in place, the Institute directorship will be more enticing to prospective candidates. In the immediate term, the External Advisory board members would provide superstar leadership without financial investment. Distinguished scientists who are directors of conceptually similar centers and who are world-renowned in plant, animal, cancer and human genomics research have agreed to serve as external advisors, as described in 2.2. Furthermore, an adequate pool of other genomics "superstars" exists.

In accordance with the idea that these proposals represent Landmark Areas of research vision to guide University investment of resources over the coming years, detailed budgets are speculative at best. A preliminary budget for this proposal focuses on the establishment of an Institute director and informatics and biostatistics support personnel, along with infrastructure to support existing and recently-hired research faculty. As the Institute grows, additional faculty recruiting at all levels would reflect the natural progression of the Institute, and would be an expected and required outcome of success.

5. SPACE AND INFRASTRUCTURE

The Institute will initially exist as a distributive network of faculty members across TAMU, along with members from TAMHSC, other TAMUS components, and related agencies. The infrastructure required for the activities described in this white paper includes resources for the faculty researcher, shared resources that are essential for TAMU to achieve and maintain excellence in all areas of science and engineering, as well as shared resources that are required for success of the proposed Institute. Significant overlap of needs is described in several white papers. As discussed with regard to personnel in Section 4.2, authors of several white papers are working together to coordinate efforts. For example, infrastructure needs for the proposed Institute overlap significantly with Systems Biology & Bioinformatics, Mass Spectrometry, Phage Technology, the Center for Environmental and Health Research (CEHR), and Cancer Drug Discovery. These shared resources include instruments, equipment and software tools, plus the staff to manage and maintain them. Professional staff who have expertise to offer training and short courses are needed to assist researchers in using these resources, and identifying other research collaborators when standard solutions are not applicable. Through the Genomics Institute listserv, several groups of investigators were identified who are currently pursuing Core Facility improvement and equipment funds as a result of the recent allocation of NSF and NIH stimulus fund opportunities.

Resource requirements for faculty researchers. The Institute director and administrative staff will require office and laboratory space. Additional requirements would consist primarily of office and laboratory space for other faculty recruits. With construction of the Interdisciplinary Life Sciences Building (ILSB) and planned construction in Veterinary Medicine and Agriculture, administrative and laboratory space can most likely be identified within existing construction projects for the near term. A Bioinformatics core facility will require machine room space, and the director and programmers would require office space. A computer lab for training and meeting with clients is also needed.

Common, University-level Portal. While TAMU has some excellent shared resources (e.g., the Supercomputing Center and the Laboratory for Molecular Simulation), what is lacking is a common, overarching infrastructure that provides researchers with a single entry point (portal) to locate the training opportunities, facilities and services they need. At the highest level, this information should be available on a website that is coordinated and managed by the VPR; it must be a dynamic, up-to-date portal that all researchers and students regularly visit and use in support of their research activities. To this end, a new Institute website has been initiated (http://genomics.tamu.edu) to give the Institute a virtual home and to enable access to these resources, and crosslinking to other communities (particularly ABCS http://abcs.tamu.edu). The Institute will work with the VPR to maintain updated information, and will strive to identify opportunity for shared resources and collaboration among other communities. This effort will promote interdisciplinary interaction and permit more efficient resource utilization by reducing duplication.

Professional Staff. A critical component for sustained excellent infrastructure is the existence of professional staff to maintain equipment and assist and train the user community. Indeed, the most effective shared resources on campus today have such staff. We will need PhD level staff to provide training and short courses and to assist users in proper application of resources for their research. Again, we will actively seek synergies with other communities and the AMSCS to identify opportunities for leveraging. For example, professional staff in bioinformatics could support researchers in many areas of the life sciences, such as genomics, proteomics, and systems biology. The co-location of such staff and training facilities, such as in the ILSB, would promote collaboration and cross-disciplinary training.

Computational Infrastructure. Computational infrastructure, including high-performance computing and large-scale storage, are resources that are required by many communities. These resources need not be co-located, however, better management and planning could lead to some economies of scale. For example, many small to medium sized clusters maintained by individual labs require more system administration support than a more centralized solution. Most importantly, it distracts faculty from their core research. In terms of computing resources, while there are currently fairly good resources available on campus, additional support is needed for them, and upgrades are continually needed to keep up with the latest technologies. In terms of resources for large-scale data storage and management, researchers at TAMU have clear, unmet needs. At several town hall-style meetings held during preparation of this white paper, general consensus among Genomics researchers emphasized the need for better solutions for managing large-scale storage. Forty members in attendance at the recent ABCS symposium unanimously called for petabyte storage capability. With the explosion in use of high-throughput sequencing, genotyping, and dense (2.1 million element) microarray technology, the critical need for robust and effective methods for managing large-scale data will continue to increase in genomics, systems biology, and related research areas.

Next-generation sequencing and similar high-throughput technologies are creating new problems because a single instrument run, which costs thousands of dollars, can produce millions of datapoints. Instruments for high-throughput sequencing, genotyping and gene expression analysis all currently produce digital images as an initial step in the analysis process. Eventually, image data are converted to text output. To put this in perspective, a single sequencing run currently can produce 115,200 tiff images requiring 4 terabytes of storage capacity for the raw data. Transfer via USB to a storage drive may take 8 hours. Storage of these raw data digital images is critical because many of the algorithms for analyzing such images are nascent and are being rapidly improved. Illumina SGIIa analysis software has undergone 3 significant upgrades in only 8 months. Because of the expense of the experiments, researchers are reluctant to discard data, at least until storage space is exhausted. If researchers resort to discarding raw data (images) because of current storage limitations, opportunities to improve the analysis of raw images is lost. Technology for sequence and protein analysis is rapidly advancing and instrumentation that will soon appear on the market may require even greater storage space.

We have already utilized our commercial partnership with BioTeam to update a BLAST-analysis server cluster that is widely-used by the TAMU genomics community. Additional BioTeam solutions for high-throughput sequencing may help address immediate needs, along with cooperation and input from AMSCS. We will work closely with AMSCS for general computational and statistical expertise to provide efficient support for the core facilities

Core facility instrumentation. A number of shared instrumentation facilities already exist on campus, although many are not widely known outside their home departments. Experimental facilities for life sciences at Texas A&M include the Gene Technologies Laboratory, Center for Environmental and Rural Health (CERH) Genomics core facility for transcriptome analysis, Laboratory of Biological Mass Spectrometry (LBMS) and Protein Chemistry Laboratory (PCL) for proteomic analysis, Microscopy and Imaging Center (MIC) for fluorescence and confocal microscopy, and the Materials Characterization Facility (MCF) for microfabrication. Coordinated efforts begun during preparation of this white paper led directly to funding of an Agilent microarray scanner, currently housed in the VRB for shared use. An Illumina genome sequencer (“Solexa”) is housed in the Borlaug Center’s Laboratory fo Plant Genome Technology.

Current Genomics faculty have identified urgent and widespread need for additional high-throughput sequencing and genotyping resources, namely Roche 454 FLX Titanium sequencer and Illumina Infinium platform. Instrumentation such as K-Biosciences KASPar flexible genotyping platform, a Roche Nimblegen Hybridization system, and 2D-gel electrophoresis systems, would be immediately put to use by large numbers of faculty. The Institute will be enhanced by additional instrumentation required for excellence in mass spectrometry, systems biology and phage technology as described in separate white papers.

For the proposed Institute, a generous, annual instrumentation budget is necessary. Some critics may argue that many types of high-throughput work can be “sent out.” However, for the Institute to succeed, TAMU must be the place where the best technology can be found. Our peer institutions have recognized this need for investment and do not send work elsewhere. This Institute must have first-rate instrumentation available for both leading research, and student education. Additional areas of infrastructure and instrumentation needs will come with advances in technology. Additional funds must be allocated for instrument repair, service contracts, and upgrades. Rapid technological advances indicate that new ultra high throughput sequencing instrumentation will become available soon, and transformative proteomics technology is also expected to make commercial debuts in the coming years. Maintaining “state-of-the-art” instrumentation will be essential for successful research.

6. JUSTIFICATION FOR INVESTMENT OF RESOURCES

The NIH CRISP database for 2006-2008 listed more than 50,000 “hits” for the key word genetic or genomic and more than 7,000 “hits” for PO or center grants. Currently, 588 active awards for NSF specify genomics as a key word. Continued long-term support for genomics across numerous agencies is anticipated. TAMU genomics faculty have successfully secured tens of millions of dollars of extramural funding as PI/Co-PI's during the past decade. The bulk of these funds have come from the major federal funding agencies; NIH, NSF, USDA, DOE, Dept. Interior, supplemented by private and corporate investments. Patented and licensed technologies have resulted from these funded projects, and disclosures and licenses in this field are expected to increase substantially in the coming years. Nevertheless, TAMU currently lags behind peer institutions in the availability of a facility such as a bioinformatics core, and furthermore has insufficient high-throughput sequencing capabilities. Infrastructure needs are most critical.

7. COST EFFECTIVENESS

Institute core facilities with associated personnel would serve as both technical and intellectual resources for anyone in TAMU/TAMUS wanting to utilize genomic techniques as a component of their research, driving further multidisciplinary interaction and innovation. Data analysis is a current bottleneck for genomics research, and the need for data storage, analysis, and interpretation will continue to increase. Centralized computing resources, hardware, and skilled technical personnel to run the facilities and train users, particularly in the area of genome bioinformatics, are essential for continued research progress. This core will have strong ties to the existing campus resources including the Alliance for Bioinformatics, Computational Biology, & Systems Biology group. The proposed Institute will be complemented by the Texas A&M Institute for Genomic Medicine, Texas A&M Institute for Preclinical Studies and the Center for Animal Biotechnology and Genomics. The proposed Institute would be augmented by Landmark Area white paper initiatives including systems biology, mental health & well-being, biological clocks, obesity, aging, cancer research group, reproductive fertility, plant biology, crop biosecurity, and food safety.

As genomics research accelerates, newly developed instrumentation is necessary for TAMU scientists to maintain and enhance their standing among peer researchers. New instrumentation for high throughput biological sample analysis is critical. A Roche 454 FLX Titanium DNA sequencer is needed because it produces longer sequencing reads than other ultra high-throughput sequencing systems, and is complementary to other sequencing platforms. A critical need exists for high-throughput and flexible genotyping platforms. Improved mass spectrometry equipment for proteomics and metabolomics is required. Genomics instrumentation is undergoing rapid development as competing teams try to create the platform for the "$1000 genome". These new tools are on the horizon, and once they are available they will be a necessity.

Over the last 3 years (2006-2008), an NIH Research Center grant averaged about $1.9 million total costs per year and the average Program Project grant (P01) award was $1.6 million total costs. Securing one P01 or Research Center grant would bring in about $740,000 - $800,000 in indirect costs (46.5% IDC rate) per year. Clearly, when the Institute brings in one of these grants any investment in equipment or staff could be recouped over the life of the grant. Only institutions that demonstrate cohesive organization can successfully compete for such funding. Awards of this nature would help the Institute to become financially self-propelling.

APPENDICES
APPENDIX A. RESEARCH PARTICIPANTS

Name	Position	Department	Special Qualifications
Garry Adams	Professor and Associate Dean	Veterinary Pathobiology	In vitro and in vivo pathomics
Nancy Amato	Professor	Computer Science & Engineering	Algorithms & applications
Marcel Amstalden	Assistant Professor	Animal Science	Reproductive neuroendocrinology
Rodolfo Aramayo	Associate Professor	Biology	Developmental genetics
Fuller Bazer	Distinguished Professor	Animal Science	Functional genomics
Deborah Bell-Pederson	Professor	Biology	Neurospora genetics, genomics of circadian rhythms
Michael Benedik	Professor	Biology	Microbial genetics & microbial biotechnology
Christian Brannstrom	Associate Professor	Geography	Estimating land change, environmental governance
Mary Bryk	Associate Professor	Biochemistry & Biophysics	Silent chromatin
Mark Burow	Associate Professor	Texas AgriLife Research	Peanut breeding & genetics
Surgiy Butenko	Assistant Professor	Industrial and Systems Engineering	Optimization, analysis of biological networks
Raymond Carroll	Distinguished Professor	Statistics	Bioinformatics
Robert Chapkin	Professor	Nutrition & Food Science	Cancer genomics
Bhanu Chowdhary	Professor	Veterinary Integrative Biosciences	Equine genomics & comparative genomics
Jeffrey Cirillo	Associate Professor	Microbial & Molecular Pathogenesis, TAMHSC	Guinea pig genomics
Craig Coates	Associate Professor	Entomology	Genetic transformation & biotechnology in insects
Ernest (Gus) Cothran	Clinical Professor	Veterinary Integrative Biosciences	Equine genomics
Charles Criscione	Assistant Professor	Biology	Ecology & evolution of parasites
Michael Criscitiello	Assistant Professor	Veterinary Pathobiology	Immunogenetics
Elizabeth Crouch	Director	Biomedical Sciences	Education
Larry Dangott	Research Scientist	Biochemistry & Biophysics	Proteomics
James Derr	Professor	Veterinary Pathobiology	Conservation genomics
Marty Dickman	Professor	Plant Sciences	Fungal-plant interactions
Scott Dindot	Assistant Professor	Veterinary Pathobiology	Epigenetics
Nancy Duran	Agriculture & Life Sciences Librarian	Medical Sciences Library	Agriculture & life science literature support
Chris Dwan	Director of Technology	Bioteam	Clustered computing system administration
Daniel Ebbole	Professor	Plant Sciences	Fungal genetics & functional genomics
Scott Finlayson	Assistant Professor	Soil & Crop Sciences	Reproduction & development in monocots

Name	Position	Department	Special Qualifications
Richard Finnell	Professor & Director	Institute of Biosciences and Technology, The Texas A&M University System Health Science Center	Mutation analysis
Terry Fossum	Professor & Director	Division of Research & Graduate Studies	Director of Texas A&M Institute for Preclinical Studies
Terry Gentry	Assistant Professor	Soil & Crop Sciences	Soil & aquatic microbiology
Clare Gill	Associate Professor	Animal Science	Bovine genomics
Margaret Glasner	Assistant Professor	Biochemistry & Biophysics	Evolution of protein structure & function
John Gold	Professor	Wildlife & Fisheries Sciences	Organization and evolution of fish genomes
Mike Golding	Assistant Professor	Veterinary Integrated Biosciences	Epigenetics
Carlos Gonzalez	Professor	Plant Pathology & Microbiology	Virulence and pathogenicity
Pat Goodson	Associate Professor	Health & Kinesiology	Public health genomics
Jim Grau	Professor	Psychology	Behavioral neuroscience
Juergen Hahn	Assistant Professor	Chemical Engineering	Systems Engineering, Modeling
Tim Hall	Distinguished Professor	Biology	Plant epigenetics
Paul Hardin	Distinguished Professor	Biology	Molecular genetics of circadian clocks
Ping He	Assistant Professor	Biochemistry & Biophysics	Functional genomics
Eric Hequet	Associate Director	Fiber & Biopolymer Research Institute, Texas Tech & Texas AgriLife Research	Genetic improvement of cotton
Andy Herring	Associate Professor	Animal Science	Quantitative Genetics
Jim Hu	Associate Professor	Biochemistry & Biophysics	*E. coli* proteomics
Janie Hurley	Technology Licensing Manager	Office of Technology Commercialization	Technology Licensing
Nancy Ing	Assistant Professor	Animal Science	Reproductive physiology & genomics
Ivan Ivanov	Assistant Professor	Veterinary Physiology & Pharmacology	Genomic signal processing & mathematical modeling
Laurie Jaeger	Adjunct Professor	Veterinary Integrative Biosciences	Conceptus-maternal interactions
Wendy Jepson	Assistant Professor	Geography	Geosciences
Russell Jessop	Assistant Professor	Soil & Crop Sciences	Perennial grass breeding
Larry Johnson	Professor	Veterinary Integrated Biosciences	Environmental education & rural health
Spencer Johnston	Professor	Entomology	Genome size evolution
Patricia Klein	Associate Professor	Horticulture; Institute for Plant Breeding & Genomics	Sorghum genomics, next generation sequencing

Name	Position	Department	Special Qualifications
Mike Kolomiets	Associate Professor	Plant Pathology & Microbiology	Disease & insect resistance of maize
Duane Kraemer	Professor	Veterinary Physiology & Pharmacology	Reproductive physiology & genetic engineering
Konstantin Krutofsky	Associate Professor	Ecosystem Science & Management	Forest tree genomics
Heather Lench	Assistant Professor	Psychology	Emotion and social interactions
Pingwei Li	Assistant Professor	Biochemistry & Biophysics	Nucleic acid detection in innate immune response
Charles Long	Assistant Professor	Veterinary Physiology & Pharmacology	Animal biotechnology & cloning
Carol Loopstra	Associate Professor	Ecosystem Science & Management	Forest tree genomics
Bani Mallick	Professor	Statistics	Analysis of microarray data
Michael Massett	Assistant Professor	Health & Kinesiology	Exercise physiology
Mariana Mateos	Assistant Professor	Wildlife & Fisheries Science	Evolutionary biology
David McIntyre	Director	Integrative Center for Homeland Security	Homeland security & terrorism
Thomas McKnight	Professor	Biology	Plant molecular & cell biology
Jennifer Mercieca	Assistant Professor	Communication	Genomics rhetoric
John Mullet	Professor	Biochemistry & Biophysics	Functional genomics of plants
William Murphy	Associate Professor	Veterinary Integrative Biosciences	Comparative & evolutionary genomics
Seth Murray	Assistant Professor	Soil & Crop Sciences	Molecular quantitative genomics in plant breeding
Eun-Gyu No	Assistant Research Scientist	Institute for Plant Breeding & Genomics	High throughput sequencing technology
Kathleen O'Reilly	Assistant Professor	Geography	Social & environmental impacts of genomics
Vlad Panin	Associate Professor	Biochemistry & Biophysics	Glycosylation genes & glycoproteins
William Payne	Professor	Norman Borlaug Institute for International Agriculture	Plant genomics & environmental stress
Alan Pepper	Associate Professor	Biology	Genomics of plant nutrient metabolism
Suresh Pillai	Professor	Poultry Science	Food & environmental microbiology
Keerti Rathore	Associate Professor	Soil & Crop Sciences	Plant improvement through biotechnology
Terje Raudsepp	Assistant Professor	Veterinary Integrative Biosciences	Genomics of fertility & reproduction
Karl Rehn	Training Manager	Texas Engineering Extension Service (TEEX)	Project management, genomic signal processing
Penny Riggs	Assistant Professor	Animal Science	Functional genomics
Bill Rooney	Professor	Soil & Crop Sciences	Sorghum breeding and genetics
David Russell	Professor	Chemistry	Mass spectrometry and gas-phase ion chemistry

Name	Position	Department	Special Qualifications
William Russell	Research Scientist	Chemistry	Biological mass spectrometry
Jim Sacchettini	Professor	Biochemistry & Biophysics; Chemistry	Structure-based design & synthesis of novel drugs
Matthew Sachs	Professor	Biology	Genomics of filamentous fungi
Stephen Safe	Distinguished Professor	Veterinary Physiology & Pharmacology	Drug targets of microRNA
Paul Samollow	Professor	Veterinary Integrative Biosciences	Marsupial & evolutionary genomics
Jim Sanders	Professor	Animal Science	Animal Breeding
Jason Sawyer	Assistant Professor	Animal Science	Ruminant nutrition
Christopher Seabury	Assistant Professor	Veterinary Pathobiology	Animal genomics & computational genetics
Libo Shan	Assistant Professor	Plant Pathology & Microbiology	Gene discovery in the post-genomic era
Dorothy Shippen	Professor	Biochemistry & Biophysics	Telomere biology
Deborah Siegele	Associate Professor	Biology	Microbial physiology & genetics, genome annotation
Loren Skow	Professor	Veterinary Integrative Biosciences	Mammalian genomics & immunogenetics
Tom Spencer	Professor	Animal Science	Physiological genomics
David Stelly	Professor	Soil & Crop Sciences	Plant genomics & cytogenetics
Paul Straight	Assistant Professor	Biochemistry & Biophysics	Genomics of microbial secondary metabolism
Joseph Sturino	Assistant Professor	Nutrition & Food Science	Bacterial functional genomics, epigenomics & metabolomics
Sing-Hoi Sze	Associate Professor	Computer Science & Engineering	Biological network analysis
Cecilia Tamborindeguy	Assistant Professor	Entomology	Aphid genome annotation
Lee Tarpley	Associate Professor	Soil & Crop Sciences	Plant metabolomics
Matthew Taylor	Assistant Professor	Animal Science	Food safety microbiology
Terry Thomas	Professor	Biology	Functional genomics & bioinformatics, biological clocks, systems biology
Nancy Turner	Associate Professor	Nutrition & Food Science	Nutrition & carcinogenesis
Gary Varner	Professor	Philosophy	Animal ethics & environmental welfare
Wayne Versaw	Assistant Professor	Biology	Genomics of plant metabolic control
Alice Villalobos	Assistant Professor	Nutrition & Food Science	Physiological genomics
Dan Waldron	Professor	Texas AgriLife Research, San Angelo	Sheep & goat breeding
Deeann Wallis Shultz	Research Scientist	Texas A&M Institute of Genomic Medicine; Texas A&M Health Science Center	Developmental genetics

Name	Position	Department	Special Qualifications
Jane Welsh	Professor	Veterinary Integrative Biosciences	Recovery of neurologic function, multiple sclerosis
Tom Welsh	Professor	Animal Science	Interactions among genes, hormones, & immunopeptides
Mark Westhusin	Professor	Veterinary Physiology & Pharmacology	Animal biotechnology & cloning
Tiffani Williams	Assistant Professor	Computer Science & Engineering	Phylogeny & computational biology
James Womack	Distinguished Professor	Veterinary Pathobiology	Bovine and comparative genomics
Guoyao Wu	Professor	Animal Science	Nutritional genomics
Byung-Jun Yoon	Assistant Professor	Electrical & Computer Engineering	RNA sequence prediction & analysis, biological network analysis
Ry Young	Professor	Biochemistry & Biophysics	Phage genomics
John Yu	Research Geneticist	USDA-ARS	Cotton Genomics
Joshua Yuan	Assistant Professor	Plant Pathology & Microbiology	Plant functional genomics, systems biology
Hongbin Zhang	Professor	Soil & Crop Sciences	Structural, evolutionary & applied genomics
Huaijun Zhou	Assistant Professor	Poultry Science	Functional genomics & host-pathogen interactions
Warren Zimmer	Professor	Physiology, TAMHSC	Developmental & cancer genomics