JAXGENOMIC MEDICINE

October 17, 2011

JAX Genomic Medicine will initially occupy a 173,000 square foot, world-class, LEED-certified research facility constructed on the lower campus of the University of Connecticut Health Center in Farmington. UConn will provide the site and temporary space while the JAX Genomic Medicine facility is being constructed. JAX Plans to ultimately build out the site to include a total of 250,000 square feet of space, as pictured in the conceptual rendering at right.

Reinventing Connecticut
A Bioscience Connecticut Collaboration

The Objective

To create thousands of jobs over time in Connecticut by building a critical mass of researchers, clinicians, entrepreneurs and technical workers, which will enable our state to assume a position of global leadership in the most promising frontier in the life sciences: personalized medicine.

The Project

The Jackson Laboratory (JAX), the world leader in mammalian genetics research, will build JAX Genomic Medicine, an institute for personalized medicine at the University of Connecticut Health Center's Farmington campus. At maturity, 20 years, the institute will employ 600 scientists and technicians in 250,000 square feet of state-of-the art lab space. The total 20-year capital and research budget for the institute is projected to be $1.1 billion, of which the State of Connecticut will contribute $291 million, $192 million in a secured, forgivable construction loan and $99 million in grants for research and related activities. Jackson Laboratory will raise the balance of $860 million through federal research grants, philanthropy and service income.

The Promise

This is a transformational opportunity that leverages the State's first Bioscience Connecticut investment in the expansion of UCHC. According to PriceWaterhouseCoopers, the personalized medicine industry currently is worth $284 billion in sales per year, and it is growing by 11 percent annually. Connecticut has the potential to capture as many as 96,000 new jobs in this industry over the next 20 years *if it invests strategically in its research capabilities.* Together, the UCHC and JAX investments will enable the State to capture 23,000 jobs in the projected growth of the industry. JAX Genomic Medicine will augment Connecticut's research and commercialization capacity while improving health and lowering healthcare costs, helping to position Connecticut as a major U.S. hub for personalized medicine.

About The Jackson Laboratory

Discovering the genetic basis for preventing, treating and curing human disease

Founded in 1929, The Jackson Laboratory (JAX) is an independent, nonprofit genetics research institute headquartered in Bar Harbor, Maine, with a facility in Sacramento, California.

JAX's mission is to discover the genetic basis for preventing, treating and curing human diseases, and to promote biomedical research and education worldwide. Its 38 research teams study the genetic basis of cancers, heart disease, osteoporosis, Alzheimer's disease, glaucoma, diabetes and many other human diseases and disorders, as well as how genes impact normal development, reproduction and aging.

- The National Cancer Institute has designated JAX a Cancer Center.
- JAX is the world's source for more than 6,000 strains of laboratory mice used to study the role of genes in human health and disease.
- The Bar Harbor campus is an international hub for scientific courses, conferences, training and education.

What is genomics research?

There are an estimated 20 trillion living cells within the human body. Within each of those cells is a substance called DNA, the material of genes. Our cells contain about 20,000 genes, and this entire collection of genes is called the genome. The genome contains the biomolecular "recipe" for making the proteins that form a human being.

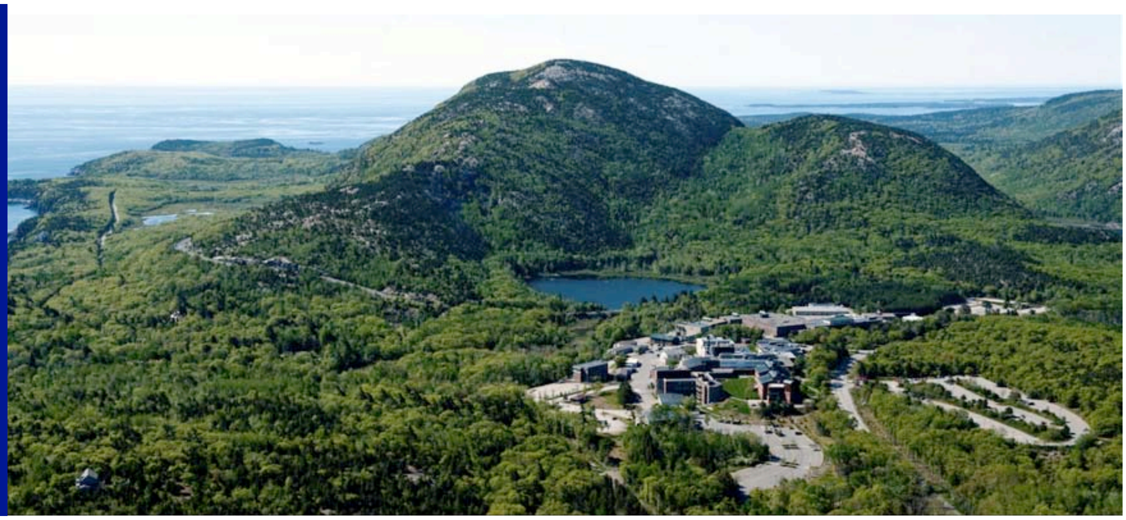
"We are on the leading edge of a true revolution in medicine."
--Francis Collins

Genomics research reveals how genes and networks of genes within the genome interact to affect human health and disease. Understanding these genetic interactions is essential to creating new medicines and treatments for some of humankind's worst diseases and conditions.

Major JAX discoveries

- Made the first link between cancer and viruses in mammals, leading to the discovery of a cancer-causing virus passed through breast milk, key for understanding how genes affect cancer.
- Discoveries were the basis of the first human bone marrow and organ transplants.
- Discovered Leptin in the 1960s. Leptin is a protein hormone that plays a key role in regulating appetite and how the body uses energy from food. It is the foundation for

The Jackson Laboratory employs 1,400 people--1,200 at its Bar Harbor facility pictured at right and 200 in California



current research in obesity and type 2 diabetes.
- Laid the foundation for modern stem cell research through pioneering experiments on testicular tumors in mice.
- Successfully transplanted human immune system cells into a mouse, creating new model organisms for AIDS and cancer research.
- Pinpointed the molecular basis for why a particular strain of mice is a useful model for late-onset neurodegenerative disease, including Alzheimer's disease.
- Some rare forms of leukemia are now treatable because of JAX research advances.
- In vitro fertilization, the freezing of embryos and other assisted reproductive technologies were invented and/or perfected by Jackson.
- Identified the first pre-symptomatic biomarkers of glaucoma in a mouse model, and blocked the development of the disease using a drug already FDA-approved for other uses.

JAX's collaborators

Jackson researchers collaborate with scientists at hundreds of top academic research laboratories around the world, including:
- The Howard Hughes Medical Institute,
- Yale University,
- Harvard University,
- MIT,
- Scripps Clinic,
- Memorial Sloan Kettering,
- Stanford University,
- Johns Hopkins University,
- The California Institute of Technology,
- The National Institutes of Health,
- The universities of California, Maine, Michigan, Virginia, Massachusetts, Pennsylvania,
- The Max Planck Institute in Germany,
- The German-based European Molecular Biological Laboratory,
- Japan's RIKEN Institute,
- The University of Geneva, and
- The Leiden Medical Center in Holland, among others.

JAX awards

George Snell won the Nobel Prize in 1980 for his work in immunology. At least 26 other Nobel prizes can be linked to research, resources or genetic principles first developed at JAX. In 2010, a JAX professor emeritus accepted the prestigious Albert Lasker Award. Another was named to the National Academy of Sciences in 2011, and dozens of other faculty have won prestigious scientific awards throughout Jackson's 82-year history.

Financial and legal structure

In fiscal year 2011, the Laboratory's operating revenue of $214.7 million consisted of: $144.4 million in mouse sales and services; $65.0 million in grants; and $5.3 million in gifts and other.

The laboratory is a 501(c)3 private, nonprofit research institution. It is governed by a Board of Trustees, which is advised on scientific matters by a Board of Scientific Counselors. Surplus revenues are reinvested in research, the development of new scientific resources and education programs. Unlike a for-profit organization, because JAX is held in the public trust, no dividends or profits are paid.

Like other academic and nonprofit research institutions, the laboratory tries to benefit financially from its own scientific discoveries. However, its nonprofit status ensures that any financial gains are used to support its current and future research activities.

The Laboratory patents its discoveries when the patent system is the best means to further the development of new therapies and products for public benefit. It does so with the encouragement of the National Institutes of Health (NIH), which funds most of its research with federal grants.

In September 2011, JAX announced the appointment of Ed Liu as its new CEO. Liu is one of the world's leading geneticists, serving an unprecedented second term as the President of the Human Genome Organization (the oldest international genomics organization). For the past 10 years, Liu has served the Executive Director of the Genetics Institute of Singapore (GIS), which he founded in March 2001. From a staff of three at the beginning, GIS expanded to 270 by January 2011, with 27 principal investigators and 14 research scientists. GIS is now one of the top 10 research institutes in Asia, and is having a significant effect on the Singapore economy by providing trained manpower to life science companies; by engaging and recruiting multinational companies with biomedical intentions to expand existing facilities and to setup R&D units in Singapore; and by directly generating revenues through contracts, grants and spin-offs. Liu plans to play a similar role with the JAX Genomic Medicine in Connecticut.

About JAX Genomic Medicine

A research institute to develop genetics-based approaches to predicting, preventing, and curing human diseases

The Jackson Laboratory for Genomic Medicine (JAX Genomic Medicine) would be a nonprofit institute located adjacent to the University of Connecticut Health Center. It would conduct genomics research consistent with the Laboratory's mission of improving human health. JAX would build on its experience in research to create a world center for discovering and understanding the multiple, complex genetic interactions that are associated with disease. JAX Genomic Medicine would also collaborate with other institutions to develop medical diagnostics and therapeutics. The likely initial research focus would be on cancer and neurodegeneration.

JAX Genomic Medicine is an enhanced and slightly larger project than one which the Jackson Laboratory proposed to build in Florida. Due to the downturn in the economy, Florida was no longer financially willing or able to commit to The Jackson Laboratory.

Why Connecticut?

JAX Genomic Medicine builds upon existing bioscience infrastructure and research expertise in the state. Life science employment overall in Connecticut is three times more concentrated than in Florida, and life science research is **10 times more concentrated.** Connecticut is reinventing itself as a leader in bioscience. The state's ideal location between New York City and Boston, its world-class colleges and universities, and its existing work in the bioscience field made Connecticut a compelling choice. The investment in Bioscience Connecticut in May sent a message to companies and research institutes around the world that Connecticut is willing to be a partner. The Bioscience Connecticut initiative will help link the state's bioscience and research facilities at UConn's main campus in Storrs, its Health Center campus in Farmington and the work being done in this field at Yale and points in between. JAX Genomic Medicine will combine JAX's strengths in mammalian genetics and genomics technologies with the clinical care and biological research strengths of UConn and Yale University. By deciphering the genomic complexity of human disease and testing emerging discoveries in disease models, Yale, UCHC, JAX and the state's clinical providers can jointly deliver on the promise of personalized medicine.

Scale of the project

Total expenditures in the first 20 years of operation are projected to be $1.1 billion:

- $809 million raised by Jackson Laboratory through a combination of federal grants, philanthropy and service income
- $291 million provided by the state
    - $192 million in a forgivable, secured construction loan
    - $99 million in grant support for research and related activities
- Jackson Laboratory will spend roughly $3 dollars for every $1 dollar the state spends.

How the State would finance the project:

The General Assembly would approve the project through enactment of the Connecticut Bioscience Collaboration Act at the October 26, 2011 Special Session. The Act would authorize $290,686,000 in General Obligation Bonds.

Fiscal Year Ending June 30	Amount
2012	$34,162,000
2013	$85,113,000
2014	$59,728,000
2015	$19,669,000
2016	$21,425,000
2017	$21,108,000
2018	$15,820,000
2019	$12,525,000
2020	$10,565,000
2021	$10,570,000
TOTAL	**$290,684,000**

The amount provided for the sale and issuance of bonds for the project will be capped for each fiscal year, as at right, but provided that any used amounts may be carried forward and added to the cap for the next fiscal year.

Spreading out the bonding for the project in this way, and taking advantage of the State's very low current borrowing costs, makes the incremental revenues required to cover costs on a cash flow basis (incremental state revenues versus incremental debt service cost) very low, such that the project is net positive in the first year, as explained in the REMI model analysis on page 9.

The state will issue bonds and establish a a fund within Connecticut Innovations (CI). This fund will be administered by the board of directors of CI.

A portion of the fund ($192 million) will be managed as a secured, forgivable loan. The loan will have an interest rate of 1% and will be drawn down during construction based on construction spending. The loan will be fully collateralized by the building, fixtures and improvements. At the end of the 10-year term, the loan will be forgivable provided Jackson Lab has built and operated the facility and has created at least 300 jobs.

In addition, the state will bond an additional $99 million that will be managed as a series of grants to support research and related activities at the facility.

After the startup period, JAX Genomic Medicine would be funded by research grants and contracts from the National Institutes of Health and other sources, revenue from scientific services and educational programs, and by philanthropy. Federal funding, primarily grants from the National Institutes of Health (NIH) would be used to fund the research programs at JAX Genomic Medicine. In fiscal year 2009, the laboratory's Bar Harbor campus received $54.3 million in federal funds, almost all of which supported research.

Benefits

The addition of JAX Genomic Medicine would strengthen Connecticut's growing reputation as a magnet for science, research and technology. The Laboratory's understanding of genetic disease research would complement the research programs at other institutions and make JAX a desirable partner in the shared effort to improve medical care and human health.

Scientific research institutions generate discoveries, knowledge and expertise that are vital to private enterprise. They attract companies that are seeking to develop and commercialize products and services resulting from discoveries made by research institutes. These research "clusters" take time to grow, but they bring with them tremendous benefits for their local communities.

Local medical institutions and physicians have expressed great enthusiasm for this project. Local hospitals and JAX Genomic Medicine could enjoy several mutual benefits by working with one another. Hospital physicians could participate in JAX's educational offerings. They could also collaborate with JAX scientists on research projects. There is also the potential for collaborations on clinical trials to assess possible medical applications for JAX research findings.

JAX Genomic Medicine would look to collaborate with university researchers, train university students and cosponsor events with the universities. The emerging science of genomic medicine will create demand for new varieties of medical and allied medical training.

Education is an important part of The Jackson Laboratory's mission, and the laboratory has mentored more than 3,000 high school and college students at its Bar Harbor campus over the years.

Low-cost genome analysis will make personalized medicine the norm

Analyzing the Job Impact

Almost 7,000 new jobs, a half billion of net present value, and over $1 billion in research capability for only $292 million of State funds

Type	Jobs
Construction	861
Direct	661
Spinoff	4000
Indirect	2000
Total Permanent	6661

Net Present Value: $472 million

Economic Analysis

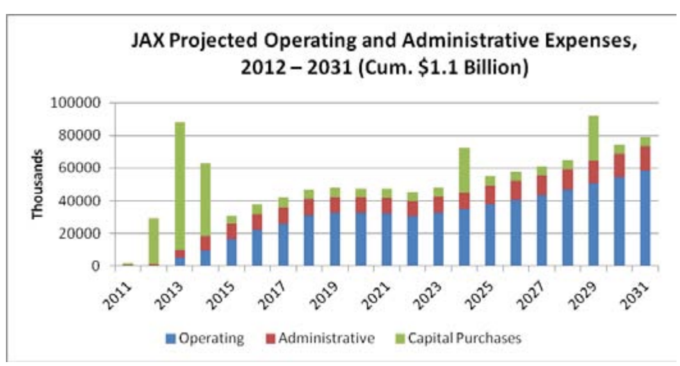
Overview

Jackson Laboratory's proposal to create a new research institute in Connecticut will generate many positive short- and long-term benefits for the state. This analysis details the direct and indirect impacts of the project on the state's economy and provides insights as to how quickly the state will benefit from its investment.

Key results from this analysis are:

- The JAX project and estimated spinoff activity increase state GDP on average each year by $546.5 million from 2011 through 2031.
- The JAX project and the estimated spinoff activity increase net state revenue on average each year by $45.4 million from 2011 through 2031.
- On average each year, the JAX project and spinoffs create through ripple effects 3,900 jobs (1,909 direct and 1,993 indirect jobs).
- Project 'breakeven' in less than two years in terms of new gross state product and in 10 years in terms of new state revenue.

Total project expenditures in the first 20 years of operation are projected to be $1.1 billion as displayed below. A detailed 20-year financial projection is in Appendix 2 on page 15.



Key Assumptions

Sources of revenue include and are not limited to

- $809 million raised by Jackson Laboratory through a combination of federal grants, philanthropy and service income
- $291 million provided by the state
    - $192 million in a forgivable, secured construction loan
    - $99 million in support for research and related activities

Jackson Laboratory will spend roughly $3 dollars for every $1 dollar the state spends.

After the startup period, JAX Genomic Medicine would be funded by research grants and contracts from the National Institutes of Health and other sources, revenue from scientific services and educational programs and by philanthropy.

The state will issue bonds to capitalize a fund that will be established within Connecticut Innovations. This fund will be administered by the board of directors of CI. A portion of the fund ($192 million) will be managed as a forgivable loan. The loan will have an interest rate of 1% and will be drawn down during construction based on construction spending. The loan will be fully collateralized by the building, fixtures and improvements. At the end of the 10-year term, the loan will be forgivable provided Jackson Lab has built and operated the facility as outlined in the agreement with the state and has created at least 300 jobs. In addition, the state will bond an additional $99 million that will be managed as a series of grants to support research and related activities at the facility.

Methodology and Modeling Strategy

JAX provided a schedule of proposed construction and equipment expenditures as well as a schedule of direct job creation from 2011 through 2031. Table 1 displays these expenditures as well as the estimated direct jobs created by spinoff firms in Panel 1. All dollar numbers appear as millions of current dollars. JAX provided a ten-year schedule of operating and capital support from the State of Connecticut appearing in Panel 2 of Table 1. New bonding occurs in each year from 2011 through 2021 (column three of Panel 2) to cover the JAX operating and capital support. New debt service accumulates as new bonds are issued (column four of Panel 2) until 2040 when the last issue made in 2021 is paid off (the total reported in Table 1 is for the 21-year period 2011 through 2031). The increase in non-residential capital reflects the plant and equipment JAX adds to the Grand List of the municipality in which it resides.

We model the ten years of operating support as a reduction in JAX production costs that renders the firm more competitive with respect to its peers and competitors inside and outside the state. We model the ten years of state capital support for JAX as a dollar-for-dollar reduction in its capital

Table 1: JAX Direct Project Investment, Employment and Financial and Fiscal Impacts (Dollars in Millions)

	Panel 1						Panel 2			
Project Year	Institutional Structures	Lab Equipment	Computer Equipment	Increase in Non-Residential Capital	JAX Direct Hires	Spinoff Direct Hires	Capital Cost	Production Cost	Annual Bond Issue	State Spending (Cumulative New Debt Service)
2011	$1.27	$0.0	$0.0	$1.27	0	0	-$1.27	$0.0	$1.27	-$0.10
2012	$24.38	$2.0	$1.51	$27.89	3	0	-$27.89	-$5.0	$32.89	-$2.81
2013	$74.81	$2.18	$1.13	$78.11	32	0	-$78.11	-$7.0	$85.11	-$9.82
2014	$35.70	$6.25	$2.78	$44.73	85	223	-$44.73	-$15.0	$59.73	-$14.73
2015	$1.17	$1.45	$2.05	$4.67	157	471	-$4.67	-$15.0	$19.67	-$16.35
2016	$1.17	$2.64	$2.61	$6.42	196	746	-$6.42	-$15.0	$21.42	-$18.11
2017	$1.17	$1.79	$3.25	$6.21	248	1052	-$6.21	-$15.0	$21.21	-$19.86
2018	$1.17	$0.75	$4.0	$5.92	313	1391	-$5.92	-$10.0	$15.92	-$21.17
2019	$1.17	$0.45	$4.0	$5.62	334	1767	-$5.62	-$7.0	$12.62	-$22.21
2020	$1.17	$0.49	$4.0	$5.66	337	2185	-$5.66	-$5.0	$10.66	-$23.09
2021	$1.17	$0.50	$4.0	$5.67	339	2648	-$5.67	-$5.0	$10.67	-$23.96
2022	$1.17	$18.47	$4.0	$23.64	361	2762	$0.00	$0.0	$0.00	-$23.96
2023	$1.17	$0.0	$4.0	$5.17	382	2881	$0.00	$0.0	$0.0	-$23.96
2024	$21.17	$0.0	$4.0	$25.17	405	3005	$0.00	$0.0	$0.0	-$23.96
2025	$1.17	$0.50	$4.0	$5.67	430	3134	$0.00	$0.0	$0.0	-$23.96
2026	$1.17	$0.50	$4.0	$5.67	457	3269	$0.00	$0.0	$0.0	-$23.96
2027	$1.17	$2.50	$4.0	$7.67	487	3409	$0.00	$0.0	$0.0	-$23.96
2028	$1.17	$0.50	$4.0	$5.67	520	3556	$0.00	$0.0	$0.0	-$23.96
2029	$21.17	$0.50	$4.0	$25.67	556	3709	$0.00	$0.0	$0.0	-$23.96
2030	$1.17	$0.50	$4.0	$5.67	595	3868	$0.00	$0.0	$0.0	-$23.96
2031	$1.17	$0.50	$4.0	$5.67	638	4035	$0.00	$0.0	$0.0	-$23.86
Totals	**$196.13**	**$42.40**	**$69.34**	**$307.86**	**NA**	**NA**	**-$192.18**	**-$99.00**	**$291.18**	**-$411.74**

costs because this support translates into funds the firm does not need to obtain from the capital markets.

To obtain the estimate of spinoff direct jobs over the analysis period, we consulted an October 2009 report from PricewaterhouseCoopers (PWC)[1] that estimates the growth of the personalized medicine industry in the U.S. from 2009 through 2015. JAX is part of this growing industry group that PWC estimated will grow at 11% through 2015 from a 2009 national sales level of $232 billion. We obtained the Connecticut 2009 employment for the relatively narrow sector in which JAX is situated (2,030 jobs in NAICS sector 541711, 'Research and development in biotechnology') and grew this base by 11% per year until 2022.[2] The base grows from 2,030 jobs in this sector in 2014[3] to 2,648 jobs in 2022. We call this period a growth spurt as JAX ramps up its operation, the UConn Health Center expands significantly and collaborations escalate with Yale and other institutions and businesses. We anticipate this activity will attract researchers and firms in personalized medicine and the subsector involved with human genomics, proteomics and in vitro diagnostics (IVD) among others in this field to Connecticut from other states. In addition, we anticipate a robust rate of commercializable patents to spawn new firms that add to direct employment in the spinoff category.[4]

From 2023 through 2031, we expect the growth rate to decelerate significantly as Connecticut's new spinoff firms mature and the low-hanging fruits of intense genomic and proteomic research are harvested. There will be increased competition for grant funds and states will mount their own campaigns to retain and attract firms and jobs in the rapidly expanding personalized medicine space. Thus, we assume conservatively the 2022 base of 2,648 direct spinoff jobs grows by 4.3% per year until it reaches 4,035 direct spinoff jobs in 2031 when the analysis period ends.

Economic Impact Results

Table 1 contains the drivers of economic impact that represent new, direct economic activity. This new activity in turn creates jobs and new sales in most other sectors of the Connecticut economy. A good measure of economic activity is state gross domestic product (GDP) that measures the value of all goods and services produced in the state in a year. The JAX project and the estimated spinoff activity increase state GDP on average each year by $546.5 million from 2011 through 2031. The net present value of increased state GDP is $5.5 billion discounted at 5.3% per year. This represents the value in today's dollars of the future annual state GDP increases expressed in future dollars. These increases express the value of the project and measure this as changes from the no-build or status quo forecast of the Connecticut economy that the Connecticut economic model calculates.[5]

Another measure of project value is net state revenue. The new economic activity generates new taxes and new expenditures as people migrate to the state in search of job opportunities. New state residents and businesses increase their demand for public services and the concomitant expenditure increases as new residents increase tax revenues at each level of government. Net state revenue is the difference between these two large numbers and we need it to be positive as it incorporates the cost of the project to the state. The cost to the state appears in column four of Panel 2 in Table 1. We model this cost as reduced state spending as we assume the state does not raise taxes to cover new debt service. The state may not actually reduce spending but it may defer or forgo hiring and capital projects to offset the increased debt service cost.

The JAX project and the estimated spinoff activity increase net state revenue on average each year by $45.4 million from 2011 through 2031. The net present value of increased net state revenue is $472.5 million discounted at 5.3% per year. An important measure of economic value is job creation. As direct jobs at JAX and spinoffs ramp up, they spend their paychecks in the state and in turn stimulate additional job creation. JAX and other new businesses purchase goods and services from existing Connecticut firms and in so doing stimulate job creation in these businesses. These subsequent rounds of spending represent the induced and indirect effects of direct job creation at JAX and spinoffs. The direct jobs created by JAX and spinoffs appear in columns five and six of Panel 1 in Table 1. On average each year, the JAX project and spinoffs create through ripple effects 3,900 jobs in the

[1] "The new science of personalized medicine: Translating the promise into practice," available at http://pwchealth.com/cgi-local/hregister.cgi?link=reg/personalized-medicine.pdf.

[2] Source is County Business Patterns at www.census.gov/econ/cbp/index.html.

[3] We assume because of the recession and state cuts to research there is no job growth in this sector between 2009 and 2014.

[4] In this analysis, the spinoff jobs category includes jobs created in new firms resulting from commercializable patents and jobs migrating to Connecticut and jobs expanding at existing firms in the state because of collaborations, subcontracts and a clustering or agglomeration effect.

[5] We use the REMI model from Regional Economic Models, Inc. in Amherst, MA. It is a tool widely used by cities, states and the federal government to explore the potential economic effects of policy changes. REMI is a computer program that incorporates decades of historical data on inter-relationships between industries and among regions (calibration constants). It enables users to see how changes in specific variables, such as population, employment or prices in a certain industry, will affect other variables, such as market demand and production of goods. The U.S. Department of Commerce developed and maintains the data on which the model is based. The REMI model calculates the expected changes due to investments like the Jackson Lab project. The model relies on the calibration constants to forecast changes in employment, GDP and state revenue based on the specifics of the region under analysis. Like any model, REMI relies on assumptions that the U.S. Department of Commerce updates on an annual basis.

Figure 1: Timepaths of New State GDP, State Revenue and State Debt Service

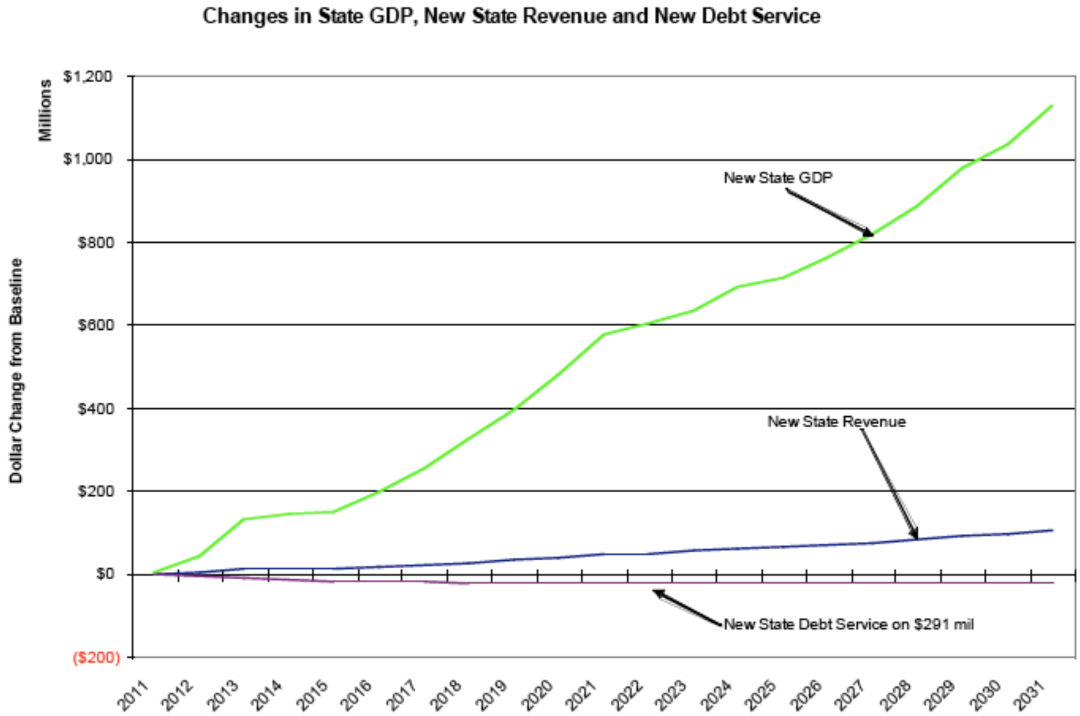
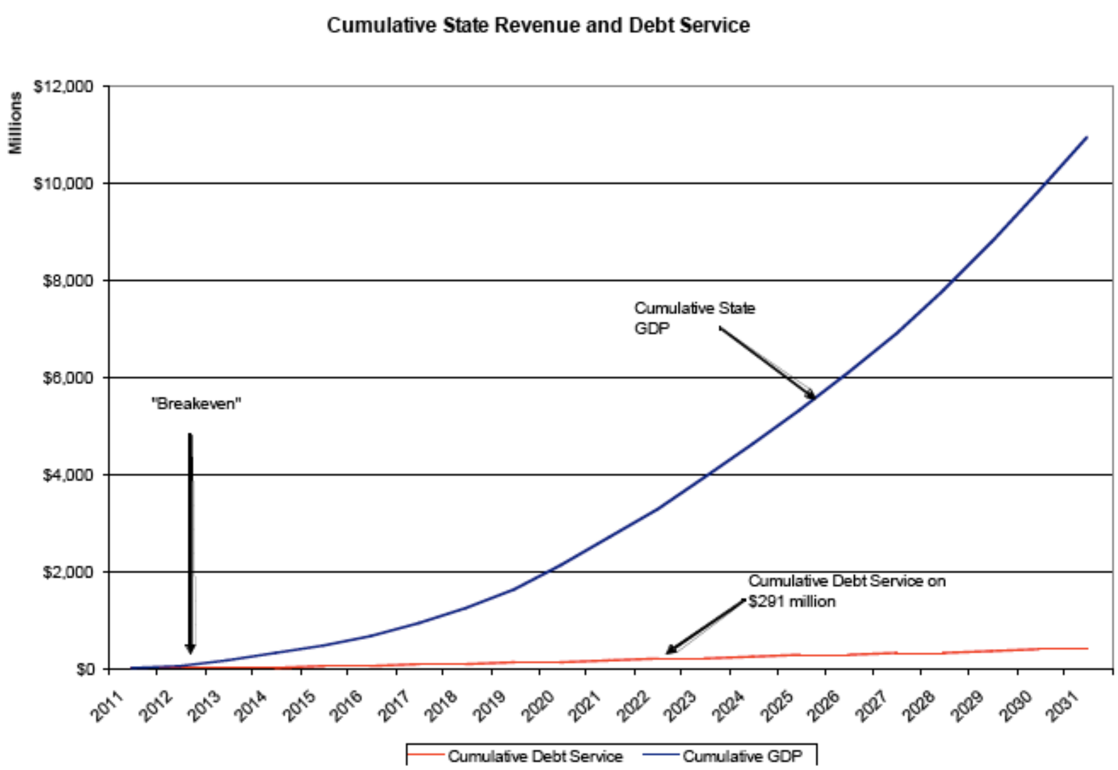


Figure 2: Timepaths of Cumulative State GDP and Debt Service on Proposed State Investment



state that include 1,909 direct and 1,993 indirect jobs. This implies an average jobs multiplier of 2.04 meaning that for each JAX and/or spinoff job created an additional 1.04 jobs are created in the Connecticut economy.

Figure 1 shows the timepath of new state GDP, new state revenue and new state debt service. The fact that new state GDP is significantly greater than new debt service indicates the new economic activity generated by JAX and spinoffs is easily affordable all else equal. Figure 2 shows cumulative state GDP and cumulative debt service and illustrates the breakeven year is 2012 in the state's ability to pay terms. Figure 3 shows another breakeven concept by displaying the state's investment commitment and cumulative state revenue. When these curves cross, the state has recouped sufficient revenue to offset completely its investment commitment. This occurs in 2022, ten years after project inception.

Job Creation Detail

As JAX hires staff and begins to generate commercializable patents alone and in collaboration with UConn and Yale and other collaborators inside and outside Connecticut, there will be jobs created in all sectors and all occupations in the state economy. These new jobs in sectors other than the narrow industry groups in which JAX and its collaborators are embedded result in part from new hires spending their paychecks in the state to support their households. Construction, real estate, retail and several service sectors satisfy the demand for net new household consumption. In addition, JAX, its collaborators and the spinoff companies created purchase goods and services in the Connecticut economy. These purchases in turn stimulate growth of the relevant supply chain industries and the occupations therein.

Indirect jobs are those created by the local purchases made by JAX and its employees and by the spinoff firms and their employees. Indirect jobs will be primarily in the following sectors: Construction, Wholesale Trade, Retail Trade, Information, Real Estate and Rental and Leasing, Professional and Technical Services, Administrative Services, Educational Services, Health Care and Social Assistance, Arts, Entertainment.

Figure 4: The Evolution of Job Creation by Sector

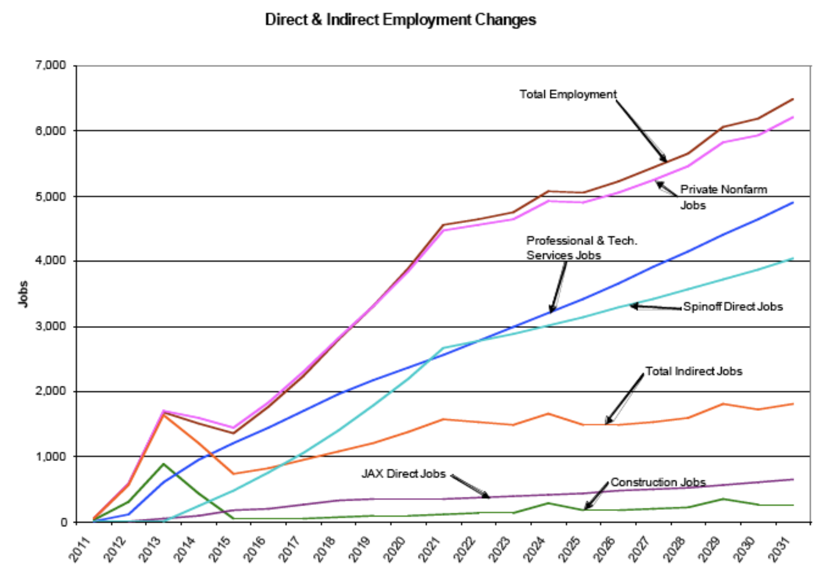
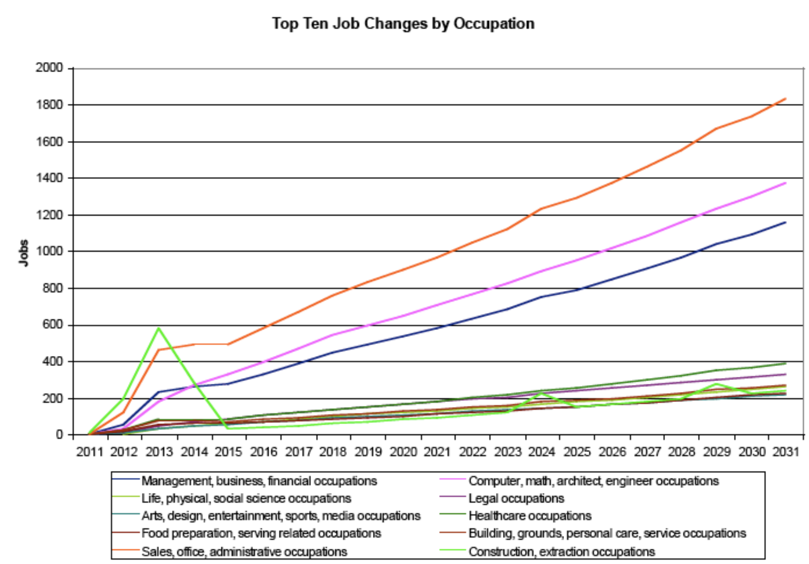


Figure 5: Job Growth by Occupation



JAX Genomic Medicine
a scientific prospectus

By Edison Liu, September 11, 2011

Personalized Medicine and Systems Genomics

All life forms and all diseases have a genetic basis. Today, powerful genomic technologies and approaches are permitting us to view disease and health with unparalleled precision and completeness. The promise is to personalize and tailor treatments for human diseases, to maximize therapeutic outcomes and to minimize damaging side-effects. Moreover, personalizing treatments targeting only those who are likely to respond favorably and avoiding those with potential adverse reactions provides significant savings in healthcare delivery. The challenge now is to integrate the thousands to millions of genetic differences between normal and disease states to provide a systems solution to treat and to prevent these diseases. There is therefore a need for institutions that can assess and integrate complex biological and clinical information using genomics and genetics as the conduit.

The Jackson Laboratory (JAX) proposes to establish an institute for personalized medicine and systems genomics to accelerate discovery in personalized medicine. We believe that deciphering the genomic complexity of human disease and mechanistically testing the emerging hypotheses in mouse models for these diseases will provide the most comprehensive solutions. This institute will integrate the strengths of JAX in mouse genetics and genetic technologies with the clinical and biological strengths of the University of Connecticut and Yale University. Special clinical areas of focus can be neuropsychiatry, aging, human genetics disorders, cancer, stem cell and reproductive biology, and metabolic diseases.

We propose five conceptual blocks for how The Jackson Laboratory for Genomic Medicine can provide added value to the existing talent in the state. First, JAX will build a research facility that will supplement the state's research infrastructure; second, JAX recruitment of faculty will increase the talent pool for research in personalized medicine; third, JAX will help promote cooperation among Connecticut institutions in personalized medicine projects; fourth, JAX will advise and coordinate with the UConn Health System in their next phase of faculty growth; and fifth, JAX, with its long experience in converting basic science into products, will assist state economic development agencies in identifying the best industrial and biotech partners for advancing personalized medicine. The new institute will make Connecticut the national center for genomic and personalized medicine, with substantial economic impact that will increase the inflow of research funds, enhance the generation of new companies and augment the prestige and effectiveness of healthcare delivery in Connecticut.

The Jackson Laboratory for Genomic Medicine

A key platform for personalized medicine is the ability to analyze genomic complexity in order to identify medically actionable targets. Current technologies are able to precisely uncover the genomic differences among normal and affected individuals, but this information is highly complex and most common disorders are a result of complex interactions between multiple genetic drivers. The goal of the institute would be an understanding of the precise gene components that cause disease and a roadmap for comprehensive diagnostic and tailored therapeutic interventions. It will be a nexus for genomic studies that accomplish this goal by bridging human disease and mouse models, integrating human and mouse genetics at the level of complex systems through the lens of genomics.

Key Components

Access to genomic technologies: sequencing, arrays, genotyping. The Jackson Laboratory for Genomic Medicine can be a portal for the clinical community in Connecticut to access deep sequencing and analytical capabilities available to JAX. We plan to configure the technologies for the analysis of genomes, epigenomes and transcriptomes.

Deep analytics: computational biology, statistical genetics, database analysis. This would be an area of major focus with a special emphasis on systems computational biology that can take advantage of proximity to the UConn engineering school and provide necessary complementary skills for the university. Moreover, systems analytics can be modularly applied to different problems of interest to the universities, such as stem cell biology. JAX's non-university structure is to our advantage because computational groups are often dispersed in different departments in universities. As a research institute (much like the Broad or the Genome Institute of Singapore), JAX can assemble the disparate computational groups into functional consortia more quickly and efficiently.

Clinical-biological interface. Contemporary translational sciences require interaction between the basic science community and healthcare systems. Though these interactions are built on one-to-one engagements between a basic scientist and a clinician, the ultimate impact needs scale at community and systems levels. Proximity to the clinical community for collaborative interactions will be key for The Jackson Laboratory for Genomic Medicine. We wish to provide space for clinician scientists to conduct research so that they may provide the in-house interface for scientists with the clinical community. Program resources to fund sequencing for clinical questions will immediately attract such interactions. Establishing a disease-focused and well-annotated biobank to be housed at The Jackson Laboratory for Genomic Medicine will facilitate translational activity.

Focused biological investigations (functional studies). There needs to be a cadre of investigative biologists who are enabled to assess the functional consequences of mutations detected or regulatory networks perturbed in human disease states. These may include cell biologists (human iPS systems) and other model systems biologists. For example, the zebra fish has become an important and cost-effective validation model system for human genetics. The Jackson Laboratory for Genomic Medicine offers a unique opportunity to initiate a zebra fish program dedicated to providing "first" pass validation for the function of genes discovered to be mutated in human disorders (i,ii,iii).

Biomarker development/translational technologies. A final endpoint of these investigations will be conversion of fundamental science into actionable diagnostics. To this end, we will develop a translational unit that focuses on genomic diagnostics that are "hardened" for clinical use. In this manner this translational genomics group can function as the engine to commercialize fundamental discoveries into diagnostics and therapeutics.

Integrating with JAX Maine

JAX has great strength in the fundamentals of systems genetics. This includes haplotype analysis in inbred mice, classical QTL mapping in crosses, genome scans in genetically complex mouse populations (DO mice), expression QTL mapping and, importantly, modifier genetics. These approaches are being applied to a large number of biological areas, including metabolism and diabetes, aging, cancer, neuroscience, drug addiction, renal disease, cardiovascular disease, hematology and reproductive biology. The Jackson Laboratory for Genomic Medicine will be the critical anchor allowing these Bar Harbor capabilities to interact with the clinical and scientific communities in Connecticut. Therefore, a key strategy will be to leverage JAX expertise in Maine to untangle the genetic complexity of human disease by direct comparison to mouse genomic data. Thus, the establishment of The Jackson Laboratory's Connecticut facility may launch comparative systems biology as a new approach to understanding human disease.

Organizational Build-Out

Conceptually, The Jackson Laboratory for Genomic Medicine will build out computational genomics and biological analysis and validation capacity. Computational genomics will be the engagement point with the clinical/translational communities at UConn and Yale and the mouse genetics and mouse models of human disease community at Bar Harbor. Through its primary analytical and systems modeling function, the new institute will also be the key intersection among the major translational components. The areas of medical focus will depend on joint interest and expertise; however, cancer/cancer stem cells, neuropsychiatry and aging are promising areas for collaborations, with faculty strength apparent in all participating institutions.

Other biological areas of shared strengths with the two institutes in Connecticut (UConn and Yale) that would add depth to and complement our existing research portfolio include: behavioral and cognitive neuroscience, cancer, aging, stem cell and reproductive biology, and genetics of Mendelian disorders. For example, JAX currently has an Aging Center that is supported by an NIA Shock Aging grant and by substantial funding from the Ellison Foundation. Expansion of this program could complement the longstanding program in aging research at Yale and UConn.

A hypothetical fractional effort for The Jackson Laboratory for Genomic Medicine might be:

1. Computational Genomics and Systems Analytics
2. Clinical interface and biological investigation/validation
3. Genomic technologies (including biobanking and diagnostics)

Interaction with UConn and Yale

There should be a core group of JAX investigators. Joint appointments between JAX and university investigators should be encouraged. Lab space for university investigators, especially clinician scientists, should be provided at The Jackson Laboratory for Genomic Medicine. This lab space sharing will require a financial arrangement that will resolve rental, overhead, IP, duration of tenancy and dispute resolution issues clearly. In this set-up, The Jackson Laboratory for Medical Genomics investigators can draw on and contribute to expertise at both UConn and Yale.

Functional Operational Model

The Jackson Laboratory for Genomic Medicine is envisaged to house 30 principal investigators along with a commercialization activity, various support services and administrative departments. We anticipate that wet lab to dry lab PI ratio will be 15:15. Of the wet lab investigators, a number will be primarily quantitative and computational but have laboratories. Not all PIs will be 100% JAX. We anticipate some will hold joint appointments with a university, and several, especially the translational scientists, will primarily be associated with a medical center but have research housed in The Jackson Laboratory for Genomic Medicine and be part of the integrated institute. All JAX affiliated investigators will have access to enormous sequencing and bioinformatics capabilities through JAX's founding membership in a large scale genome center that is now being established.

We will also have space to commercialize the application of the research for the medical and scientific community. Specifically, we will dedicate between two to three PI-type positions engaged primarily in translating science into commercializable products or services, along with a team of individuals to support them. It is expected that the commercialization will result in a moderately sized business providing a high margin and low capital / labor intensive research-related product. Areas would include computational services, diagnostic products and drug screening in the "virtual" tumor or organ system.

The primary funding of the long-term operations will be grants, with business and philanthropic revenues supporting the inevitable research shortfall. Some collaboration funding from pharmaceutical companies is also expected. Some operations support will be necessary to supplement these JAX revenue sources for the first few start-up years, but over time the Laboratory will become fully self-supporting.

Organizationally, we would avoid segregating into classical departments to avoid "silo" programs. Instead, we would consider developing an organizational matrix so that each PI may be involved in several (2-3) functional scientific groups. Some of the groups will be technology based (genomics vs. biologics vs. computational analytics), some will be disease and translationally based.

Engagement with UConn

We believe that The Jackson Laboratory for Genomic Medicine can be helpful in the dramatic expansion plans of the UConn Health Care System. Strategic expansion that coordinates several centers of excellence towards a set of common goals would be optimum. Because personalized medicine is a major direction for UConn, the JAX scientific community would be pleased to provide advice and to participate in the planned growth of the UConn Health System.

Space and Facilities

Housing staff and accommodating the planned development will require a world-class research facility. The 173,000 square foot facility will house up to 15 bioinformatics and computational biology dry labs and up to 20 wet labs, along with required scientific services and administrative support spaces. Bioinformatics and wet-bench research facilities will be designed to create interaction, foster collaboration and allow flexible reconfiguration to meet the ever-changing needs of our research programs and staff. The LEED-certified facility will be constructed with sustainability, operational efficiency, collaboration and a sense of place in mind.

Temporary space will be required for a minimum of 24 months while a permanent facility is built. This space would house administrative staff, bioinformatics and computational biology faculty and services staff. If the project proceeds on schedule, it is estimated that the temporary facility will require 12,000 to 15,000 square feet to allow our institute to develop and grow while our permanent facility is being constructed.

Massive datasets will require high-performance, scalable storage, computational capacity and networking infrastructure. We project close to a quarter petabyte of usable storage, more than 800 cores of high-performance computational capacity and 10 gigabit network connectivity to UConn, Yale, and Bar Harbor, as well as to high-speed national and international research networks. The permanent facility will include a data center that will offer petascale infrastructure and will scale to dozens of petabytes and tens of thousands of computational cores over 10 years, while ensuring high availability and security commensurate with work involving human subjects.

NOTES

i Sheng D, Qu D, Kwok KH, Ng SS, Lim AY, Aw SS, Lee CW, Sung WK, Tan EK, Lufkin, T, Jesuthasan S, Sinnakaruppan M, Liu J. Deletion of the WD40 domain of LRRK2 in Zebrafish…. PLoS Genet. 2010 Apr 22;6(4):e1000914. **ii** Kim S, Zaghloul NA, Bubenshchikova E, Oh EC, Rankin S, Katsanis N, Obara T, Tsiokas L. Nde1-mediated inhibition of ciliogenesis affects cell cycle re-entry. Nat Cell Biol. 2011 Apr;13(4):351-60. **iii** Davis EE, Zhang Q, Liu Q, Diplas BH, Davey LM, Hartley J, Stoetzel C, Szymanska K, Ramaswami G, Logan CV, Muzny DM, Young AC, Wheeler DA, Cruz P, Morgan M, Lewis LR, Cherukuri P, Maskeri B, Hansen NF, Mullikin JC, Blakesley RW, Bouffard GG; NISC Comparative Sequencing Program, *et al.* TTC21B contributes both causal and modifying alleles……. Nat Genet. 2011ar;43(3):189.modifying alleles across the ciliopathy spectrum. Nat Genet. 2011 Mar;43(3):189-96.

APPENDIX 2
20 Year Financial Projection

Statement of Operations	Startup (1/2 Yr)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total (10 yrs)	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Total (20 yrs)
Operating Revenue																							
Public Funding																							
Grant Revenue		-	-	1,668	6,666	8,257	10,310	15,274	18,347	19,315	19,527	99,365	20,504	21,529	22,605	23,736	24,922	26,169	27,477	28,851	30,293	31,808	357,259
Shared PI OH		-	-	170	677	839	1,048	1,552	1,865	1,963	1,985	10,099	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	29,945
State Operating Subsidy		5,000	7,000	15,000	15,000	15,000	15,000	10,000	7,000	5,000	5,000	99,000	-	-	-	-	-	-	-	-	-	-	99,000
Total Public (Grant and State) Funding		5,000	7,000	16,838	22,344	24,097	26,357	26,826	27,212	26,278	26,512	208,463	22,488	23,514	24,590	25,720	26,907	28,153	29,462	30,836	32,278	33,793	486,204
Collaboration Revenue		-	-	-	-	500	1,000	1,750	2,500	3,250	4,000	13,000	4,320	4,666	5,039	5,442	5,877	6,347	6,855	7,404	7,996	8,636	75,582
Royalty Revenue									150	350	500	1,000	560	627	702	787	881	987	1,105	1,238	1,387	1,553	10,827
Service Revenue		-	-	150	300	2,600	3,567	6,780	7,527	8,007	9,197	38,127	10,300	11,536	12,921	14,471	16,208	18,153	20,331	22,771	25,503	28,563	218,883
Total Operating Revenue		5,000	7,000	16,988	22,644	27,197	30,924	35,356	37,389	37,884	40,209	260,590	37,669	40,343	43,252	46,420	49,873	53,640	57,753	62,248	67,164	72,545	791,497
Expenses																							
Laboratory		-	1,103	4,744	9,578	12,813	15,791	19,168	20,443	20,443	20,443	124,526	21,465	22,538	23,665	24,848	26,091	27,395	28,765	30,203	31,713	33,299	394,509
CT/ME PI Collaboration		-	1,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	12,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	1,375	26,125
Scientific Services																							
IT Suppport		-	1,416	1,719	2,629	2,930	3,331	3,444	3,468	3,541	3,666												
Other SS Depts		-	208	1,216	2,376	4,036	4,796	6,056	6,278	6,242	5,894	37,102	6,602	7,394	8,281	9,275	10,388	11,634	13,030	14,594	16,345	18,307	152,951
Internal transfers		-	(125)	(700)	(1,100)	(1,600)	(1,900)	(2,000)	(2,000)	(2,000)	(2,000)	(13,425)	(2,100)	(2,205)	(2,315)	(2,431)	(2,553)	(2,680)	(2,814)	(2,955)	(3,103)	(3,258)	(39,839)
Net (to Service Related Expense)		-	83	516	1,276	2,436	2,896	4,056	4,278	4,242	3,894	23,677	3,985	5,189	5,966	6,844	7,835	8,954	10,216	11,639	13,243	15,049	112,596
Courses and Conferences		-	511	511	632	632	632	632	632	632	632	5,448	708	793	888	995	1,114	1,248	1,397	1,565	1,753	1,963	17,873
Sales and Marketing		-	530	634	1,091	1,776	2,160	2,315	2,315	2,315	2,315	15,449	2,592	2,903	3,252	3,642	4,079	4,568	5,117	5,731	6,418	7,189	60,940
Total Operating Expenses		-	5,019	9,499	16,580	21,963	26,186	30,990	32,510	32,547	32,325	207,619	30,642	32,798	35,146	37,704	40,494	43,540	46,870	50,513	54,502	58,875	638,702
Gross Margin	-	5,000	1,981	7,489	6,063	5,234	4,738	4,366	4,879	5,338	7,884	52,972	7,027	7,545	8,106	8,717	9,379	10,100	10,883	11,735	12,661	13,670	152,794
Administrative Expenses																							
Research Administration		-	352	897	1,035	1,184	1,213	1,293	1,283	1,158	1,158	9,574	1,216	1,277	1,341	1,408	1,478	1,552	1,629	1,711	1,796	1,886	24,868
Administration	500	374	2,293	2,810	2,930	2,835	2,855	2,905	2,822	2,824	2,825	25,973	2,966	3,114	3,270	3,433	3,605	3,785	3,975	4,173	4,382	4,601	63,277
Facility Costs		926	1,192	2,195	2,323	2,326	2,326	2,326	2,326	2,326	2,326	20,591	2,326	2,326	2,326	2,907	2,907	2,907	2,907	3,489	3,489	3,489	49,663
Utilities		-	864	2,593	2,593	2,593	2,593	2,593	2,593	2,593	2,593	21,608	2,593	2,593	2,593	3,241	3,241	3,241	3,241	3,889	3,889	3,889	54,021
Depreciation												-											
Insurance		100	100	100	200	200	200	200	200	200	200	1,700	216	233	252	340	367	397	428	555	600	648	5,737
Interest	105	-	22	65	227	416	602	721	553	221	-	2,932											2,932
Total Administrative costs	605	1,400	4,825	8,660	9,308	9,554	9,789	10,038	9,776	9,321	9,101	82,378	9,317	9,543	9,781	11,330	11,599	11,882	12,181	13,818	14,156	14,513	200,497
Net Operating Surplus	(605)	3,600	(2,844)	(1,171)	(3,245)	(4,320)	(5,051)	(5,672)	(4,897)	(3,984)	(1,218)	(29,406)	(2,290)	(1,998)	(1,675)	(2,613)	(2,219)	(1,783)	(1,298)	(2,083)	(1,495)	(843)	(47,703)
Other Operating Support																							
Gifts		100	300	500	700	1,200	1,800	3,000	6,000	7,500	10,000	31,100	12,000	12,120	32,241	12,364	12,487	12,612	12,738	32,866	12,994	13,124	196,647
Endowment income								250	750	1,000	1,250	3,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	15,750
Total Other Operating Support	-	100	300	500	700	1,200	1,800	3,250	6,750	8,500	11,250	34,350	13,250	13,370	33,491	13,614	13,737	13,862	13,988	34,116	14,244	14,374	212,397
Net Surplus (Cash Basis)	(605)	3,700	(2,544)	(671)	(2,545)	(3,120)	(3,251)	(2,422)	1,853	4,516	10,032	4,944	10,960	11,372	31,816	11,001	11,518	12,080	12,690	32,033	12,749	13,531	164,694
Capital Purchases	1,270	27,892	78,113	44,728	4,669	6,425	6,208	5,920	5,625	5,665	5,670	192,184	5,670	5,670	27,670	5,670	5,670	5,670	5,670	27,670	5,670	5,670	292,883
State Capital Subsidy	1,270	27,892	78,113	44,728	4,669	6,425	6,208	5,920	5,625	5,665	5,670	192,184											192,184
Net Cash Flow	(605)	3,700	(2,544)	(671)	(2,545)	(3,120)	(3,251)	(2,422)	1,853	4,516	10,032	4,944	5,291	5,702	4,147	5,331	5,848	6,410	7,020	4,363	7,080	7,861	63,995

	Startup (1/2 Yr)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total (10 yrs)	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Total (20 yrs)
State Funded Activities																							
Operating Support	-	5,000	7,000	15,000	15,000	15,000	15,000	10,000	7,000	5,000	5,000	99,000	-	-	-	-	-	-	-	-	-	-	99,000
Capital Support	1,270	27,892	78,113	44,728	4,669	6,425	6,208	5,920	5,625	5,665	5,670	192,184	-	-	-	-	-	-	-	-	-	-	192,184
Total State Support	1,270	32,892	85,113	59,728	19,669	21,425	21,208	15,920	12,625	10,665	10,670	291,184	-	-	-	-	-	-	-	-	-	-	291,184

	Startup (1/2 Yr)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total (10 yrs)	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Total (20 yrs)
Capital Purchases																							
Building	1,270	24,384	74,806	35,699	1,175	1,175	1,175	1,175	1,175	1,175	1,175	144,383	1,175	1,175	21,175	1,175	1,175	1,175	1,175	21,175	1,175	1,175	196,131
Scientific Equipment		1,995	2,175	6,246	1,445	2,640	1,785	745	450	490	495	18,466	495	495	2,495	495	495	495	495	2,495	495	495	27,416
IT Equipment		1,512	1,132	2,783	2,049	2,610	3,248	4,000	4,000	4,000	4,000	29,335	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	69,335
Total	1,270	27,892	78,113	44,728	4,669	6,425	6,208	5,920	5,625	5,665	5,670	192,184	5,670	5,670	27,670	5,670	5,670	5,670	5,670	27,670	5,670	5,670	292,883
Operating Expenditures																							
Expenditures	605	1,400	9,844	18,159	25,889	31,517	35,975	41,028	42,286	41,868	41,426	289,997	39,958	42,341	44,927	49,033	52,093	55,423	59,051	64,331	68,659	73,388	839,200
Total Expenditures	1,875	29,292	87,957	62,887	30,558	37,941	42,183	46,948	47,911	47,533	47,096	482,181	45,628	48,011	72,597	54,703	57,762	61,093	64,721	92,001	74,328	79,058	1,132,082

	Startup (1/2 Yr)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total (10 yrs)	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Total (20 yrs)
Employment																							
JAX Funded																							
PI's		-	3	7	11	16	19	20	20	20	20		21	22	23	24	26	27	28	30	31	33	
Lab Employees		-	4	24	56	73	92	121	133	133	133		143	150	157	165	174	182	191	201	211	222	
All Other		3	27	56	77	95	109	121	124	127	129		119	132	146	162	180	200	222	247	275	306	
Total		3	32	80	133	168	201	242	257	260	262		283	304	327	352	379	409	442	478	517	560	
Collaboration Funded																							
PI's				1	2	3	4	5	5	5	5		5	5	5	5	5	5	5	5	5	5	
Lab Employees				3	10	14	19	30	33	33	33		34	34	34	34	34	34	34	34	34	34	
Total	-	-	-	4	12	17	23	35	38	38	38		39	39	39	39	39	39	39	39	39	39	-
Total All Employees																							
PI's	-	-	3	8	13	19	23	25	25	25	25		26	27	28	29	31	32	33	35	36	38	-
Lab Employees	-	-	4	27	66	87	111	151	166	166	166		177	184	191	199	208	216	225	235	245	256	-
All Other	-	3	27	56	77	95	109	121	124	127	129		119	132	146	162	180	200	222	247	275	306	-
Total	-	3	34	92	156	201	244	297	315	318	320		322	343	366	391	418	448	481	517	556	599	-

Report:
State Bioscience Rankings & Climate for Investing in New Bioscience Initiatives

August 15, 2011

JAX Corporate and Foundation Relations staff were asked to look at the states that are top ranked in the aggregate field of bioscience and determine which states have "the will and the wallet" to make a significant investment in both recruiting and supporting a major new bioscience institution.

This research—which focuses on Massachusetts, Utah, Connecticut, Pennsylvania and New York—is summarized in this report. Information was gleaned from a number of public sources (listed at right). Most data and written information cover the period 2008 to July 2011. Therefore, information reported here is the most recent available, but it cannot forecast future developments or planned activities that have not yet been publicly reported.

Information reported here includes: 1) current bioscience rankings; 2) current political climate; 3) current state budget outlook; and 4) significant recent investments or cuts relative to the bioscience industry within each state.

Research sources (selected)

Milkin Institute State Technology & Bioscience Index
Battelle/BIO State Biosciences Initiative 2010
Pew Center for the States
State Science & Technology Institute
Moody's Analytics
BioCom Institute
New York Times
Boston Herald
Pittsburg Tribune-Review
Business Facilities
Connecticut Business & Industry Association
Commonwealth of Massachusetts Budget Office
Utah State Legislature website
New York Governor's Office website

Massachusetts

Massachusetts' bioscience industry is a national leader, is highly specialized and has grown rapidly since 2001. Known for its world-class aggregation of research universities, Massachusetts ranked #1 in NIH funding received in 2008 (most recent year, per capita), #3 in academic bioscience R&D expenditures per capita and #1 in R&D, available risk capital, entrepreneurial infrastructure and work force.

Recognizing the economic importance of the biosciences to the commonwealth, in 2006 Massachusetts pledged $1 billion over 10 years for its Life Sciences Initiative, which may invest up to $25 million annually to recruit and grow life sciences enterprises. The state pledged another $15 million for a Life Sciences Infrastructure Fund over the same period. This fund has invested in and granted tax credits to new companies as well as giants such as Genentech, enabling them to expand and create jobs.

However, the recession of 2008 took a toll not only on Massachusetts' state coffers, but also on the outlook for state-supported bioscience companies. Only three-quarters of jobs promised under the Life Science Initiative's tax credit in 2009 have been created. Fourteen of 26 firms have yet to meet commitments and five have given their money back to the commonwealth.

Gov. Deval Patrick (D) froze annual funding for the Life Science Center (which administers the Life Sciences Initiative) at $10 million for FY 2012, contingent upon a net budget surplus for FY11.

This bioscience-related spending freeze could be lifted in the FY13 budget, as Massachusetts is recovering from the recession more quickly than a majority of states. Unemployment has fallen to 7.6%—well below the 9.1% U.S. rate. Housing prices have stabilized and state revenue receipts are exceeding estimates, with most overage coming from payroll taxes. Boston may be ahead of this curve, if renewed spending on bioscience is indeed in the cards. Boston created an Innovation District last year as a home to startup, research-based and other innovative companies. Adding to this strategy, the city will establish Venture Boston to encourage more venture capital companies to move to the area.

In summary, Massachusetts is a major and relatively stable player that will continue to grow and invest in its bioscience industry. However, one must consider how yet another, relatively small institution can gain attention, credibility and significant investment in the vast sea of Massachusetts bioscience.

Utah

Utah has a specialized and rapidly growing bioscience industry. With the state and state universities leading the charge, Utah is already benefitting economically from significant investment in bioscience start-ups and commercialization. While the Milkin Institute ranks Utah #1 for technology concentration and dynamism, the state's other rankings do not yet reveal the increasingly positive picture. (In 2008, Utah ranked #25 in NIH funding received per capita in 2008 and #27 in academic bioscience R&D expenditures per capita.)

Utah has adopted a strategy of relatively heavy investment in bioscience as an economic driver, with the intent of snapping up bioscience companies that aren't being properly tended by other states. The Utah Science, Technology & Research Initiative, passed in 2006, allocated $179M to R&D in the state, with $15M/year going to universities and $4M to economic outreach for bioscience. And, while other states are facing record budget deficits, a recovering economy and good fiscal management allowed Utah's legislature to balance the state's $12 billion FY2012 budget without tax increases. Even more encouragingly, the Republican-dominated legislature passed a one-time tax credit for the Life Science Industry for $1,300,000 for FY2012.

If Utah can maintain its financial equilibrium and stick to its strategy of bioscience investment, it is likely to see significant growth in the sector, along with a sharp rise in industry rankings. However, it must be noted that to date, the lion's share of Utah's bioscience investments has gone to its two state universities. Alliance with one of these institutions is key.

Connecticut

Thanks to the presence of five major pharmaceutical companies, Connecticut is a solid performer in the bioscience arena, with plans underway to become a major player. In 2008, the state ranked #5 in NIH funding received per capita and #4 in academic bioscience R&D expenditures per capita. In a move that could be interpreted as a harbinger of things to come, Connecticut jumped eight positions in risk capital and entrepreneurial infrastructure.

2010 gave the state its first democratic governor and legislature since 1991. Both wasted no time in making a massive investment in bioscience: $864 million to be spent on research, medical education and healthcare development at the University of Connecticut. The state also invested $10M in stem cell research and is offering tax credit and financial support to start-ups in the life sciences, a move that Gov. Dan Malloy says "demonstrates Connecticut's promise as a leader in bioscience." With this infusion of cash, the state should see a significant jump in its overall bioscience ranking for 2011.

For the moment, the state's financial picture is positive. After the largest tax increase in the state's history (2011), the state budget is projected to produce a $1 billion cumulative surplus over the next two fiscal years. At the same time, the state's unemployment rate climbed over 9% in March—above the national average of 8.8% for that month—and the state's labor markets reported a loss of 6,000 jobs. The impact of the recession continues to be felt sharply by Connecticut employers, who are already facing at least $70 million in new unemployment compensation taxes.

It remains to be seen whether Gov. Malloy can maintain positive economic and political momentum. However, for the moment, strategic investment in bioscience coupled with a budget surplus, the presence of big pharma and proximity to both New York's and Massachusetts' life science clusters should ensure that Connecticut enters the top tier of bioscience heavyweights.

Pennsylvania

Pennsylvania is known for its world-class research universities and strong state university system, which have greatly benefited the state's bioscience rankings. The commonwealth is #7 in NIH funding received per capita (2008) and #4 in academic bioscience R&D expenditures per capita. However, Pennsylvania dived 14 spots to 21st in risk capital and entrepreneurial infrastructure after losing ground in venture capital investments. Although lack of VC has been a chronic condition for the past two years nationwide, few other states dropped so precipitately in this category.

Compounding the private investment problem, Pennsylvania significantly cut funding for the Department of Community and Economic Development (DCED) in the commonwealth's FY2012 budget. Overall, DCED experienced a 35% decrease in funding, which will impact the availability of and create competition for economic incentive funds. In addition, funding for the Ben Franklin Technology Development Authority was cut by $2.5 million. The authority provides access to capital and entrepreneurial support services to tech companies.

All is not gloomy on the commonwealth's bioscience investment front, however. Lawmakers approved $25 million for Pennsylvania First, a fund providing grants for job creation, infrastructure and workforce development. The budget also increased the cap on the R&D tax credit from $40 million to $55 million. To support early-stage life sciences risk capital, the budget appropriated $3 million for Life Sciences Greenhouses, the same as last year. The FY2012 budget also funds $9.9 million for "Discovered in PA, Developed in PA" initiative to help entrepreneurs obtain state resources.

While Pennsylvania navigates rough financial waters, the standing of its academic research institutions should remain stable, despite cuts of up to 50% in funding to higher education proposed by Gov. Tom Corbett (R). Regardless of the amount of bioscience funding that may or may not be available, it should be noted that the vast majority of state bioscience R&D support goes to the University of Pennsylvania and Penn State, rather than to institutions outside the commonwealth.

New York

Despite strong academic and medical research institutions, New York placed 16th overall in the Milkin Institute's science and technology ranking for 2010. The state ranks #8 in academic bioscience R&D expenditures per capita (2008) and #9 in NIH funding received per capita.

New York shows strongest performance in venture capital, with $1.8 billion in VC invested in New York bioscience companies over the last six years. Drugs and pharmaceuticals led New York-based bioscience patents, followed by biochemistry and surgical and medical instruments. This may be reflective of the role of the state's biomedical institutions in clinical trials, with more than 1,000 active trials held in 2009.

Under the guidance of very popular first-time Gov. Andrew Cuomo (D), New York appears to be breaking even during challenging financial times. During the 2011 session, New York closed its $10 billion deficit with $9.3 billion in spending reductions, including $1 billion in cuts to education. To ease the blow, lawmakers passed a measure establishing the Innovate NY Fund to invest $25 million ***of federal funds*** in technology development organizations, research universities and seed-stage investment funds. Funding comes from the State Small Business Credit Initiative and must be invested in New York-based, seed-stage companies with substantial potential growth and job development in emerging technology fields.

Under another Cuomo initiative, research universities under the State University of New York (SUNY) could increase tuition by 8% annually for five years, with funds supporting the NYSUNY 2020 Challenge Grant Program. The program seeks to incentivize bottom-up, long-term economic development plans on SUNY campuses and in surrounding communities.

Therefore, while New York has balanced its budget and elected an adroit and popular governor, it seems that for the moment, most significant state bioscience R&D investment is directed to in-state public universities and companies.

State Technology and Science Index Overall Rankings, 2010

State	Rank 2010	Rank 2008	Rank change 2008 to 2010	Academic R&D $ per capita	Average Score
Massachusetts*	**1**	**1**	**0**	**3**	**82.61**
Maryland	2	2	0		77.05
Colorado	3	3	0		75.73
California	4	4	0		73.85
Utah*	**5**	**8**	**3**	**27**	**71.26**
Washington	6	5	-1		70.23
New Hampshire	7	9	2		68.69
Virginia	8	6	-2		68.05
Connecticut *	**9**	**7**	**-2**	**4**	**66.56**
Delaware	10	14	4		63.26
New Jersey	11	12	1		62.97
Minnesota	12	11	-1		62.65
North Carolina	13	18	5		61.42
Pennsylvania*	**14**	**13**	**-1**	**4**	**60.78**
Arizona	15	17	2		60.21
New York*	**16**	**15**	**-1**	**8**	**59.47**

Early Evidence of Success: Connecticut's Stem Cell Initiative

Connecticut is a leader in advancing stem cell initiatives because it has a strong foundation of political stability and bi-partisan support for stem cell science. Connecticut welcomes biomedical pioneers and investors. We have a proactive collegiality among stem cell scientists at Yale University, the University of Connecticut, Wesleyan University and emerging biomedical research companies, which is building a vibrant life science industry by turning laboratory successes into commercial successes.

Connecticut is a small, strategically located state with a wealth of intellectual, financial and economic development talent and the political will to make good things happen quickly. That includes facilitating public/private partnerships, expediting national/international outreach efforts and otherwise working with stakeholders to solve their problems, meet their needs and achieve their goals.

The Connecticut Stem Cell Initiative

Connecticut became a leader in stem cell research when legislation was passed in 2005 authorizing a $100 million dollar commitment over 10 years. In November of 2006, we became the first state in the nation to award stem cell research grants with a distribution of $20 million in support of approximately 26 projects.

The State of Connecticut's grants-in-aid currently support over 100 research projects. Stem cell research in Connecticut has literally become an economic engine, creating 128 new positions at Yale University, 115 scientists at the University of Connecticut, and a number of researchers at Wesleyan University. Many of these individuals have migrated to our state solely because of the opportunity to participate in Connecticut's stem cell initiative. We are not only doing cutting-edge research, but we are also creating important new jobs, thus stimulating our state's economy.

Stem Cell Research at Yale

The Yale Stem Cell Center (YSCC) was founded in 2006, soon after the Connecticut stem cell legislation was adopted. In 2006, Dr. Haifan Lin, a world leader in stem cell research was recruited to head the YSCC. With the first round of CT stem cell funding, Yale received $2.5 million to establish a Stem Cell Core laboratory, which provides key training, services, and access to the highest levels of research technology to stem cell investigators throughout Connecticut.

Connecticut stem cell funding has leveraged significant resources from outside the State. For example, in 2010 alone, Yale has attracted $36 million in funding from NIH and $2.6 million in gifts from international donors to the State in supporting stem cell research, approximately 70% of which is directly spent on the employment of a highly technical work force in the State. Overall, stem cell research at Yale that is supported by funding from federal, state, and private sources lays a solid foundation for developing a new biotech industry in the State.

The YSCC membership, which includes 65 investigators who oversee research laboratories comprising well over 300 individual Yale researchers (technicians, graduate students, post-doctoral fellows, and faculty), consists of basic scientists as well as researchers who are performing translational and clinical research. Human embryonic stem cell research expanded at Yale from 1 lab in 2005 to over 28 laboratories in 2010.

Multiple laboratories at Yale cover the spectrum of discovery from bench to bedside in disease-related research teams. For example, Haifan Lin discovered that there are over 60,000 small "genes" in the genome in addition to the known 26,000 genes, which revealed an exciting new world of genetics with potentially important implication in stem cell biology, cancer, and regenerative medicine. Yibing Qyang is establishing optimal approaches for producing cardiac muscle cells to repair the heart after a heart attack or other injury. Eugene Redmond is performing preclinical studies in nonhuman primates to test novel stem cell therapy for Parkinson's disease, and pediatric surgeons Christopher Breuer and Toshiharu Shinoka have just started a human trial to use biomedical scaffolds seeded with bone marrow-derived cells to repair the heart in babies born with heart deformities.

Stem Cell Research at UCONN

The University of Connecticut has received over $30 million in support from the State Stem Cell Fund. These competitive research awards have allowed UCONN scientists in over 30 laboratories to initiate studies in several areas ranging from stem cells in colon cancer to stem cell models of mental retardation. A recent award was to a multidisciplinary team of UCONN scientists whose research is focused on the cellular and molecular mechanisms of drug-induced liver injury. Liver injury, caused by a large number of drugs taken by patients, is a major clinical problem that also hampers drug development. The researchers aim to convert patient-derived skin cells into induced pluripotent stem cell lines, and then produce liver cells (hepatocytes) from the stem cells to assess genetically determined predispositions to drug-induced liver disease. The medical outcome of this research will be the development of genetic tests that can be used to improve the safety and efficacy of drug treatments.

The internationally renowned University of Connecticut Stem Cell core facility supports the work of UCONN scientists. The Core has produced four human embryonic stem cell lines, CT1, CT2, CT3 and CT4, in the State of Connecticut, through the efforts of Drs Ge Lin and Ren-He Xu. These lines have been approved and are eligible for federally-funded research in NIH Stem Cell Registry. The Core facility is also an important element of UCONN's stem cell Technology Incubation Program (TIP). The new state-of-the-art incubator facility co-located with the UCHC Stem Cell Core Lab and other cell science departments provide companies with wet lab space ranging in size from 300 square feet to 1000 square feet, as well as business services. This strategic move assures that UCONN will deliver on the commercial promise of the State's investment to UCONN stem cell research. The State Stem Cell fund recently made a large award to Chondrogenics Inc., a new start-up company based at the Health Center, to fund its ongoing preclinical testing using chondrogenic cells derived from human embryonic stem cells to repair joint cartilage damaged by injury or aging. Two federal grants have been also obtained through collaboration between the TIP and the UCONN Stem Cell Institute, which provides access to unique equipment that will further research of for both TIP firms as well as faculty researchers.

Parting with Researchers in Other States and Countries

Our state stem cell initiative is responsible for the creation of the Interstate Alliance on Stem Cell Research (IASCR). This is an organization with representation from ten states, as well as members from Canada, the United Kingdom, and the International Society for Stem Cell Research and the National Academy of Sciences.

Changing Lives through Research

All of these activities have the potential to produce discoveries, which will enable us to better treat human diseases, injuries, and afflictions such as diabetes, Parkinson's disease, Alzheimer's, ALS (Lou Gehrig's disease), multiple sclerosis, autism, macular degeneration, spinal cord injuries and many other devastating problems. In addition, we will be able to gain greater insights into the development of cancers, heart disease and other medical problems. Currently we are already seeing advances in how new drugs are being tested. This is the reason why pharmaceutical companies are so interested in stem cell research and in what we are doing in Connecticut. This will all lead to new and innovative pathways for more effective treatment and will revolutionize how medicine is practiced in the 21st century. As a result, there will also be potential reduction of health care costs, since it will decrease the number of chronic and lingering medical problems. At the same time, we will be creating thousands of new jobs which will enhance our economy while creating hope for so many.

APPENDIX 5

Life Science Cluster Case Studies
Investing in Job Growth

Introductory Comments on Clusters

Excerpted from "The Global Biomedical Industry: Preserving U.S. Leadership," Milken Institute 2011

"Industry clusters and their associate support infrastructure are a powerful force in driving [technology-based economic development], both at the regional level and at the national macroeconomic level. Since knowledge is generated, transmitted, and shared more efficiently in close proximity, economic activity based on new ideas has a high propensity to cluster within a geographical area. Locations with top biomedical industry clusters will be less likely to see the economic benefits escape to other regions."

"The clustering effect has distinguished the United States from all other nations, creating an unusually fertile environment for R&D. By effectively leveraging public funding to attract private funding, valuable partnerships and research collaborations have been formed. In dense regional biomedical clusters, strategic partnerships between public organizations (such as universities and institutes) and private firms have fostered cross-disciplinary research of the sort that lends itself to innovation."

"The top clusters provide a robust support network for entrepreneurs, including venture capitalists, high-tech absorptive capacity and providers of professional services. Given the industry's growing importance, biomedical clusters have also become undisputed engines of economic growth, creating millions of jobs, many of which pay above-average salaries. Many states and localities have targeted the biomedical sector as an important component of their economic development strategies in an effort to add high-wage jobs and build their tax base."

Case Studies

The table below shows bioscience employment change by percent between 2001 and 2008 in the states in these case studies and in Connecticut. This table shows that California, North Carolina and Florida, which each have significant life science cluster activity, in general perform better than the U.S. in life science employment, while Connecticut has significant room for improvement in life science employment gains, relative to the U.S. The following three case studies may help to explain the differences in performance.

Employment Change by Percent, 2001-2008

Industry Subsector	California*	North Carolina	Florida	Connecticut	United States
Agricultural Feedstock & Chemicals	-3.8%	-8.1%	-4.0%	-48.5%	1.9%
Drugs & Pharmaceuticals	9.9	0.0	27.0	-26.7	2.3
Medical Devices & Equipment	-5.2	16.0	7.7	3.5	2.0
Research, Testing & Medical Laboratories	50.2	109.3	36.8	11.6	46.1
Total Biosciences Industry	17.6	29.1	18.0	-8.3	15.8

Source: Battelle/Bio State Bioscience Initiatives 2010

*The table above represents employment statistics from California as a whole, not strictly from the San Diego area, which the case study contained here focuses on exclusively.

San Diego

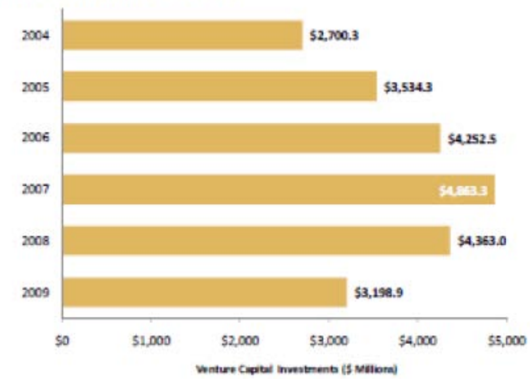
The roots of San Diego's life sciences cluster lie in the founding of three research organizations: The Scripps Institution of Oceanography, founded in 1903, and the subsequent development of both The Scripps Research Institute and General Dynamics nuclear division in the middle of the century. These organizations lobbied the University of California system to establish a branch in San Diego, in large part to provide the skilled researchers and laboratory capacity the organizations needed to excel. The UC San Diego campus opened in 1961.

Meanwhile the City of San Diego granted Jonas Salk land to start the Salk Institute for Biological Studies in 1960 (Milken 2004, 10-12; and Milken 2011, 31). These organizations created research facilities and a talent pool from which a biotechnology cluster eventually could grow.

The cluster finally began to emerge after UC San Diego enticed two Stanford researchers to move to the San Diego area in 1977. A year later the two researchers rented a small lab space and launched Hybritech, a bioscience firm based on advances in monoclonal antibody manipulation. The firm grew quickly, attracting a fun-loving, long-haired cadre of scientists, who soon began founding other firms, even while employed at Hybritech. First, one of the founders helped start Gen-Probe in 1983, then other employees founded IDEC Pharmaceuticals, Clonetics and Pacific Rim Bioscience in 1985 (Milken 2004, 12-17).

In 1986 Eli Lilly bought Hybritech and employees found their playful culture at odds with Lilly's buttoned-up attitude. This culture clash turned out to be a good thing for San Diego. As employees left the company, many founded their own biotech firms. As of 2003, the San Diego Tribune counted 50 companies that traced their founding to Hybritech employees (Crabtree 2003) and in 2008 one reporter concluded that former Hybritech employees had founded over 175 life science companies in San Diego (SignOn San Diego 2008).

Bioscience-related Venture Capital Investments in California, 2004–2009



Source: Battelle/BIO California 2010, 4

(NB: The chart above represents venture capital investments in California as a whole, which has another large bioscience cluster in San Francisco and many bioscience firms in other parts of the state.)

As the activity and network of researchers and entrepreneurs in San Diego grew, they attracted and produced over 200 companies and a new group of research institutions. The life sciences cluster that began with Scripps and UCSD now employs more than 40,000 people in over 400 companies and research organizations, including Idec Corp, Amylin, and Avanir, the Burnham Institute, the Neurosciences Institute, the La Jolla Institute for Allergies and Immunology and the Sidney Kimmel Cancer Center (Milken 2011).

Research Triangle Park, NC

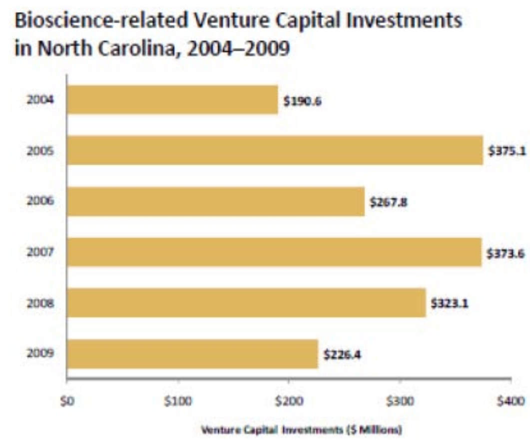
Perhaps the ultimate example of a successful research community is North Carolina's Research Triangle Park. In the 1950s, visionary leaders patiently began transforming vacant pine lands between Raleigh and Durham into Research Triangle Park, the nation's largest research park and one of the world's most exclusive high-tech addresses. They did so by building on the research strengths of three major research institutions nearby: Duke University, North Carolina State University and the University of North Carolina-Chapel Hill. In 1959 these three institutions jointly created both the Research Triangle Foundation to develop and manage the park, and the Research Triangle Institute, a nonprofit to conduct contract-research for industry and government (Weddle et al. 2006).

The Research Triangle Institute (RTI) served a crucial function for park development, signaling to the private sector and universities that the park's founders had sufficient faith in the park model to create the first tenant company. The earliest outside firm to join RTI in the park was Chemstrand, a Monsanto company, in 1960. For five years the park carried on with no new tenants. Finally, in 1965 IBM and the National Environmental Health Science Center moved in. This newfound critical mass set the park on a path of growth. From 1965 to 2004 the park added an average of six companies and 1,800 employees per year (Weddle et al. 2006). Today, bioscience tenants include Biogen-Idec, GlaxoSmithKline, Bayer CropScience, Merck BioManufacturing Network, the National Institute for Environmental Health Sciences, Eisai, United Therapeutics and many others, large and small (Research Triangle Park, Companies).

The mix of companies in the park reflects the initial strategy for recruitment. Park leaders sought to attract "larger, established companies that would build a culture in which smaller, start-up industries could thrive" (Weddle et al. 2006). The park now has 170 tenant companies and nonprofit institutes that employ 38,000 full-time people and another estimated 10,000 contract workers. These companies have an annual payroll of $2.9 billion and occupy 25 million square feet of developed space (Research Triangle Park, About). The Park is an economic engine not only for the Raleigh-Durham metropolitan area but the entire state.

Case Studies on Life Science Clusters

Department of Economic and Community Development



Source: Battelle/BIO Florida 2010, 4

Florida

Florida's life sciences effort began quite recently, in 2003 under Governor Jeb Bush, who sought to diversify Florida's economy. Through public subsidies and targeted recruitment efforts he and his successor Charlie Crist enticed several research institutes to open facilities in Florida. The effort took a few years to bear fruit. In 2005, Scripps Research Institute opened in Jupiter, Florida, using temporary laboratories. The State of Florida invested $579 million in Scripps, which opened an entirely new campus in 2009. The institute now employs 40 principal investigators and a total of 450 staff members, with plans to expand to 60 principal investigators and staff of 545 by 2014 (Kellogg 2011).

The Scripps project caused the global life sciences community to take notice of Florida, and paved the way for a series of new developments. Florida succeeded in attracting another major research institute from San Diego, the Sanford-Burnham Institute for Medical Research, to open a new facility in Orlando. With the help of the state's $310 million investment, Sanford-Burnham opened a facility in May of 2011 at Orlando's Lake Nona Medical City, and Germany's Max Planck Society is already locating staff in its new Max Planck Florida laboratory, with plans to open a whole new facility in 2015 (Kellogg 2011).

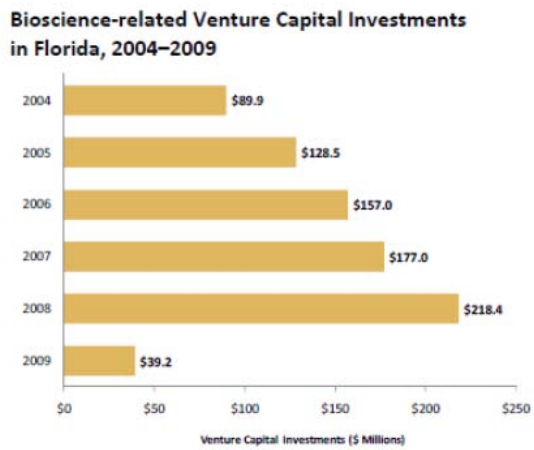
In the midst of these recruitment projects, universities and hospitals have planned expansions, made possible by the newfound willingness of researchers to consider relocating to Florida. In addition to anchor tenant Sanford-Burnham, the Lake Nona Medical City has attracted the following institutions:

- The 95-bed Nemours Children's Hospital, which will employ 2,600
- The Orlando Veterans Affairs Medical Center, a $665 million complex that will serve more than 400,000 Central Florida veterans
- The M.D. Anderson Cancer Center, which employs 25 research groups in temporary space on the University of Central Florida's campus, is building a new facility
- The University of Central Florida's new College of Medicine and Burnett School of Biomedical Sciences, a $166 million project with 412 faculty and staff
- The University of Florida Academic and Research Center, expected to employ 120, serve 200 students, and include a Comprehensive Drug Development Center, a College of Pharmacy and 15 biomedical research laboratories
- The University of Central Florida Health Sciences Campus

Once fully built out in 2017, Lake Nona Medical City is expected to employ 30,000 people and create an economic impact of $7.6 billion (Kellogg 2011).

Although Florida's bioscience initiative is still young, the state saw significant growth in key areas of life science employment from 2001 to 2008. Employment in all biosciences in Florida grew 18.0%, compared to 15.8% in the U.S. as a whole, and medical devices & equipment subsector employment grew 7.7% when the U.S. saw only 2.0% growth in the same subsector. Most impressive, employment in drugs and pharmaceuticals grew 27.0% in Florida while the U.S. saw only 2.3% growth in pharmaceuticals (Battelle/BIO Florida 2010, 2).

In the latter part of the 2000s, except immediately after the 2008 crash, venture capital investment in Florida's bioscience sector grew steadily. See the chart below.



Source: Battelle/BIO Florida 2010, 4

Life Sciences in Other States

Excerpted from Battelle/Bio State Bioscience Initiatives 2010

States continue to make investments designed to encourage the growth of the bioscience sector despite challenging state fiscal conditions. According to the National Association of State Budget Officers, the 50 states are facing the worst fiscal period since the Great Depression, with fiscal conditions deteriorating significantly in fiscal year FY 2009 and the trend expected to continue through FY 2010 and into FY 2011. Forty-three states reduced their enacted budgets in FY 2009 as tax revenues declined as a result of the national recession. In response, however, some states are creating new initiatives aimed at growing the economy by investing in technology-based economic development. Many of these initiatives are targeted to the biosciences, which have continued to be a key driver of economic growth.

- The Kansas Bioscience Authority (KBA) is slated to receive $35 million in FY 2011. KBA was created in 2004 and is funded by a percentage of the increases in state taxes paid by bioscience companies. The Authority offers a comprehensive set of programs designed to attract and grow bioscience companies.
- Maryland continues to implement its BIO 2020 Initiative, a commitment to invest $1.1 billion to support the state's life-science industry over a 10-year period. The Maryland Biotechnology Center, designed to serve as a one-stop center for linking bioscience companies with a variety of services and programs, opened in 2009. The Governor's proposed budget for FY 2011 includes $43 million for BIO 2020.
- Massachusetts continued to support its Life Science Initiative, which was enacted in 2007. The state fully funded $25 million in tax credits for life science companies and provided $15 million for its Life Science Investment Fund, which makes investment to stimulate bioscience R&D in FY 2009. Another $15 million was appropriated for the Life Sciences Infrastructure Fund."

States continue to put in place new programs to build bioscience R&D capacity and to encourage the commercialization of new discoveries. Recognizing that a strong bioscience R&D base is a prerequisite to growing a robust bioscience industry cluster, states continue to create mechanisms designed to position universities to compete for bioscience R&D awards and to commercialize the results of research findings. Since 2008, the following programs have been implemented:

- Arkansas enacted legislation that created the Arkansas Research Alliance. The program, modeled after the Georgia Research Alliance, is a collaboration of research universities and private sector leaders whose mission is to create greater economic opportunities in Arkansas by advancing university.based innovation. The Alliance plans to raise funds that will be used to recruit Eminent Scholars in a number of scientific fields, including in the biosciences.
- The Colorado Institute for Drug, Device and Diagnostic Development was launched in 2009, with the mission of accelerating the commercialization of biomedical technologies. Partners in the Institute include the University of Colorado.Boulder, Colorado State University, Colorado Bioscience Association, Colorado Science + Technology Park at Fitzsimons, and the University of Colorado Denver.
- Four Georgia research and healthcare organizations, with support from the Georgia Research Alliance, have created a Global Center for Medical Innovations at Georgia Institute of Technology. The mission of the Center, which will contain a medical device prototyping center, is to

accelerate the development and commercialization of next.generation medical devices and medical technology.

- South Dakota announced five new 2010 Research Centers in 2008 and 2009, one of which is focused on translational cancer research. The Centers are aimed at growing the state's economy by targeting investments in specialized research at South Dakota public universities.

States continue to create programs to address the need for early-stage capital for bioscience companies. Venture capital firms invested approximately $7.7 billion in bioscience companies nationally in 2009, down from $11.4 billion and $11.6 billion in 2007 and 2008, respectively. In addition to the fact that there has been a decline in overall venture capital investing, only about 6 percent of the total dollars invested between 2004 and 2009 was invested in start-up bioscience companies, with another 17.7 percent in early-stage bioscience firms. Also, bioscience venture investing is geographically concentrated, with about 70 percent of the total being invested going to firms in just five states: California, Massachusetts, New Jersey, Pennsylvania, and Texas. As a result, states seeking to grow their bioscience industry continue to look for ways to help firms within their state access needed capital by investing in funds that agree to make in-state investments or locate offices in a particular state, helping companies tap the federal Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) and directly investing in companies. Examples of recent state efforts to increase access to early-stage capital include the following:

- In 2009, the Kansas Bioscience Authority invested $50 million in eight funds that committed to having an office in Kansas. Each fund has a focus in a specific area of the biosciences, such as human health, plant biology, bioenergy, and biomaterials. The funds must raise a minimum of $25 million each from private and institutional sources.
- The Michigan Retirement Fund is seeking to leverage public assets to increase the amount of locally managed venture capital willing to make investments in Michigan companies at all stages, from microloans through later-stage venture capital and buyout funds. The Retirement Fund has allocated $300 million to two private equity partnerships that agreed to make in-state investments.
- Virginia created a new program that provides matching grants for SBIR awards. The Omnibus Bioscience Bill, signed into law in April 2009, authorized matching grants for NIH SBIR/STTR awards.

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End Word

The Cost of the Road Not Taken
Connecticut Institute of Technology

Probably the single most successful example of public investment in cluster development was the creation of the Springfield Armory by the federal government in the 1900's. It spawned not only a cluster of gun manufacturers in Springfield and Hartford, but a center of innovation rivaling today's Silicon Valley and Route 128, and triggering the second, explosive stage of the Industrial Revolution based on precision manufacturing. As Merritt Roe Smith at MIT puts it, "if only 1 in 10 government investments pay off like the Federal Armories did, it pays for 9 failures."

The pre-eminent spinoff from the Springfield Armory was Colt Firearms in Hartford. Connecticut had an opportunity to capitalize on this early success when Sam Colt approached the city fathers to create Charter Oak Hall, where Colt intended to bequeath one-fourth of his estate so the hall would become a center of a school of mechanics and engineering in Hartford to surpass the scientific schools then rising at Harvard and Yale. There was an elaborate plan that included scholarships for the sons of his workers and for Hartford residents and then to residents of Connecticut. Colt's plans for civic amenities faltered when he found the community unable or unwilling to share in the cost of development and maintenance. The dream remained unfulfilled. After six years of relentless haggling with the city over taxes and permits, Colt revoked the bequest.

Had the City and the State seized that opportunity, what later evolved as the Massachusetts Institute of Technology would instead have been the Connecticut Institute of Technology and America's Technology Highway would have been 91 rather than 128.

[See William N. Hosley, *Colt: The Making of An American Legend*, November, 1996.]

Staff economists at the Connecticut Department of Economic and Community Development prepared this analysis to support the initiative to attract the Jackson Laboratory's genomic research initiative to Connecticut.