SB

56

<TARGET><BILL>SB 56</BILL><SUBJECT>SB
56</SUBJECT><COMM>SEDC27</COMM></TARGET>

SENATE EDUCATION COMMITTEE

TO: All Members

FROM: Senator Kevin Meyer, Senator Joe Thomas
Co-Chairs, Senate Education Committee

RE: Hearing: SB 56/SB 206 University Capital Appropriations

LOCATION: BELTZ 105 (TSBldg)

DATE/TIME: Wednesday, February 10 – 8am

AGENDA

SB 56 - **"An Act making a special appropriation for a life sciences innovation and learning facility at the University of Alaska Fairbanks; and providing for an effective date."**

SB 206 **"An Act making special appropriations for new engineering buildings for the University of Alaska in Anchorage and Fairbanks."**

Bills Previously Scheduled & Heard

Jomo Stewart, Committee Aide
(907) 465-6874

Murray Richmond, Committee Aide
(907) 465 - 6443

Senate_Education@legis.state.ak.us

ALASKA STATE LEGISLATURE

SENATOR JOE THOMAS

Sponsor Statement Senate Bill 56

"An Act making a special appropriation for a life sciences innovation and learning facility at the University of Alaska Fairbanks; and providing for an effective date."

SB 56 is an appropriation bill for the proposed Life Sciences Innovation and Learning Facility at the University of Alaska Fairbanks. This project is the University of Alaska's only request for new facility funding in this year's capital budget.

In a world where technological changes are increasing at an exponential rate, it is imperative to have an educational infrastructure which keeps Alaska competitive worldwide. The University of Alaska Fairbanks has a unique opportunity to solidify its place as world leader in life sciences through the addition of the UAF Life Sciences Innovation and Learning Facility.

This building is an investment in the University of Alaska, in the economy of Alaska, and in the future of Alaska.

Conditions in current life sciences laboratories and classrooms are cramped and limited. The proposed 110,000 square foot building will provide new research and teaching facilities that will house existing and new projects, serving the needs of future generations of teachers, researchers and students.

The economic impact of this facility will extend far beyond the campus of UAF. Research is a growth industry in Alaska. Every state general fund dollar invested in research at UAF generates $5.80 in outside funding resources. Each research dollar brought in from federal sources generates $1.70 in direct and indirect economic activity in communities across Alaska.

The direct expenditure on the building construction will generate another $48 million in the local economy in indirect and induced spending. Those benefits will extend to Southcentral Alaska through port and transportation activities and other construction-related jobs.

This project will benefit all of Alaska in other ways. The research done at the Life Sciences facility will improve the quality of life for Alaskans. The Center for Alaska Native Health Research is studying diabetes and obesity rates that are skyrocketing in rural Alaska. There will be an internationally renowned group of researchers studying infectious diseases - many of which could severely impact Alaska's people and

January – May: State Capitol – Juneau, Alaska 99801 – (907) 465-2327 – 1 (800) 336-7383 – Fax (907) 465-5241
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Senator.Joe.Thomas@legis.state.ak.us

environment - and toxicants which may be transmitted through commercial, sport and subsistence harvest in Alaska. The Alaska Basic Neuroscience Program is currently conducting groundbreaking research in Sudden Infant Death Syndrome, a critical research area for Alaskans, whose children suffer SIDS at a rate 2.5 times the national average. Other revolutionary health research that would be housed at the Life Sciences building involves the study of hibernation, where understanding the science behind Alaska's hibernating animals could be utilized to treat and heal those who suffer paralysis or other nerve damage.

The Life Sciences Innovation and Learning Facility will be a positive asset for education, economic activity, and the general well-being of Alaskans.

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Senator.Joe.Thomas@legis.state.ak.us

SPONSOR SUBSTITUTE FOR SENATE BILL NO. 56

IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTY-SIXTH LEGISLATURE - FIRST SESSION

BY SENATOR THOMAS

Introduced: 2/9/09
Referred: Education, Finance

Funding Information:	**General Fund**	**$ 82,200,000**
	Other Funds	**-0-**
	Total	**$ 82,200,000**

A BILL

FOR AN ACT ENTITLED

"An Act making a special appropriation for a life sciences innovation and learning facility at the University of Alaska Fairbanks; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

*** Section 1.** The sum of $82,200,000 is appropriated from the general fund to the University of Alaska for the design and construction of, and utilities and equipment for, a life sciences innovation and learning facility at the University of Alaska Fairbanks.

*** Sec. 2.** The appropriation made by this Act is for a capital project and lapses under AS 37.25.020.

*** Sec. 3.** This Act takes effect July 1, 2009.

Witness List for SB 56

Brian Rogers, Chancellor, University of Alaska Fairbanks (in person)

Brian Barnes, Director, Institute of Arctic Biology (via offnet teleconference)

Cord Brundage, Biology Graduate student (just got accepted to Vet School) (with Brian Barnes)

Gail Phillips, President, UAF Alumni Association (via offnet teleconference)

Pending - **Bert Boyer**, The Center for Alaska Native Health Research (via offnet teleconference)

SB 206 - List of planned testimony- In order

In person-

1) Grant Baker, Chair, Mechanical and Electrical Engineering

Online-

2) M. Anne Brooks P.E., Brooks & Associates (Ms. Brooks is only available until 8:45)

In person-

3) Dr. Dan White, Director of the Institute of Northern Engineering

4) Rob Lang, Dean of UAA Engineering and recent past President of APDC (Alaska Professional Design Council)

UNIVERSITY of ALASKA

Faculty Alliance

Dr. Jonathan Dehn, Chair
President, UAF Faculty Senate
Associate Research Professor
Geophysical Institute 108G
Fairbanks AK 99775
Phone: 907-474-6499
Fax: 907-796-7290
jdehn@gi.alaska.edu

MOTION SUPPORTING UAF LIFE SCIENCES CLASSROOM AND LAB FACILITY

"Whereas the Faculty Alliance has in the past supported capital projects that promote the university's mission of teaching and research, and

Whereas, the greatest need for facilities to carry out the university's missions in the FY11 budget is the UAF Life Sciences Classroom and Laboratory Facility, and

Whereas enrollments across the University of Alaska are likely to grow as more students from Alaska's high schools remain in state for college through new scholarship programs, the need for classroom space will become critical,

Therefore, be it resolved that the Faculty Alliance supports the UAF Life Sciences Classroom and Lab facility as the highest priority in the FY11 capital budget.

This action is effective November 27, 2009."

Motion passed unanimously

FAIRBANKS BUILDING & CONSTRUCTION TRADES COUNCIL

RESOLUTION No 2009 – 03

A RESOLUTION REQUESTING THE UNIVERSITY BOARD OF REGENTS TO MAKE THE UNIVERSITY OF ALASKA LIFE SCIENCES FACILITY THE ONLY CAPITAL PROJECT FOR THE FISCAL 2011 STATE BUDGET REQUEST

WHEREAS, the Fairbanks Building and Construction Trades Council is made up of 15 craft unions who represent nearly 5000 tradesman and tradeswomen; and

WHEREAS, the Fairbanks Building and Construction Trades Council has been a chartered member of the American Federation of Labor and Congress of Industrial Organizations since 1961; and

WHEREAS, the Fairbanks Building and Construction Trades recognize the value in education, and that value is enhanced by learning and researching in updated facilities and using the most current technologies; and

WHEREAS, UAF's biology facilities date back to the 1960s, and renovations have not been adequate to accommodate the 25% enrollment increase in biology and wildlife students over the past decade; and

WHEREAS, the project scope includes 37,200 square feet of academic space and 50,000 square feet of research space enabling UAF to address a shortage of instructional classrooms and research lab space, which in turn will also provide space to attract and retain talented research scientist; and

WHEREAS, the estimated cost of construction of $102.8 million will create a substantial benefit to construction industry businesses and craftsman in the way of 300 plus jobs over a four year period.

NOW, THEREFORE, BE IT RESOLVED:

The Fairbanks Building and Construction Trades Council respectfully urges the University Board of Regents to make the University of Alaska Life Sciences Facility the only capital project in the 2011 State budget request.

PASSED AND APPROVED THIS 28th DAY OF October, 2009

Jay Quakenbush
President

Banner Health
Denali Center
Fairbanks Memorial Hospital

1650 Cowles Street
Fairbanks, AK 99701
Phone 907-452-8181
Fax 907-458-5324
www.fmhdc.com

RESOLUTION

WHEREAS,

The demand for qualified health care professionals continues to increase and the University of Alaska Fairbanks (UAF) has assisted Fairbanks Memorial Hospital & Denali Center (FMHDC) in educating Alaskans for many positions at FMHDC. UAF has identified the Life Sciences Building project are critical to the growth and development of these programs. State-of-the-art facilities are necessary to attract and keep the best researchers and students.

UAF is the most important single resource for the expansion of educational programs of vital interest to the Fairbanks community and Fairbanks Memorial Hospital. FMHDC relies heavily on the continued excellence of UAF to train and equip many of our health care professionals. Indeed, there has been a long-standing and mutually productive relationship between UAF and FMHDC for 35 years.

THEREFORE, BE IT RESOLVED

Fairbanks Memorial Hospital and Denali Center strongly supports the construction of a new Life Sciences Building on the UAF campus. A new Life Sciences Building is good for UAF; is good for Fairbanks and is good for the State of Alaska. Fairbanks Memorial Hospital & Denali Center fully supports the UA Board of Regents request for full funding of the Life Sciences Building.

Copies of this resolution shall be sent to the Honorable Governor Sean Parnell, Alaska Interior Delegations, and the UA Board of Regents.

Mike Powers
CEO, FMH/DC

Jim Lynch
CFO, FMH

Karl Sanford
Assoc. Admin of Cardiology and Therapies, FMH/DC

John Cotter
Assoc. Admin of Professional Services, FMH/DC

Jon Lundquist
Assoc. Admin of Plant Operations, FMH/DC

Dan Whitlow
CHRO, FMH/DC

Shelby Nelson
Assoc. Admin of Communications and Planning

Carl Kegley
IT Systems Director, FMH/DC

Juneau & Vicinity Building and Construction Trades Council, Inc.
813 West 12th St.
Juneau, AK 99801
Phone (907) 586-3050
Fax (907) 586-9614

Affiliates: *BRICKLAYERS LOCAL 1, CARPENTERS LOCAL 2247, CEMENT MASONS/PLASTERERS LOCAL 867, ELECTRICAL WORKERS (IBEW) LOCAL 1547, HEAT/FROST INSULATORS & ASBESTOS WORKERS LOCAL 97, IRONWORKERS LOCAL 751, LABORERS LOCAL 942, OPERATING ENGINEERS LOCAL 302, PAINTERS LOCAL 1959, PLUMBERS/PIPEFITTERS LOCAL 262, SHEETMETAL WORKERS LOCAL 23, SPRINKLER FITTERS LOCAL 669, TEAMSTERS LOCAL 959*

1-21-2010

We the 13 trade unions comprising the Juneau and Vicinity Building and Construction Trades Council would like to heartily express our support of full funding for the proposed University of Alaska Life Sciences Innovation and Learning Facility on the Fairbanks campus. It may seem somewhat strange that we would be supporting a project in Fairbanks, but in reality we too are concerned about the entire Alaska economy and want all regions to flourish, not just our own.

We recognize the importance and value of education, and that learning and researching in updated facilities using the most current technologies would be a definite enhancement to our collegians and our University system. The current facilities are nearly forty years old, and the renovations that have been done there over the years don't adequately address what we understand to be a 25% increase in enrollment in biology and wildlife studies over the past decade.

This project would encompass about 37,000 square feet of academic space and 50,000 square feet of research space allowing the University of Alaska Fairbanks to address the current shortage of classrooms and research lab space. This would also go a good distance towards attracting and retaining talented and well-paid research scientists to the community.

This facility would be an economic boon to Fairbanks as well, in that the estimated $102.8 million project would provide a substantial benefit to the construction industry businesses and the nearly three hundred workers constructing it over the estimated four year period.

Mike Notar
President
586-3050
813 W. 12th St.
Juneau, AK 99801

By: Nadine Winters
Introduced: 09/10/09
Adopted: 09/10/09

FAIRBANKS NORTH STAR BOROUGH

RESOLUTION NO. 2009-29

A RESOLUTION SUPPORTING FUNDING FOR THE UNIVERSITY OF ALASKA LIFE SCIENCES INNOVATION AND TEACHING FACILITY

WHEREAS, the Fairbanks North Star Borough Assembly recognizes the importance of the future economic impact the Life Sciences Innovation and Learning Facility at the University of Alaska Fairbanks (UAF), both in research dollars and educational opportunities; and

WHEREAS, the Assembly has supported this project in past years through passage of Resolution No. 2007-08 and 2008-44; and

WHEREAS, the facility will provide the necessary infrastructure for teaching and research in the biological sciences disciplines to attract and retain students, as well as an opportunity to increase research revenues; and

WHEREAS, it will provide much needed space for educational training needs in biomedicine, ecosystem and global change science, biology, population genetics, Alaska Native health, toxicology, environmental physiology, virology and neurosciences; and

WHEREAS, this facility will provide jobs for Alaskans. In the short term, construction of the building will inject approximately $174 million into the economy in direct and indirect economic output and $81 million in labor income, and provide employment to an average of 385 workers over a four-year construction period; and

WHEREAS, in the long term, the facility will provide long-term employment for many Alaskans. In FY07, 2,392 jobs were supported by university research spending; . Each $1 million in state general fund appropriations for university research resulted in 121 jobs and $4.7 million in payroll within the state; and

WHEREAS, life science research is a high-value growth industry in Alaska, attracting increased research revenue and creating jobs. The capacity for increasing research dollars can only be increased with adequate facilities to support the research; and

WHEREAS, the research done in this facility will address public health issues in Alaska, such as heart attacks, stroke, Parkinson's disease, and sudden infant death syndrome to name a few.

NOW, THEREFORE, BE IT RESOLVED, that the Assembly of the Fairbanks North Star Borough urges the University of Alaska Board of Regents to pursue legislative funding of this important and vital infrastructure for the benefit of the state and its residents.

BE IT FURTHER RESOLVED, that a copy of this resolution shall be sent to the University of Alaska Board of Regents and the the Alaska Interior Delegation.

PASSED AND APPROVED THIS 10th DAY OF SEPTEMBER 2009.

Nadine Winters
Presiding Officer

ATTEST:

Mona Lisa Drexler, MMC
Municipal Borough Clerk

Ayes: Brown, Beck, Musick, Sattley, Stringer, Hopkins, Wilson, Winters
Noes: None
Excused: Blanchard II

FAIRBANKS NORTH STAR BOROUGH BOARD OF EDUCATION

DRAFT RESOLUTION 2010-06:

SUPPORT FOR THE UA LIFE SCIENCES CLASSROOM AND LAB FACILITY

WHEREAS, building a strong research program increases the intellectual capital available in the state to help train residents to solve Alaskan issues, and impacts the quality of life in the state and beyond, and

WHEREAS, this facility will provide the necessary infrastructure to prepare our students for careers in biomedicine, ecosystem and global change science, biology, population genetics, Alaska Native health, toxicology, environmental physiology, virology, and neurosciences, and

WHEREAS, the University of Alaska is committed to meeting the workforce needs of Alaska public schools, and focusing on efforts to maximize resources and increase collaborations, and has an array of programs and activities designed to support teacher recruitment and retention of K-12 educators, and

WHEREAS, the University has made K-12 outreach and bridging programs a priority to complement high school to college bridging opportunities, offering over 120 programs dedicated to college preparation, professional development and teacher recruitment and retention, and

WHEREAS, the Life Sciences Classroom and Lab Facility will complement high school science education and provide modern, consolidated classrooms and integrated laboratories essential for teaching and research in the biological sciences disciplines at a post-secondary level, and

WHEREAS, Alaska students depend on the quality of education they receive from elementary through post-secondary opportunities.

NOW THEREFORE, BE IT RESOLVED, the Fairbanks North Star Borough Board of Education recognizes the importance of future long-term educational impacts of this facility, and strongly urges the Governor and the Alaska State Legislature to support funding the UA Life Sciences Classroom and Lab Facility in FY11 to provide the necessary infrastructure to benefit Alaska and its citizens.

Passed and approved: November 17, 2009

Leslie Hajdukovich, President
Board of Education

ATTEST:

Sharon Tuttle
Secretary to the Board

Fairbanks North Star Borough School District

SUPPORTING THE UNIVERSITY OF ALASKA LIFE SCIENCES PROJECT

The Greater Fairbanks Chamber of Commerce endorses the University of Alaska Board of Regents FY11 capital funding request for the Life Sciences Classroom and Lab project as it benefits all communities in the state of Alaska in the following ways:

• **LIFE-SCIENCE RESEARCH BENEFITS ALASKANS:** Life sciences research is aimed at benefiting Alaska's people and communities. Potential discoveries related to diabetes, food safety and nutrition, SIDS, avian flu, and therapies that may help victims of stroke, heart attack and traumatic brain injury, are just a few examples of the hundreds of research projects currently underway with potential statewide benefits. This facility will provide the necessary infrastructure for integrated research and teaching focusing on biomedicine, ecosystem and global change science, evolutionary biology, population genetics, Alaska Native health, toxicology, environmental physiology, virology and neurosciences.

• **RESEARCH IS A HIGH-VALUE GROWTH INDUSTRY FOR ALASKA**: Life sciences research is a high-value growth industry, and the facility is essential to capitalize on this growth. Externally funded life sciences research expenditures at UAF is $20 million per year, with potential for much more if adequate research space is available, allowing for continued growth (+30 percent in 5 years) in externally-funded research.

• **LIFE SCIENCE RESEARCH INCREASES THE VALUE OF EDUCATION:** Additional research increases the value of student education. The new facility will allow positive interaction among life sciences faculty and students, with hands-on research adding value to the student experience, and in turn, engaging more Alaska students in science and health care related careers.

• **MORE ALASKAN GRADUATES SERVING ALASKA:** A new facility will help attract and retain more Alaskan students and it will have a positive impact on creating **Alaskan graduates for Alaskan jobs**. UAF life sciences graduates tend to stay in Alaska and already fill many important professional positions throughout the state in business, government and health care.

• **THIS IS AN EXCELLENT RETURN ON INVESTMENT OF ALASKA'S PUBLIC DOLLARS:** Every $1 in state general fund money invested in research at the University of Alaska yields $5.80 in research funding attracted from out-of-state sources. In essence, life sciences research functions as a basic industry – mining, tourism, seafood and oil – all attracting revenue and good jobs into Alaska, stimulating economic growth. Just the construction of the facility will inject over $174 million into the Alaska economy, and provide over 370 jobs per year over the course of the four-year construction schedule.

• **GREAT POTENTIAL FOR ADDITIONAL ALASKA ECONOMIC GROWTH:** Continuing economic growth from research will benefit the Alaska. Economic benefits of research include increasing employment, payroll, and expenditure impacts; construction activity impacts; and substantial indirect cost recovery revenue from research programs. Total Life Sciences capacity-building federal grant funding over a period of the past 10 years totals over $95 million, with $17.7 million pending and the potential for increased funding once the facility is completed. For every dollar spent on university research in Alaska, an additional $.70 is generated in economic activity - multiplied by the number of researchers studying Alaskan life-science issues, this can amount to tens of millions of dollars annually.

Action Required for the Position: The Greater Fairbanks Chamber of Commerce recognizes the importance of research, as well as the economic impact and educational opportunities this Life Sciences Project will bring to all Alaskans, and urges the Alaska State Legislature and the Governor to fully support funding of this vital facility.

Position Sponsor Information:
The Greater Fairbanks Chamber of Commerce is the sponsor of this position.

Alaska State Chamber of Commerce
2010 Position

The University of Alaska Life Sciences Project

The Alaska State Chamber of Commerce endorses the University of Alaska Board of Regents FY11 capital-funding request for the Life Sciences Classroom and Lab Facility. This will be the only new construction project on the Board of Regents request.

The Alaska State Chamber of Commerce recognizes the importance of research, as well as the economic impact and educational opportunities this Life Sciences Project will bring to all Alaskans, and urges the Alaska State Legislature and the Governor to fully support funding of this vital facility.

Contributions of UAF Life Sciences Research to the State of Alaska

In Support of Funding for the UAF Life Sciences Innovation and Learning Facility

Prepared for:
University of Alaska Fairbanks

Prepared by:

Juneau • Anchorage

February 2009

Table of Contents

Executive Summary

The purpose of this study is to demonstrate the economic, social, and cultural benefits to Alaskans of the life sciences programs at the University of Alaska Fairbanks. The Life Sciences Innovation and Learning Facility is the number one new capital project priority for the University of Alaska system. This study highlights the important contributions of UAF life sciences research and the critical need for the new facility.

Critical Need for a New Life Sciences Facility

The Life Sciences Innovation and Learning Facility is designed to meet the critical need for updated classrooms and provide research space allowing for UAF's continued growth in its successful life sciences research programs. It will be difficult for UAF to expand life sciences research grant revenues without new facilities. Currently, there is insufficient space in modern facilities to attract and retain top researchers.

The new facility will feature 37,000 square feet of academic space, including approximately 40 classrooms with computer and lab capabilities, and a lecture hall capable of seating 80 students. The research space, at 50,000 square feet, will provide 18 research labs and 10 support labs.

The UAF Life Sciences Innovation and Learning Facility is a scaled-down version of the Biological Sciences Facility (BIOS). Total cost for the new 87,000-square-foot research and teaching facility is $102.82 million. UAF has committed to non-General Fund support for 20 percent of the new facility. The FY10 University of Alaska capital budget requests state General Funds of $82.2 million and provides non-General Fund support from UAF totaling $20.6 million for the new Life Sciences facility.

Benefits to Alaska of a New Life Sciences Innovation and Learning Facility

- **STIMULATES A HIGH-VALUE GROWTH INDUSTRY FOR ALASKA: Life sciences research is a high-value growth industry, and the facility is essential to capitalize on this growth. Externally funded life sciences research expenditures at UAF is $20 million with potential for much more if adequate research space is available.** The new facility is essential for UAF to attract and retain top researchers, and allows for continued growth (+30 percent in 5 years) in externally funded research.

- **EXCELLENT RETURN ON INVESTMENT OF ALASKA'S PUBLIC DOLLARS: Every $1 in General Fund money invested in research at the University of Alaska yields $6 in research funding attracted from out-of-state sources.** In essence, life sciences research functions as a basic industry – just as do mining, tourism, seafood and oil – attracting revenue and good jobs into Alaska, stimulating economic growth. The new facility will stimulate research revenue growth and increase Alaska's funding leverage even further.

- **INCREASES THE VALUE OF ALASKA EDUCATION: Additional research increases the value of student education**. The new facility will allow positive interaction among life sciences faculty and students, with research adding value to the student experience, and in turn, engaging more Alaska students in science and health care related careers.

- **ADDITIONAL RESEARCH PROGRAM GROWTH: Critical mass is essential for attracting the best researchers and tens of millions of dollars in additional research funding**. The University of Alaska competes with other universities for research funding and the best researchers. A competitive facility will help attract top researchers who will intern attract additional researchers.

- **ADDITIONAL ALASKA ECONOMIC GROWTH: Continuing economic growth from research will benefit the overall University of Alaska system and Alaska as a whole.** Economic benefits of research include increasing employment, payroll, and expenditure impacts; construction activity impacts; and substantial indirect cost recovery revenue from research programs ($26 million in FY 2007) that accrues to the overall University of Alaska system.

- **MORE ALASKAN GRADUATES SERVING ALASKA: The facility will have a positive impact on creating Alaskan graduates for Alaskan jobs.** UAF life sciences graduates tend to stay in Alaska and already fill many important professional positions throughout the state in business, government and health care. A new facility will help attract and retain more Alaskan students.

- **RESEARCH BENEFITS ARE FOR ALASKANS: Increased contributions of life sciences research benefit the lives of all Alaskans.** Life sciences research is aimed at benefiting Alaska's people and communities. Potential discoveries related to diabetes, food safety and nutrition, SIDS, avian flu, and therapies that may help victims of stroke, heart attack and traumatic brain injury, are just a few examples of the hundreds of research projects currently underway at UAF with potential statewide benefits.

Below are highlights and key points from this study. The body of the document provides greater detail on the impacts and benefits of the life sciences program at UAF.

Importance of Research at UAF

- The majority of UA research (more than 90 percent as measured by research expenditures) takes place at UAF. UAF research expenditures of funding from external sources was approximately $113 million in FY07, up 30 percent from FY02.

- UAF received 424 grants and managed more than 1,446 grants in FY07.

- Indirect cost recovery (ICR) is an important revenue source for UA. Of the $30.9 million in ICR revenue in FY07, $26 million (85 percent) was generated by research at UAF. If UAF research grants stagnate or decline, so will ICR, which would negatively impact UAF and the entire UA system.

- The federal government, through agencies such as the National Institutes of Health, National Science Foundation and Department of Defense, funded the majority (88 percent) of research at UAF in FY07.

UAF Research Funding

- UAF was successful in acquiring federally funded life sciences research capacity-building grants worth $95 million for 2000 to 2014 with an additional $17.7 million pending.

- As a result of the research capacity created at UAF, they have been able to acquire competitive life sciences grants worth an additional $29 million.
- For every $1 of State-funded research UAF received, UAF was able to leverage an additional $5.80 from external funding sources.
- Even though UAF has been historically successful in leveraging state funding, strong General Fund support is still needed to provide the infrastructure (including facilities and human resources) that will allow UAF to be competitive for future grants. General Fund support is used by the university for recruitment, salaries, offices, laboratories, and equipment to build capacity.

Research at UAF

One area of research where UAF has become particularly strong is life sciences. Almost all UAF life sciences research and teaching takes place in two units, the Institute of Arctic Biology (IAB) and Idea Network of Biomedical Research Excellence (INBRE). There are many research programs within these two units that are important and beneficial to Alaskans.

The largest component of UAF life sciences research and academics is contained within the IAB. IAB currently supports roughly 150 ongoing research projects, and IAB faculty (through the Department of Wildlife and Biology in the College of Natural Sciences and Math) are responsible for all academic delivery for classes in life sciences.

INBRE studies organisms that cause diseases in Alaska and toxic substances in our environment. INBRE also has a mission of outreach and support for students (high school and college) who show interest in life sciences research. Combined, IAB and INBRE have approximately 150 faculty, staff and graduate student assistants at UAF. IAB and INBRE had combined research expenditures of nearly $22 million[1]. The majority of expenditures were for wages and benefits, commodities, services and equipment at UAF.

Life sciences research at UAF is ultimately about people, especially Alaskans. Some of the major life sciences programs and projects beneficial to Alaskans under IAB and INBRE are described below.

Monitoring Toxicants and Disease in Alaska

UAF researcher Todd O'Hara is studying contaminants and infectious disease in the Arctic. Infectious agents and toxicants can be easily transmitted through commercial, sport and subsistence harvest in Alaska. INBRE toxicology projects study animals that are at the top of the food chain such as Arctic fox, polar bear and Stellar sea lions, and numerous subsistence foods.

What effect do toxicants have on animals and people? If diets change because of changing environmental conditions, will these animals be exposed to new or higher levels of toxicants and/or infectious agents? If so, how will this affect their health, as well as the health of Alaskans who rely on fish and game for food?

[1] The majority of INBRE expenditures were at UAF but INBRE also supports research at UAA and UAS.

Another of O'Hara's roles is to study and understand how infectious diseases are present in Alaska and how they can be transmitted to the public via handling and consumption of fish and wildlife. For example, there have been periodic outbreaks of rabies in Arctic foxes on the North Slope; this is potentially hazardous to North Slope residents and oil field workers. The better these outbreaks are understood, the better the public can be educated about the associated risks, and measures that can be taken to avoid contact with these diseases.

Center for Alaska Native Health Research (CANHR)

CANHR's mission is "to build and increase research capacity that will contribute knowledge to improve Alaska Native health." The primary focus of this research center is on obesity and its relationship to diabetes and cardiovascular disease among Alaskan Natives. CANHR seeks new knowledge through research that can ultimately be applied to understand, reduce and prevent health disparities in Alaska's Native communities. CAHNR partners with the Yukon-Kuskokwim Health Corporation and communities in Southwest Alaska, using a collaborative approach that incorporates local knowledge and culture into the process of scientific investigation. Following are two of CANHR's current projects.

UAF Research into Contaminants and Nutrients in Alaskan Subsistence Foods

This CANHR project is also headed by researcher Todd O'Hara. It takes the "under the microscope" work of INBRE and utilizes it to the study of how nutrients and toxicants (such as mercury, PCB's DDT, lead, arsenic and many other pesticides) directly affect Alaskans. As these toxicants work their way up the food chain, they can eventually impact human health.

UAF laboratories measure toxicants in subsistence foods such as salmon, seals, and reindeer and go beyond the lab to study how their consumption affects humans. The project also measures nutrient levels in these traditional foods. Contaminant and nutrient levels in foods that are dried, smoked, baked or rendered may change, becoming more or less concentrated. Certain preservation methods can neutralize toxicants and/or impact the nutrients available. This research is very relevant to the health of all Alaskans who consume fish and game. From an economic standpoint, Alaska needs to be vigilant in protecting the pristine image of our valuable commercial marine resources. Scientists are also learning new things about the nutritional benefits of eating fish, an important message for the state's commercial fishing industry.

Alaska Basic Neuroscience Program (ABNP)

ABNP strives to expand and stimulate basic neuroscience research (scientific study of the nervous system) with a focus on protection of the nervous system, including the brain, from disease such as stroke or physical injury. ABNP scientists also study sudden infant death syndrome (SIDS), a particular risk for Alaska infants, by studying how breathing is controlled.

UAF Sudden Infant Death Syndrome Research

SIDS is the leading cause of death in the US for infants one month to one year old. The national rate of SIDS deaths is about 0.7 (less than one) per 1,000 births. Caucasian babies born in Alaska die of SIDS at more than twice the national rate (1.6 per 1,000), and babies born to Alaska Natives die of SIDS at more than five times the national average at 3.6 per 1,000 births. SIDS is an Alaskan problem.

A look at occupational death rates helps to put Alaska SIDS death rates in perspective. In the 1990s, Alaska workers had a death rate of 0.22 per 1,000. The Alaska rate is five times that of the overall US work-related fatality rate. When you compare the Alaska worker death rate with SIDS death rates for approximately the same period, SIDS mortality among Caucasians in Alaska was seven times higher and 16 times higher among Alaska Natives than worker deaths. By far, the most dangerous occupation in Alaska is being an infant. ABNP researcher Mike Harris and his team are working to reduce vulnerability by looking at genetics, biology and behavior in Alaskan babies.

Another UAF SIDS-related research project is led by Barb Taylor and her team. They are looking at the potential effects of exposure to alcohol and nicotine on infants and unborn babies as risk factors in SIDS vulnerability. Other UAF SIDS research is trying to determine if alcohol and nicotine exposure affects the central nervous system and carbon dioxide transfer.

Hibernation Science

The Center for Molecular and Genetic Studies of Hibernation monitors Alaskan animals like the arctic ground squirrel and black bear. These hibernators spend each winter in a state in which their need for food and water is reduced to zero for six to eight months at a time. During hibernation, these animals are also resistant to harm from low blood pressure and the minimal availability of oxygen and blood sugar. Ground squirrels actually spend part of their time in hibernation with their body temperature below freezing with no ill effect.

If researchers can determine how the mechanisms that allow hibernating animals to slow body function work, there is potential for new therapies and drugs that, when administered to humans, would slow body function (including the onset of damage) and could allow first responders to stabilize patients with life-threatening conditions.

This research could lead to increasing the time that sick and injured patients have to get to a critical care facility, increasing their chances of recovery. This could be especially important in Alaska where many residents are injured in remote vehicle, ATV and snow machine accidents, or work in remote locations in the timber, fishing, oil, gas and mining industries and are hours or even days away from a critical care facility. The US Army has been financially supportive of this cutting edge research at UAF because of the potential for stabilizing seriously injured soldiers prior to treatment.

Bird Flu Research

According to the Center for Disease Control and Prevention, "The highly pathogenic avian influenza A H5N1 animal outbreak in Asia, Europe, the Near East, and Africa is not expected to diminish significantly in the short term. It is likely that H5N1 virus infections among domestic poultry have become endemic in certain areas and that sporadic human infections resulting from direct contact with infected poultry and/or wild birds will continue to occur. So far, the spread of H5N1 virus from person-to-person has been very rare, limited and unsustained. However, this epizootic (transferrable from animals to humans) continues to pose an important public health threat."[2]

[2] Center for Disease Control and Prevention website 2/6/2009. http://www.cdc.gov/flu/avian/outbreaks/

UAF researcher Jon Runstadler and his team have been researching biological mechanisms in birds (mostly ducks). How are the viruses transferred among birds? How are they transferred to humans? What are the risks to human health in Alaska?

The migration routes of many species of ducks cross paths where Alaska and Asia meet over the Bering Sea. There is potential for Asian ducks to spread H5N1 bird flu to Alaska and other parts of North America. If the highly pathogenic H5N1 were to occur in Alaska, there could be serious implications for the health of Alaskans.

Because of the capacity built by INBRE, Runstadler's team was able to acquire RO1 grant funding for the Center for Rapid Influenza Surveillance and Research (CRISAR). This five-year, $3.8 million, NIH-funded RO1 grant is a joint UAF, UCLA and UC Davis research project. The research involves surveillance and monitoring of birds in the US, Russia, Japan, China and Southeast Asia to see were there may be a potential threat of an outbreak of bird flu. The study looks at how the virus is carried and transferred as birds migrate around the Pacific Rim. CRISAR is an excellent example of how place-based research has been enhanced by the research capacity built through INBRE. CRISAR allows UAF to use its traditional strengths in wildlife biology to benefit people both inside and outside of Alaska.

Life Sciences Academic Program

Some of the benefits of investment in UA research are quantifiable; however, many benefits are less readily valued. How do we quantify the results of research spending that excites a young Alaskan student to pursue an academic career in a science or health-related field, who then returns to her home community and increases the quality of life for those she serves? UAF research, in close coordination with academic programs, allows many Alaskans opportunities to pursue science or health-related education that not only lead to better income and increased quality of life for their household, but also provides benefits to many other Alaskans and their communities.

Enrollment

- With nearly 500 degree-seeking students, the UAF biology and wildlife program is one of the largest degree programs in the entire UA system. This includes enrollment of over 300 life sciences graduate students. Compared to other programs, UAF life sciences programs, particularly biology, have seen the greatest increases in enrollments at UAF in recent years.

Quality Faculty

- Academic delivery in life sciences at UAF is provided by some of the best researchers in their fields. In order to attract and retain these top instructors, UAF academic facilities need to be on par with other institutions.

- If top researchers can be attracted to UAF, they not only bring their research skills but also increase the number and quality of classes that can be offered at UAF. Additionally, the availability of high-quality research options provides critical hands-on experiences where students can apply their academics.

Alaskan Graduates

- Producing graduates with the skills needed by businesses, government and other agencies in Alaska is a crucial contribution of UA to the state's economy. UA graduates also contribute to the Alaskan economy at a higher level than non-graduates (on average, university graduates earn substantially more over their lifetime than non-graduates).

- UAF educates Alaskans who will be making policy decisions for Alaskans. UAF graduates have worked for local, state and federal agencies such as schools, Alaska Department of Fish and Game, National Park Service, US Forest Service and US Fish and Wildlife. Many of these positions have direct influence on issues that affect all Alaskans.

- Alaskan graduates tend to live and work in Alaska, helping the economy grow and serving state residents. Nearly two-thirds of UAF graduates (from 1989 to 2006) were still living in the state of Alaska in 2006. Rural Alaskan graduates have an even higher likelihood of staying in the state after graduation.

- As of 2005, nearly three-quarters of UAF graduates still living in Alaska worked in a field related to their UAF education. This high retention rate is an important element in creating economic growth within the state.

The Economic Impact of Life Sciences Research

Impacts of Construction

The following construction impacts for the new Life Sciences Learning and Innovation Facility were estimated based on a 2006 McDowell Group study of the construction impacts of the BIOS facility. Cost estimates were adjusted for the difference between the $105 million BIOS facility in 2006 and the $102.8 million Life Sciences Innovation and Learning Facility.

- **There will be a substantial amount of short-term employment and economic activity related to the construction of a new Life Sciences Facility in Fairbanks** as well as in other areas of the state. Estimated statewide output associated with facility construction would be substantial, at about $170 million in total economic output (direct, indirect and induced) that includes $80 million in labor income, and annual average employment of 370 workers (in construction and other sectors of the economy) over a four-year construction period for the new facility. A total of nearly $145 million ($102.8 million for construction, plus $42 million in indirect and induced spending) would enter the Fairbanks economy.

- **The economic effects of this project would benefit other areas of the state, primarily Anchorage, Mat-Su and the Kenai Peninsula.** Total economic output for the Southcentral region of the state from the facility project would be about $20 million with total direct and indirect annual average employment of about 50, and total payroll of about $8 million. The majority of these benefits would occur in the Anchorage area.

Impacts of a Research Team

- **A new Life Sciences Facility at UAF could generate $1 million to $3 million in new wages and benefits.** Adding new space, and the resulting space made available by intercampus moves, could result in an increase in new research-related wages and benefits in the range of $1 million to $3 million at UAF. In addition to these wages and benefits, there would be increases in direct spending for goods and services. Indirect and induced impacts would have further positive effects on Alaska's economy.

- **On average, a research team at UAF is worth $850,000 to $1 million per year in economic activity for the state.** According the economic modeling system IMPLAN, for every dollar spent on university research in Alaska there is additional economic activity of $0.70.[3] Multiplying the average range of $500,000 to $600,000 in grants acquired per year, per researcher, by the 1.7 multiplier results in a range of $850,000 to $1 million in economic activity for the state, per research team. Twelve research teams at UAF represents approximately $10.2 million to $12 million in economic activity for the state.

[3] Minnesota IMPLAN Group, *IMPLAN Professional Version2*. 2006: Stillwater, MN

Importance of Research at UA

The three primary missions of the University of Alaska are instruction, research and public service. Research at UA plays a key role in expanding and diversifying the state's economy, protecting the health of Alaskans and their environment, and strengthening state agencies and institutions. The extensive economic benefits of UA research programs were documented in a 2007 study by the Institute of Social and Economic Research (ISER).[4]

- In 2006, 2,392 jobs were supported by university research spending, including 1,292 direct jobs and 1,100 indirect jobs.
- The combined direct and indirect payroll for jobs generated by university research was $92 million in 2006.
- Direct and indirect university research generated $125 million in sales throughout Alaska in 2006 (including procurement, business sales, and employee spending).
- In 2006, each $1 million in General Fund appropriations for UA research resulted in 121jobs and $4.7 million in payroll within the state.
- Because non-General Fund research revenue comes mostly from outside Alaska, the University's research programs (like mainstream industries) bring new dollars into the state.

In addition to the economic benefits, research at UA is an important component in the delivery of academic and service programs that are valuable to Alaskans. Building a strong research program also increases the intellectual capital available in the state to help train residents to solve Alaskan problems, increasing the quality of life in the state.

UA is the primary source of research and development in the state of Alaska. In most states, private industry conducts a majority of research and development efforts. The majority of UA research (more than 90 percent as measured by research expenditures) takes place at UAF.

Even though UAF is a small school on a national scale, it has been very successful in research and development. UAF conducts research that is relevant to human health and climate change in Alaska, translating into solutions for problems unique to our environment.[5]

Alaska's proximity to the Arctic has allowed UAF researchers an advantage in competing for grants. While UAF is a small school and does not have the same level of facilities and equipment as some of the largest institutions, "place-based research" has allowed them to be competitive on a national scale.

[4] Goldsmith, S., *University of Alaska research: an economic enterprise.* 2007, Institute of Social and Economic Research: Anchorage, Alaska.
[5] Maddox, David C., *Environmental Scan for the University of Alaska's Research Enterprise,* 2006.

Measuring UAF Research

Two measures that gauge the scale of research at UAF are the volume of restricted revenue generated by grants and actual research expenditures. Reviewing the volume of grant awards shows the level of success that a university has had in obtaining funding for specific research projects. Some portions of research grant dollars are reallocated through indirect cost recovery (ICR) to fund other campus and system-wide activities. Looking at actual research expenditures allows a more focused view of research program impacts.

Note: Unless otherwise stated, all figures in this document are for FY07.

Grant Awards

The UA system received 694 new grants and managed 2,136 ongoing grants.[6] New grants totaled $237.5 million systemwide. During the year, UAF received 424 of all new grants and managed 1,446 of all ongoing grants. In comparison, UAA received 217 new grant awards and managed 546 ongoing grants.

New grants totaled $237.5 million system wide of which approximately $200 million (83 percent) were at UAF.

Research Expenditures

UAF research expenditures from externally sponsored funding sources totaled about $113 million in FY07, up 30 percent from FY02. (This does not include $22.8 million in State General Fund support.) The majority of UA research (more than 90 percent as measured in research expenditures) takes place at UAF.

Research Expenditures by Major Academic Unit, FY02 to FY07

MAU	FY02 ($millions)	FY07 ($millions)	% Change FY02 – FY07
UAF	$87.2	$113.0	+30%
UAA	9.1	10.3	+13
UAS	0.8	1.2	+42
Total	**$97.1**	**$124.5**	**+28%**

Note: Figures are in millions and have been rounded; they include indirect cost recovery distributed to each MAU (Major Academic Unit).
Source: UA in Review 2008.

Indirect Cost Recovery

Indirect cost recovery (ICR) is an important revenue source for UA. Of the $30.9 million in ICR revenue, $26 million (85 percent) was generated by research at UAF. ICR is revenue captured from federal and other

[6] 2008 UA in Review, UA Statewide Planning and Budget, http://www.alaska.edu/swbir/ir/ua-in-review/

restricted grants that reimburses the University for related administrative, facility, and other support costs. ICR is charged to the grant source as a percentage, up to 42 percent of the grant amount.

UAF Indirect Cost Recovery Distribution, FY02 to FY07

	FY02 ($millions)	FY07 ($millions)	% Change FY02 – FY07
ICR distributed back to originating unit	$10.3	$14.0	+36%
ICR distributed to other UAF departments	5.9	8.9	+50
ICR distributed to UA Statewide MAU	2.4	3.3	+38
Total ICR	**$18.6**	**$26.2**	**+41%**

Note: Figures are in millions and have been rounded.
Source: UA Banner Finance.

Total UAF-generated ICR has increased by 41 percent from FY02 and has become an increasingly important revenue source for maintaining UA facilities and administrative functions.

Slightly more than half (about $14 million) of ICR collected from UAF research went directly to augment the research program or unit that brought in that revenue (the originating unit), while 34 percent ($8.9 million) was distributed to other areas of UAF, such as the library, administrative services and building maintenance. The remaining 13 percent ($3.3 million) was distributed to the UA Statewide MAU.[7] The Statewide MAU provides services such as accounting, legal, human resource and information technology services to UA system-wide.

ICR has been the revenue source for much of the construction of new research space in the last decade, including the West Ridge Research Building, UAF Museum research space, Institute of Arctic Research Center, Lena Point facility, and the BiRD Building.

The $3.3 million distributed to the Statewide MAU represented approximately 6 percent of its revenues. The $8.9 million distributed to other UAF departments accounted for about 2.5 percent of UAF revenues. If the level of UAF research were to stagnate or decline, the effect could have serious implications for university operations.

[7] UA has four major administrative units (MAU's): UAA, UAF, UAS and Statewide.

Funding for UAF Research

Overall, externally funded (non-General Funds) research at UAF increased by 30 percent from FY02 to FY07. The federal government, through agencies such as the National Institutes of Health, National Science Foundation and Department of Defense, funded the majority (88 percent) of research at UAF. Other sources of funding included Native Corporations, non-profit organizations, private businesses and other universities, which accounted for about 11 percent of research revenue. State General Fund support increased slightly from about $1.4 million to $1.5 million and accounted for about 1 percent of total research revenue at UAF.

The majority of growth (in dollars) was due to federal funding, while funding from sources such as Native Corporations, non-profit organizations, private businesses and other universities increased at the highest rate (46 percent) over the period. Examples of state agencies include the Department of Natural Resources and the Department of Health and Social Services.

UAF Externally Funded Research Expenditures by Sponsor, FY02 to FY07

	FY02 ($millions)	FY07 ($millions)	% of Expend. FY07	% Change FY02 – FY07
Federal	$77.6	$99.4	88%	+28%
Other	8.2	12.0	11	+46
State agencies	1.4	1.5	1	+6
Total	**$87.2**	**$113**	**100%**	**+30%**

Note: Figures are in millions and have been rounded. Figures include ICR expenditures.
Source: UA in Review 2008.

Leverage

One measure of the productivity of a research program is to compare the value of external funding leveraged by university General Funds. For every dollar of state-funds for research in FY07, UAF was able to leverage an additional $5.80 from external funding sources. UAF has been fortunate to receive multiple capacity-building grants over the last six to eight years. The State must capitalize on this opportunity.

Strong General Fund support is still needed to build the infrastructure (including facilities and human resources) so that UAF has the capacity to be competitive for new grants. Such funds will be used for recruitment, salaries, offices, laboratories, and equipment to build capacity.

The expectation of top UAF researchers is that they will eventually bring in significant grant funding to support their own salaries, staff and equipment, as well as contribute to the university as a whole.

Building Research Capacity

Since 2000, UAF has made a concentrated effort to build capacity for life sciences research. Since that time UAF has received a series of grants designed to increase capacity in basic and applied research. These grants are for limited periods of time (some can be renewed for a second or third phase) but are not long-term sources of funding for research. The purpose of the grants is to build capacity among research programs so that they can conduct research that is capable of receiving funding on a nationally competitive basis.

Most research at UAF is funded by either the National Institute of Health (NIH) or the National Science Foundation (NSF).

NIH Funding

In addition to capacity-building grants, NIH RO1 grants are made to support specific projects to be performed by an investigator in an area representing the investigator's competencies, and to meet the mission of the NIH. One intent of the capacity-building grants is to increase the number of RO1 awards to Alaska which is currently at or near the bottom of all states in NIH-funded RO1 research grants.

NIH RO1 grants are awarded to the top 10 to 15 percent of applicants. Even Harvard University researchers have a success rate of only about 50 percent when applying for NIH grants.

In addition to the merits of an individual proposal, NIH looks at several critical components of a proposed research project:

- Research must be relevant to health issues on a national level.
- NIH panels look for strong scientists with quality degrees, a pattern of excellent work, public speaking, published work, and previous receipt of grant funding.
- Laboratory facilities and equipment must be up to date.
- Research programs need a strong intellectual community (a critical mass of students, graduates and other researchers) for support.

NSF Funding

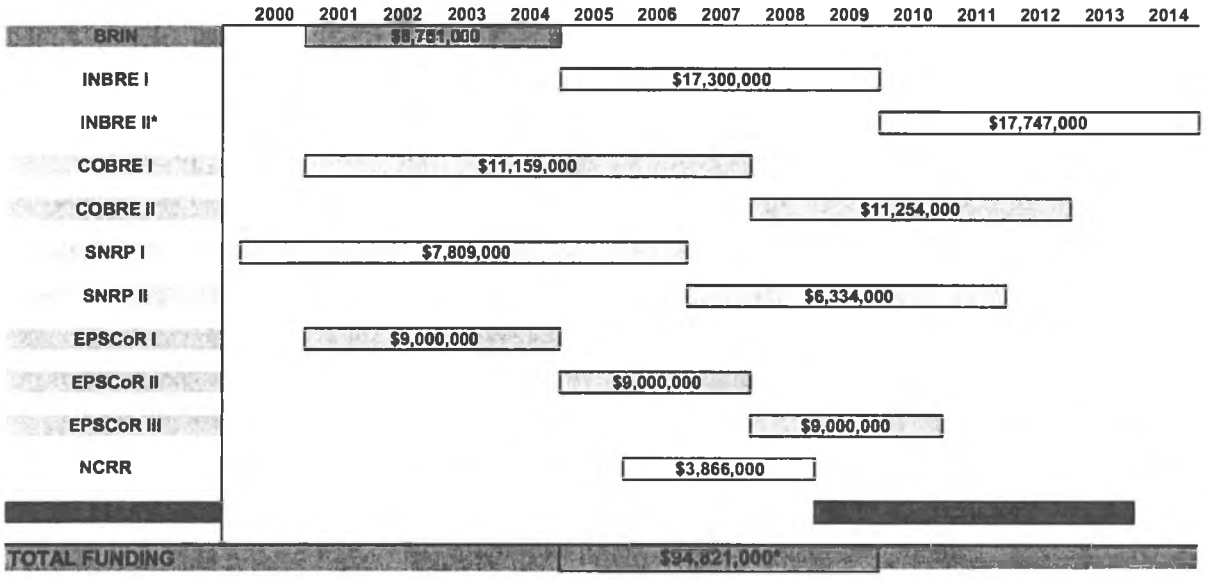
The National Science Foundation (NSF) is an independent federal agency that promotes science to advance national health, prosperity, welfare and national defense. NSF funds about $6 billion worth of research through term-limited grants. NSF currently issues about 10,000 new awards per year, with an average project duration of three years. Research proposals must be judged the most promising by a rigorous and objective merit-review system. Most of these awards go to individuals or small groups of investigators. Others provide funding for research centers, instruments and facilities that allow scientists, engineers and students to work at the outermost frontiers of knowledge.

"NSF's goals—discovery, learning, research infrastructure and stewardship—provide an integrated strategy to: advance the frontiers of knowledge; cultivate a world-class; broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens; build the nation's research capability through investments in advanced instrumentation and facilities, and support excellence in science and engineering research and education through a capable and responsive organization. NSF's mission includes support for science and engineering education, from pre-K through graduate school and beyond. The research is thoroughly integrated with education to help ensure that there will always be skilled people available to work in new and emerging scientific, engineering and technological fields, and capable teachers to educate the next generation."[8]

The challenge at UAF is to create and maintain a research program that has a critical mass of top researchers, facilities and intellectual strength. To meet these criteria, a research program must have very strong support from the University of Alaska and from the State. In order to meet NIH and NSF qualifications and the goals of UAF, proposed research needs to be relevant not only on a national level, but also relevant within the state.

The table below shows federal funding for capacity-building grants received by UA. Almost all funding shown in the table was for research conducted at UAF. The exceptions are INBRE which has program components at UAA and UAS, and EPSCoR which provides programs statewide. Following the table are brief descriptions of these capacity-building grants. To date approximately $95 million has been received and an additional $17.7 for INBRE II is pending.

Life Sciences Capacity-Building Federal Grant Funding



*Note: INBRE II is not included in this total but the expectation is that this grant will be awarded.

[8] National Science Foundation website 2/8/2009 http://www.nsf.gov/index.jsp

INBRE/BRIN

The Idea Network of Biomedical Research Excellence (INBRE) is a national program of grants from National Institutes of Health designed to increase capacity for high quality research. INBRE provides grants for research institutes like UAF that have strong programs and the potential to be increasingly competitive with top researchers from other states for NIH RO1 grants. After the grant period ends, the program is expected to be at a level where its researchers can be nationally competitive. UAF received its first NIH capacity-building grant (then called BRIN) for 2001 to 2004. The first INBRE grant was for 2004 to 2009. INBRE at UAF is in the process of being renewed and is likely to be funded for 2009 through 2013. More details about INBRE projects will be presented in the UAF Life Sciences Research Programs section of this report. INBRE funds research at UAF, UAA and UAS.

COBRE

The Center of Biomedical Research Excellence (COBRE) is an NIH-funded program to build research capacity in specially designated areas. The COBRE program promotes the initiation and development or expansion of unique, innovative state-of-the-art biomedical and behavioral research centers at institutions. COBRE funds basic and applied research. The objectives of COBRE are to strengthen institutions' biomedical research infrastructure and to enhance the ability of investigators to compete independently for NIH individual research grants.[9] COBRE funds Center for Alaska Native Health Research at UAF.

SNRP

Specialized Neuroscience Research Programs (SNRP) program is designed to strengthen research capabilities of faculty, students, and fellows at minority institutions by supporting the development and/or the enhancement of ongoing, basic and clinical neuroscience research projects and programs. SNRP funds the Alaska Basic Neuroscience Program.

SNRP grants are intended "to enhance the research capacity of a group of academic institutions that historically have not been major participants in NIH [neuroscience] programs specifically." An important long-term goal has been to foster the capability of minority institutions to compete successfully within the NIH peer review process for research grants. SNRP grants were designed to achieve the following programmatic goals:

- To assist in infrastructure development leading to well established, state-of-the-art neuroscience research programs.
- To foster innovative and effective partnerships and collaborations between minority institutions and established neuroscience laboratories at federal and non-federal research institutions.
- To create, support, and maintain a stimulating academic and intellectual milieu to inspire and prepare students and fellows to pursue research centers in neuroscience. [10]

[9] National Institutes of Health website 2/8/09 http://grants.nih.gov/grants/guide/pa-files/PAR-09-079.html#SectionI

[10] National Institutes of Health, Specialized Center Cooperatives Agreement Programs website http://snrp.nih.gov/about_SNRP/about.htm

- To provide support to develop and sustain competitively funded neuroscience research projects and programs.

EPSCoR

The Experimental Program to Stimulate Competitive Research (EPSCoR) is a National Science Foundation university-based grant program that is designed to develop states' research capabilities; increase student participation in science, math and engineering; increase the coordinated efforts between states and their universities; and to ultimately increase economic development. EPSCoR creates partnerships with states and universities to spark interest in research and build capacity among researchers. Alaska EPSCoR began in 2000 and partners with UA and the State of Alaska. Alaska EPSCoR is in its third phase (2007-2010). Each phase has granted about $4 million annually for EPSCoR with three-quarters coming from NSF and one-quarter coming from the State of Alaska (through UA) as matching funds. EPSCoR is a statewide program with a mandate to increase student participation in all areas of the state, including UA's major and remote campuses.

SEPA

Science Education Partnership Awards (SEPA) are NIH-funded, with the goal of increasing biomedical research education in Alaska middle and high schools. The grant is part of an estimated $17 million awarded by NIH to fund 16 Science Education Partnership Awards across the country.

UAF's award will provide support for the Biomedical Partnership for Research Education Pipeline in Alaska, or Alaska BioPREP, to be administrated by INBRE. According to INBRE Director George Happ, "This program blends the talents and facilities of local school teachers and health providers with those of UAF to create venues where secondary school students can pose biological and biomedical questions, find answers using molecular approaches, and gain appreciation of the importance of modem science to the practice of medicine and health policy in their daily lives."

An immediate aim of the project will be to keep students in high school through graduation by ensuring that their high school science courses are focused, challenging and relevant. The BioPREP partnership group includes school districts, teachers, researchers, science education groups and Alaska Teacher Placement. Through the partnership, university researchers provide the technical expertise, teachers provide the instructional expertise, and health care providers and community members supply practical applications and encouragement for the students.

"Hands-on investigations, individual mentoring relationships, community involvement, and incentives such as travel and scholarships all improve student enthusiasm and retention in school, and all are part of BioPREP," explained Sue Hills, outreach director of Alaska INBRE. "With the skills the students learn in BioPREP, they can jump right into undergraduate research programs or lab assistant positions when they get to college."

NCRR

The National Center for Research Resources (NCRR) was funded by NIH. Funds are granted to expand, remodel and renovate research and animal facilities.

A $3.87 million NCRR grant was used to help complete construction of the Biological Research and Diagnostic Facility (known as the BiRD building).

Capacity-Building Success at UAF

Overall, UAF research has been increasingly successful at winning competitive grants. As a result of the research capacity built by BRIN/INBRE, COBRE and SNRP, UA has been able to acquire competitive life sciences grants totaling approximately $29 million dollars.

One example of how capacity-building grants can lead to success with competitive grants is the Center for Rapid Influenza Surveillance and Research (CRISAR) project. This $3.8 million NIH-funded RO1 grant is a joint effort between UAF, UCLA and UC Davis. The 5-year competitive grant was awarded to UAF in 2007 as a result of the capacity built from INBRE funding. The research involves surveillance and monitoring of birds in the US, Russia, Japan, China and Southeast Asia to identify were there may be a potential threat of an outbreak of bird flu. The study looks at how the virus is carried and transferred. According to principal investigator Jon Runstadler, "Our proximity to the birds and the research capacity that we have built from INBRE allowed us to be successful in securing this competitive research proposal for UAF." Runstadler's team works with Mark Lindberg, a UAF wildlife biologist and expert on the life-cycle of ducks in Alaska. His understanding of migration patterns also allows researchers to know when and where to intercept wild birds so that they can be monitored for various strains of avian flu.

CRISAR is an excellent example of how place-based research has been enhanced by the research capacity built through INBRE. CRISAR allows UAF to use its traditional strengths in wildlife biology to benefit people both inside and outside of Alaska.

There are many similar examples of research success at UAF. The next section will provide an overview of the primary life sciences programs at UAF.

UAF Life Sciences Research Programs

One area of research where UAF has become particularly strong is life sciences. Almost all UAF life sciences research and takes place within Institute of Arctic Biology (IAB) or Idea Network of Biomedical Excellence (INBRE).

Institute of Arctic Biology

The largest component of UAF life sciences research and academics is contained within the IAB. IAB currently supports about 150 ongoing research projects, and IAB faculty (through the Department of Wildlife and Biology in the College of Natural Sciences and Math) teach all of the classes for undergraduate majors in biology; teach components of chemistry and biochemistry; and provide support for graduate and post-graduate education and research in biology, molecular biology, wildlife biology, physiology, genetics, and ecology.

IAB had total research expenditures of $20.1 million, up 78 percent from $11.3 million in FY02.[11] The majority (61 percent) of expenditures were for wages and benefits. Nearly one-third (30 percent) of expenditures were for commodities, services and equipment. The remaining 9 percent was spent on travel, land and buildings, student aid and miscellaneous items.

The total number of faculty, staff and graduate students involved in research at IAB was 134. There were 57 faculty and 77 staff and graduate positions (held by either post doctoral researchers, graduate researchers or undergraduate students).

IAB Faculty and Staff, 2007

	# of Faculty and Staff
IAB	105
AK Coop Fish/Wildlife Research Unit	24
Toolik Field Station	5
Total Staff	**134**

Major IAB Programs

Basic and applied research conducted at UAF has significant economic impact and quality of life benefits for Alaskans. Major research programs include the Toolik Field Station, Robert White Large Animal Research Station, Center for Alaska Native Health Research, Alaska Basic Neuroscience Program, Center for Molecular and Genetic Studies of Hibernation, Alaska Geobotany Center, the Resilience and Adaption Program, and Bonanza Creek Long-Term Ecological Research Program. Following are brief discussions of what these programs do and how they are relevant to Alaskans.

[11] Source: UA Unit Profile-UAF IAB. These figures do not include indirect cost recovery.

TOOLIK FIELD STATION (TFS)

IAB maintains the Toolik Field Station (TFS). TFS is a national and international Arctic climate change research center, primarily sponsored by the NSF. The facility is located 158 miles north of the Arctic Circle along the Dalton Highway. TFS has been operating for 30 years and is on the forefront of research on climate change that is gathered by over 300 scientists and students each year. Work at TFS will pay a key role in providing current and historic data that will help researchers, agencies, and industry to understand environmental changes in Arctic land and water based environments. Research based at TFS has been widely published in more than 225 journal articles (including *Nature* and *Science*), and portions of 47 books. The facility provides hands on research opportunities for under graduates, graduates and Alaska high school students.

ROBERT WHITE LARGE ANIMAL RESEARCH STATION (LARS)

LARS was created in 1979 and allows scientists and students hands-on opportunities to work with musk oxen, caribou and reindeer to better understand the nutritional, physiological and behavioral systems of these unique northern animals. The facility also provides educational opportunities for the general public and Alaskan schoolchildren from grade school through high school.

Basic and applied research conducted at UAF has significant economic impact and quality of life benefits for Alaskans. Major research programs include the Center for Alaska Native Health Research, Alaska Basic Neuroscience Program, Center for Molecular and Genetic studies of Hibernation, Alaska Geobotany Center, the Resilience and Adaption Program and Bonanza Creek Long-Term Ecological Research Program. Following are brief discussions of what these programs do and how they are relevant to Alaskans.

Monitoring Toxicants and Disease in Alaska

UAF researcher Todd O'Hara is studying contaminants and infectious disease in the Arctic. Infectious agents and toxicants can be easily transmitted through commercial, sport and subsistence harvest in Alaska. INBRE toxicology projects study animals that are at the top of the food chain such as arctic fox, polar bear and Stellar sea lions, and numerous subsistence foods.

What effect do toxicants have on animals and people? If diets change because of changing environmental conditions, will these animals be exposed to new or higher levels of toxicants and/or infectious agents? If so, how will this affect their health, as well as the health of Alaskans who rely on fish and game for food?

Another of O'Hara's roles is to study and understand how infectious diseases are present in Alaska and how they can be transmitted to the public via handling and consumption of fish and wildlife. For example, there have been periodic outbreaks of rabies in Arctic foxes on the North Slope; this is potentially hazardous to North Slope residents and oil field workers. The better these outbreaks are understood, the better the public can be educated about the associated risks, and measures that can be taken to avoid contact with these diseases.

CENTER FOR ALASKA NATIVE HEALTH RESEARCH (CANHR)

CANHR's mission is "to build and increase research capacity that will contribute knowledge to improve Alaska Native health." CANHR has been funded by two, 5-year, $11 million capacity-building grants (COBRE I and II). The center began operations in 2001 and was again funded in 2007. The primary focus of research at the center is obesity and its relationship to diabetes and cardiovascular disease among Alaska Natives. CANHR seeks new knowledge through basic and applied research that can ultimately be applied to understand, reduce and prevent health disparities in Alaska's Native communities.

CAHNR partners with the Yukon-Kuskokwim Health Corporation and communities in Southwest Alaska, and uses a collaborative approach that incorporates local knowledge and culture into the process of scientific investigation. By working closely with community members, local residents become part of the research process and can help to guide research and facilitate results that are culturally appropriate.

CANHR travels to communities with a team of three to four including researchers, nurses, technicians and other support staff. CANHR makes significant research expenditures in rural Alaska on travel, rent, food, fuel and supplies. They employ local workers to assist on projects as much as possible.

The following projects are an example of how CAHNR research can result in a better quality of life for Alaskans.

UAF Research into Contaminants and Nutrients in Alaska Subsistence Foods

Todd O'Hara is a UAF researcher that conducts studies for both INBRE and CANHR. His INBRE research involves microbial agents (human and wildlife diseases that can be transferred between the two) and toxicants, while his CANHR projects focus on the study of nutrients and toxicants related to human health issues that directly affect Alaskans. All of the toxicants that O'Hara studies as part of his INBRE projects end up in the food chain, such as mercury, PCB's, DDT, lead, arsenic and many other pesticides. As these toxicants work their way up the food chain, they are easily transmitted to humans through commercial, sport and subsistence harvest in Alaska, and can eventually impact human health.

UAF laboratories measure toxicants in subsistence foods such as salmon, seals, and reindeer and study how their use affects humans. This research project also measures nutrient levels in these traditional foods. O'Hara and his CANHR team study the effects that preparation methods can have on concentrations of toxicants and nutrients in food from these Alaskan animals. Contaminant and nutrient levels in foods that are dried, smoked, baked or rendered may change, becoming more or less concentrated. CANHR scientists measure levels of these contaminants to see how various preservation techniques may affect toxicity and critical nutrients. Certain preservation methods can neutralize toxicants and/or impact the nutrients available. This research is very relevant to the health of all Alaskans who consume fish and game.

From an economic standpoint, Alaska needs to be vigilant in protecting the pristine image of our valuable commercial marine resources. For example, the level of contaminants in some fish from around the world has made news in recent years. Alaska needs to be watchful that our species are not caught up in negative publicity. While there may be concerns about contaminants in farm-raised salmon, wild Alaskan salmon are

low in contaminants. Just as important, spreading the message about the nutritional value of Alaskan fish is good for Alaska and the state's economy.

UAF Research into Measuring Alaskan Subsistence Diets

Bert Boyer is a researcher with CANHR studying how diet interacts with genes to predispose people, particularly Yup'ik Eskimos, to obesity. He suspected that the Yup'ik diet, rich in polyunsaturated fatty acids found in salmon and marine mammals, might protect them from diabetes but was frustrated by the difficulty in quantifying what Yukon-Kuskokwim Delta Yup'iks were eating regularly through self-reported diet surveys and questionnaires.

He shared his concern with Diane O'Brien, a new faculty member at UAF who was not yet a part of CANHR. She suggested it is possible to measure PUFAs indirectly by using isotopic signatures that are unique to fish and marine mammals and found in human blood, fingernails or hair. Such analyses are fairly cheap, easy to do and very accurate. That idea resonated with Boyer, and testing her assumption became part of the CANHR II study. She has since proven that these cheap, easily measured markers are highly accurate proxies for polyunsaturated fatty acids in the diet in a study to be published in March.

O'Brien's isotopic work is important on two fronts. First, it will help CANHR researchers understand the relationships between a changing diet and obesity in Alaska Natives, which is a growing public health problem for Alaska; and secondly, it will develop better methods for any researcher who needs diet assessments for a wide range of medical issues."

Alaska Basic Neuroscience Program

The Alaska Basic Neuroscience Program (ABNP) strives to expand and stimulate basic neuroscience research (scientific study of the nervous system) with a focus on protection of the nervous system, including the brain, from disease such as stroke or physical injury. ABNP scientists also study sudden infant death syndrome (SIDS), a particular risk for Alaska infants, by studying how breathing is controlled.

ABNP is supported by an NIH capacity-building grant from the Specialized Neuroscience Research Program (SNRP). The first NIH $7.8 million grant was for 2000 to 2006, and the current grant (2006 to 2011) is for $6.3 million. Other program supporters include National Institute of Mental Health (NIMH) and National Center for Research Resources (NCRR). The following projects are an example of how ABNP research can result in a better quality of life for Alaskans.

UAF Sudden Infant Death Syndrome (SIDS) Research

SIDS is a leading cause of death in the US for infants one month to one year old. The national rate of SIDS deaths is about 0.6 (less than one) per 1,000 births. Alaskan babies born in the Caucasian population die of SIDS at more than twice the national rate (1.6 per 1,000), and babies born to Alaska Natives die of SIDS at more than five times the national average at 3.6 per 1,000 births.

In order to put Alaska SIDS death rates in perspective, consider a comparison with some of the most dangerous occupations in the world. Alaska is seen as a dangerous place to work. Commercial logging, commercial fishing and flying are considered by most as high risk occupations. For the 1990's Alaska workers

had a death rate of .22 per 1,000 (less than one-quarter person per 1,000). When you compare this death rate with the incidence of SIDs for approximately the same period, rates of SIDS death among Caucasians in Alaska were seven times higher than rates of worker deaths, and 16 time higher among Alaska Natives. By far, the most dangerous occupation in Alaska is being an infant. It is a dangerous place to be born and researchers don't know why. SIDS research done outside the state of Alaska will not address why Alaskan rates are so much higher than the national average. Alaskans need to take ownership of this problem. ABNP researcher Michael Harris and his team are working to understand vulnerability by looking at genetics, biology and behavior, with a goal to prevent the occurrence of SIDS in Alaskan babies.

A normal response in babies is to wake up when breathing is hindered, for example from sleeping on their stomach. The sequence is to wake up, move their head and enhance breathing (three separate reflexes.) If any one of the reflexes does not work, a relatively common occurrence, sleeping with a face in the bedding, can become a life threatening situation. One theory is that a serotonin deficiency may lead to greater vulnerability to SIDS by disrupting reflexes such as these. UAF researcher Michael Harris and his team want to know if there is anything about serotonin that can be linked to important reflex functions. They are conducting basic research at the molecular level. If a connection can be made between serotonin dysfunction and vulnerability to SIDS, then pharmacological solutions can be developed.

In order to understand how SIDS works, researchers must first identify not only the causes of increased vulnerability, but also the symptoms associated with vulnerability. If researchers can understand such symptoms then they can more readily identify which infants may be vulnerable. If simple screening tools can be developed to indentify infants at risk of SIDS ahead of time this would help save lives and facilitate further research. For example, if doctors or parents knew a particular infant had symptoms that indicated vulnerability to SIDS, in cases such as failed reflexes, steps could be taken to supplement the reflex or avoid the potentially life threatening situations. This would lead to fewer deaths. One of ABNP's current projects involves trying to develop a non-invasive screening tool that could help predict vulnerability for SIDS. The results of this research could help save lives and reduce the number of Alaskan infants that die of SIDS.

Another UAF SIDS related research project is lead by Barbara Taylor and her team. They are looking at the effects of exposure to alcohol and nicotine in animal models, that can explain why exposure to these substances in infants and unborn babies are risk factor contributing to SIDS vulnerability. Their research is trying to determine if alcohol and nicotine exposure affects the central nervous system and sensitivity to low oxygen or carbon dioxide. Basic animal research shows that exposure does have an impact. Once you have determined that there is an impact you investigate at a cellular level to understand the problem and then find solutions.

Center for Molecular and Genetic Studies of Hibernation

Scientists at the Center for Molecular and Genetic Studies of Hibernation investigate the molecular and genetic basis of hibernation in mammals, focusing on development of potential new therapies and drugs to protect and treat victims of stroke, heart attack, and severe trauma. The project has been funded by the National Science Foundation and the United States Army Medical Research and Materiel Command since 2005. Grant and non-restricted spending for this program is about $5 million to date.

Hibernation Science

Alaskan animals, like the arctic ground squirrel and black bear, spend each winter in a state of hibernation during which their need for food and water is reduced to zero for six to eight months at a time. During hibernation, these animals are also resistant to harm from low blood pressure and the minimal availability of oxygen and blood sugar. Ground squirrels actually spend part of their time in hibernation with their body temperature below freezing with no ill effect.

UAF researchers Brian Barnes, Kelly Drew and their team are trying to develop an understanding of the molecular and biochemical mechanisms that slow body function and protect hibernators, which could lead to the development of new drugs that lessen the harm from stroke, heart attack and injuries such as gunshot and head trauma.

Over 160,000 people die of stroke each year in the US (an age-adjusted rate of about 47 people per 100,000; in Alaska the age-adjusted rate for stroke is even higher, at 53 per 100,000).[12] In 2004, 858 Alaskans died from either heart disease or a stoke.[13] Essential for patient recovery from these dangerous events is to stabilize them as quickly as possible, until advanced medical care is available. If researchers can determine how mechanisms that allow hibernating animals to slow body function work, there is potential for new therapies and drugs that, when administered to humans, would quickly slow body function (including the onset of damage) and could allow first responders to stabilize patients with life-threatening conditions.

This research could lead to increasing the time that sick and injured patients have to get to a critical care facility, increasing their chances of recovery. This could be especially important in Alaska where many residents are injured in remote vehicle, ATV and snow machine accidents, or work in remote locations in the timber, fishing, oil, gas and mining industries and are hours or even days away from a critical care facility. The US Army has been financially supportive of this cutting edge research at UAF because of the potential for stabilizing seriously injured soldiers.

This type of research is an excellent example of place-based research that has significant potential to benefit Alaska and the nation. UAF's northern Alaska location and proximity to ground squirrels and bears allows researchers to study and closely monitor the animals while attempting to unlock the biological keys to slowing body functions.

Bonanza Creek Long-Term Ecological Research Program

Bonanza Creek Research focuses on improving prediction and understanding of the long-term consequences of changing climate and disturbances such as fire, insects, pathogen outbreaks, and permafrost thaw in Alaska's boreal forests.

The boreal forest is considered the second largest terrestrial ecosystem in the world, after tropical forests. The boreal forest comprises one of the world's largest carbon reservoirs. Changes or disturbances in the volume and distribution of coniferous versus deciduous boreal forests are known to affect regional and global climate.

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[12] Center for Disease Control (CDC) National Center for Health Statistics and National Vital Statistics Reports

[13] The Burden of Heart Disease and Stroke in Alaska: *Mortality, Morbidity, and Risk Factors* http://www.hss.state.ak.us/dph/chronic/chp/pubs/burden_july06.pdf

The program's objectives are to study factors like fires, melting permafrost and insects that might result in serious changes in the Arctic environment and to identify human and environmental factors that may reduce stresses on ecosystem structure and function that could otherwise lead to serious changes. For example, as the Arctic climate changes (warms), forests are more susceptible and less resistant to insect and pathogen attack. Research is conducted at two main sites: the Bonanza Creek Experimental Forest and Caribou-Poker Creeks Research Watershed.

Changes in the Arctic could have serious implications for Alaskans who rely upon animals and plants for food, soil stability (for houses, roads), water patterns and filtering (streams, rivers, wells), forest productivity (timber), and for recreational opportunities (skiing, snowmachining, camping, hunting, fishing).

Information gathered at Bonanza Creek is used by agencies such as the Alaska Fire Service and the Alaska Department of Fish and Game. For example, the Alaska Department of Fish and Game may use background data from Bonanza Creek to better understand how moose and caribou populations may be affected in fire-damaged areas in order to meet population and harvest goals.

The Bureau of Land Management Alaska Fire Service (AFS) located at Fort Wainwright, Alaska, provides fire suppression services for all Department of the Interior and Native Corporation lands in Alaska. In addition to fire suppression, AFS has other statewide responsibilities, including interpretation of fire management policy. AFS operates on an interagency basis; cooperators include the Bureau of Land Management, State of Alaska Department of Natural Resources, USDA Forest Service, National Park Service, Bureau of Indian Affairs, U.S. Fish and Wildlife Service, and the U.S. Military in Alaska.[14]

The Bonanza Creek Program has received $2.6 million to date from the National Science Foundation and supports 25 large scale research projects. In addition to principal investigator Terry Chapin and co-principal investigators Roger Ruess and David McGuire, the program is staffed by 23 senior investigators, 57 affiliated scientists, 16 master's degree students, ten Ph.D. students, one post-doctoral research associate, one data manager, one site manager, and eight technicians.

Resilience and Adaption Program

The Resilience and Adaptation Program (RAP) explores the links among cultural, economic, and ecological conditions of Alaska and the North, and provides training that prepares scholars, policy-makers, and managers to address issues of sustainability. Alaska and the Circumpolar North are appropriate places to train researchers in the dynamics of social-ecological systems because of climatic, cultural and socio-economic change. This program places special emphasis on training Alaska Native Ph.D.s who are needed as university faculty, researchers, educators, and community leaders.

Students work with UAF faculty on a broad range of interdisciplinary research projects at community, regional, and circumpolar levels. RAP offers master's and Ph.D. degrees in Biology and Wildlife, Anthropology, Resource Economics, Natural Resource Management, Northern Studies, and Interdisciplinary Studies.

RAP has received nearly $1.3 million to date from the National Science Foundation's Integrative Graduate Education and Research Traineeship Program.

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[14] Alaska Fire Service website 2/10/2009 http://fire.ak.blm.gov/afs/

Alaska Geobotany Center

The Alaska Geobotany Center (AGC) is dedicated to understanding northern ecosystems through the use of geographic information systems (GIS), remote sensing, field experiments, and cooperative team research projects. AGC documents changes in vegetation across the circumpolar Arctic and is a critical component to the understanding of permafrost, carbon reserves, water systems, wildlife populations, and the ability of humans, plants, and animals to live in the Arctic. Researchers examine landscape patterns including vegetation, snow ecology, and the disturbance and recovery of plants. This information is used by resource managers, land-use planners, ecosystem scientists, and government land agencies. These mapping resources are valuable to wildlife biologists, fire managers and timber managers in Alaska.

AGC projects collectively known as "Greening of the Arctic" include:

- **Arctic Systems Science**: Addresses the question of how vegetation of the Arctic has responded to climate change.
- **Land Cover and Land Use Change**: Addresses how the decline in Arctic sea ice will affect, and is affected by, the greening of vegetation in the Arctic.
- **Arctic Geobotanical Atlas**: Education and outreach component comprised of a Web-based, multi-scale collection of geobotanical maps and related data.
- **North American Arctic Transect**: Creates baseline information on Arctic vegetation.
- **Circumpolar Arctic Vegetation Map**: International project that mapped the vegetation and associated characteristics of the circumpolar region using a common base map.

The ACG has $755,534 in current funding from NASA and is expected to confirm receipt of approximately $950,000 in additional NASA funding in the first quarter of 2009.

Idea Network of Biomedical Research Excellence (INBRE)

Another major life sciences unit at UAF is INBRE. INBRE is supported by a national program of capacity-building grants from the National Institute of Health designed to increase capacity for high quality research. INBRE uses expertise in biology to investigate organisms that cause disease and toxic substances in the environment. INBRE operates independently from the Institute of Arctic Biology.

An additional mission of INBRE is outreach and support for students (high school and college) who show interest in life sciences research.

INBRE receives approximately $3.5 million in annual grant revenue with approximately $1.8 million in research expenditures (not including ICR contributions). Wages and benefits made up the greatest portion of expenditures (39 percent). Additionally, significant expenditures were made for commodities, contract services and equipment (32 percent). Travel expenditures accounted for 13 percent of INBRE's research expenses.

INBRE supports research at UAF, UAA and UAS. There are a total of approximately eight faculty and graduate students and four and a half staff positions.

INBRE Faculty and Staff, 2007

	# of Faculty	# of Grad Students	# of Staff
UAF	4	6	4
UAA*	3	2	0.5
UAS	1	0	0
Total INBRE staff	**8**	**8**	**4.5**

*The staff position is less than one full-time equivalent.

The following projects highlight the valuable contributions INBRE research is making to the state of Alaska.

UAF Bird Flu Research

To better understand avian flu research at UAF, following is a brief summary of the current status of avian flu. According to the Center for Disease Control and Prevention,

> *Avian influenza is an infection caused by avian (bird) influenza (flu) viruses. These influenza viruses occur naturally among birds. Wild birds worldwide carry the viruses in their intestines, but usually do not get sick from them. However, avian influenza is very contagious among birds and can make some domesticated birds, including chickens, ducks, and turkeys, very sick and kill them.*
>
> *Usually, avian influenza virus refers to influenza A viruses found chiefly in birds, but infections with these viruses can occur in humans. The risk from avian influenza is generally low for most people because the viruses do not usually infect humans. However, confirmed cases of human infection from several subtypes of avian influenza infection have been reported since 1997. Most cases of avian influenza infection in humans have resulted from contact with infected poultry (e.g., domesticated chicken, ducks, and turkeys) or surfaces contaminated with secretions/excretions from infected birds. The spread of avian influenza viruses from one ill person to another has been reported very rarely, and has been limited. However, (A) viruses are constantly changing, and they might adapt over time to infect and spread among humans.*
>
> *Influenza A H5N1 is an influenza A virus subtype that occurs mainly in birds, is highly contagious among birds, and can be deadly to them. H5N1 virus does not usually infect people, but infections have occurred in humans. Most recently, outbreaks of highly pathogenic avian influenza A (H5N1) among poultry have been associated with illness and death in humans in Asia, Africa, Europe, the Pacific, and the Near East. In the United States, from 1997 to 2005, there were 16 outbreaks of low pathogenic avian influenza A viruses (H5 and H7 subtype) and one outbreak of highly pathogenic avian influenza A (H5N2) in poultry.*
>
> *The highly pathogenic avian influenza A H5N1 animal outbreak in Asia, Europe, the Near East, and Africa is not expected to diminish significantly in the short term. It is likely that H5N1 virus infections among domestic poultry have become endemic in certain areas and that sporadic human infections resulting from direct contact with infected poultry and/or wild birds will continue to occur. So far, the spread of H5N1 virus from person-to-person has been very rare, limited and unsustained. However, this epizootic (transferrable from animals to humans) continues to pose an important public health threat.*[15]

[15] Center for Disease Control and Prevention website 2/6/2009. http://www.cdc.gov/flu/avian/outbreaks/

UAF researcher Jon Runstadler and his team have been researching biological mechanisms in birds (mostly ducks). How are the viruses transferred among birds? How are they transferred to humans? What are the risks to human health in Alaska?

The migration routes of many species of ducks cross paths where Alaska and Asia meet over the Bering Sea. There is potential for Asian ducks to spread H5N1 bird flu to Alaska and other parts of North America. If the highly pathogenic H5N1 were to occur in Alaska, there could be serious implications for the health of Alaskans.

The ability to work with Mark Lindberg, a UAF wildlife biologist specializing in ducks, facilitates Rundstadler's work because Lindberg has intimate knowledge of the life-cycle of ducks in Alaska. His knowledge of migration patterns also allows researchers to know when and where to intercept wild birds so that they can be monitored for various strains of avian flu.

Because of the capacity built by INBRE, Runstadler's team was able to acquire an NIH RO1 grant for the Center for Rapid Influenza Surveillance and Research (CRISAR). Awarded in 2007, this five-year, $3.8 million grant is a joint UAF, UCLA and UC Davis research project. This competitively funded research is a result of the capacity that was built from INBRE funding. The research involves surveillance and monitoring of birds in the US, Russia, Japan, China and Southeast Asia to see were there may be a potential threat of an outbreak of bird flu. The study looks at how the virus is carried and transferred as birds migrate around the Pacific Rim.

Monitoring Toxicants and Disease in Alaskan

UAF researcher Todd O'Hara and his team are studying contaminants, and infectious disease in the Arctic. What affect do they have on animals and people? Infectious agents and toxicants can be easily transmitted through commercial, sport and subsistence harvest in Alaska. O'Hara and his team study toxicants that can end up in the food chain, such as mercury, PCB's DDT, lead, and other pesticides. These contaminants can work their way up the food chain and eventually impact human and wildlife health. INBRE toxicology projects study animals that are at the top of the food chain such as arctic fox, polar bear and Stellar sea lions, and numerous subsistence foods.

INBRE investigator O'Hara has reported on how climate change may affect the distribution and accumulation of toxicants and infectious agents. There have been changes in the Arctic climate, and researchers are monitoring how changes may affect what Alaskan fish and animals eat. If diets change because of changing environmental conditions, will these animals be exposed to new or higher levels of toxicants and/or infectious agents? If so, how will this affect their health as well as the health of Alaskans who rely on fish and game for food?

Another of O'Hara's roles is to study and understand how infectious diseases are present in Alaska, and how they can be transmitted to the public via handling and consumption of fish and wildlife. For example, there have been periodic outbreaks of rabies in Arctic foxes on the North Slope; this is potentially hazardous to North Slope residents and oil field workers. When INBRE monitoring efforts find potentially harmful diseases such as rabies, they are reported to state epidemiology officials and the Center for Disease Control (CDC) via the appropriate management agencies (such as the Alaska Department of Fish and Game). The better these

outbreaks are understood, the better the public can be educated about the associated dangers, and the measures that can be taken to avoid contact with the diseases.

INBRE Outreach Sparks Excitement about Science

According to INBRE outreach coordinator Sue Hills, their goal is to get students (especially Alaskans) in the "pipeline" that leads to careers in health and science. The earlier they can get students involved in science the greater the potential that students will go on to study science and to make a career in science or health related fields. There is an acute shortage of qualified health care workers and scientists in Alaska. Students who have been involved in the program stay in school, and a high percentage have gone on to college, many in science and health. Many have returned to Alaska.

According to Hills, "if UAF can help get students interested in science and health care early on and provide them with some of the tools that will help them continue their education, we feel we can have a positive impact on filling health care and other science-related positions in Alaska with Alaskans."

INBRE has several programs designed to engage students in the sciences.

Alaska Rural Research Partnership (ARRP)

ARRP involves Alaskan high school students in scientific research in their own villages and encourages them to consider science and health care careers. The goal is to bring meaningful, hands-on science to rural schools using modern molecular biology. ARRP students study genetics of the animals that Native and rural children eat. Students are encouraged to graduate high school and go on to college (hopefully pursuing careers in the sciences).

Nearly 60 students, at six sites, from 11 villages, have been involved in ARRP. The students have looked at genes in caribou, reindeer, whales, and salmon. Students have also determined gender in humpback whales, investigated soil bacteria and parasites using genetics.

ARRP loans about $10,000 worth of lab equipment to each partner school, and provides chemical supplies, genetics training for teachers and students, and technical support. The school supplies students, teachers, and a small lab area. Students work during free periods or before or after regular school hours. ARRP sets up a complete genetics lab in the schools with equipment similar to what you would find in a UAF lab, such as a centrifuge (used to isolate DNA samples), a thermal cycler, a PCR (polymerase chain reaction) machine, pipettes, racks and other equipment. Students participate in either the Alaska Science Symposium or the Alaska State Science Fair. The presentations give them experience in critical thinking, scientific writing, and public speaking. Students have competed in local, regional and even national science fairs. Each student completing the project is awarded up to $1,500 as a scholarship to the college of their choice.

ARRP has been very successful. Of the approximately 115 ARRP students, most are Alaska Native. All participants have gone on to graduate from high school. Seventy-five percent of those graduates went on to attend college. To date, most have either graduated from college, or they are still attending school. Many of them are in science and health-related fields.

Alaska Summer Research Academy (ASRA)

The course was started in 2004 by a nurse at Fairbanks Memorial Hospital (FMH) in response to the serious shortage of nurses in Alaska. UAF and FMH teamed up in 2007. During two-week modules, students are exposed to several areas of health care services including handling traumas, x-rays, pharmacy, and operating room procedures. Learning about health care fields gives them an opportunity to think about careers in specific areas while they are still in high school and have time to adequately prepare academically for these challenging careers. The program has created a great deal of excitement; in 2008 there were more applications than spots available. ASRSA is a life-changing experience for many students.

The hospital is going to track students after they graduate high school (the first group graduated in 2008) to see if they continue in health and science-related careers. The hope is that some of them will take health care and science jobs in Alaska when they finish their education and help reduce the significant need for health care professionals in the State. ASRA is currently offered at four schools and will be adding four more schools each year, for the next five years.

Rural Alaska Honors Institute (RAHI)

RAHI was started in 1982. The program brings honors level students from rural communities, as well as Alaska Native honors students from semi-urban areas, to the UAF campus for six weeks. The focus is on math, English, and various science classes. Students who graduate earn between seven and 11 college credits.

RAHI II the Next Step started in 2007 with about a half-dozen students. RAHI students are introduced to more hands-on laboratory techniques, and they participate in real research side-by-side with top UAF scientists. The students take part in top-level experiments. They work with the same high-tech, expensive equipment that graduate students, PhD candidates and the researchers do. Students also earn college credits for their work.

UAF Student Support

Many undergraduate students are not sure if they want to go into a science or health-related degree program. INBRE helps them gain exposure to science in the labs. This helps them understand why they are taking calculus, chemistry, etc. They become comfortable with faculty and staff, and with basic lab procedures. The hands-on lab work and their personal contact makes them feel more comfortable when they are deciding whether to pursue science beyond the undergraduate level. INBRE also helps UAF students interested in medicine apply for the University of Washington's WWAMI program which is administrated through UAA. There are 20 scholarships available and nearly 100 UAF students who apply annually.

WWAMI is a partnership between the University of Washington School Of Medicine and the states of Wyoming, Alaska, Montana, and Idaho. The WWAMI program's purpose is to provide access to publicly-supported medical education across the five-state region. Each of the participating states designates a specific number of medical school seats. These are supported through a combination of appropriated State funds and student tuition which cover the full cost of medical education. The tuition paid by students in Wyoming, Alaska, Montana and Idaho is the same as that paid by Washington state residents. This allows for publicly supported medical education in states where no freestanding medical school exists.

Outcomes of the program at the University of Washington School of Medicine and WWAMI indicate that, over 30 years, 61 percent of graduating students stay within the five-state area to practice. Over the past 20 years, nearly 50 percent of graduating students have chosen to pursue careers in primary care. This is particularly important since 35 percent of the population in the WWAMI region lives in rural, generally underserved areas. Upon graduation, an estimated 20 percent of WWAMI graduates will practice in Health Professional Shortage Areas (HPSAs) following graduate medical education.[16]

[16] University of Washington Medicine website 2/7/2009 http://uwmedicine.washington.edu/Education/WWAMI/

Life Sciences Academic Programs

Life Sciences Programs

Through the Department of Wildlife and Biology in the College of Natural Sciences and Math UAF offers undergraduate and graduate programs in biology, botany, wildlife biology, chemistry, biochemistry, molecular chemistry, environmental chemistry, fisheries, marine biology, ocean fisheries, natural resources and agricultural sciences. A wide range of classes are offered in life sciences including: ecology, conservation biology, and environmental sciences; wildlife biology; zoology, animal physiology and animal behavior; plant biology; marine biology; cell and molecular biology; and genetics and evolutionary biology. There are a substantial number of students not pursuing a life sciences degree who enroll in Life Sciences courses for other reasons, including fulfillment of Core curriculum requirements.

This wide range of programs offers exceptional opportunities for Alaskans to engage in education that could lead to careers with policy-making agencies that are essential to our state such as the Alaska Department of Fish and Game, US Fish and Wildlife Service and the Nation Park Service.

When top researchers are attracted to UAF, they not only bring their research skills but also increase the number and quality of classes that can be offered at UAF. Additionally, the availability of high-quality research options provides critical hands-on experience for students to apply their academics. UAF must have high quality facilities for research and teaching to attract the best scientists to the campus. One example is Karsten Hueffer and assistant professor of microbiology. Hueffer came to UAF as a part of INBRE's capacity-building grants. Since arriving at UAF, Hueffer has added one class in infectious disease and another in virology. The availability of specific classes like these, taught by skilled scientists, benefits a range of students from those in pre-health to those looking for careers in research.

Enrollment

Total enrollment in UAF life sciences classes is nearly 1,200 students. UAF life sciences programs, most specifically biology, have seen the greatest increase in enrollments at UAF in recent years.

- With nearly 500 degree-seeking students, UAF biology and wildlife programs are among the largest degree programs in the entire UA system.
- The largest undergraduate enrollment increases at UAF have been in biology and wildlife, with an increase of 25 percent from 303 to 380 over a ten-year period (1998 to 2007). Total undergraduate enrollment in life sciences increased by 8 percent, from 473 to 513.
- There were just over 300 graduate students enrolled in life sciences programs. The largest increase over the ten-year period was in biology and wildlife, with a 48 percent increase from 76 to 119 enrollments.
- Undergraduate enrollment in biological sciences increased by 26 percent, from 217 in 1998 to 275 in 2007. Graduate enrollment in biological sciences increased by 170 percent, from 20 in 1998 to 54 in 2007.

Alaskan Graduates Benefit Alaska

Producing workers who have the skills needed by Alaskan businesses, government and agencies is a crucial contribution of UA to the economy of Alaska. In addition to providing the skills and services needed by the state, UA graduates also contribute to the Alaskan economy at a higher level than non-graduates (on average, university graduates earn substantially more over their lifetime than non-graduates).

Alaskan graduates tend to live and work in Alaska, helping the economy grow, and serving state residents. While there has not been a specific study of UAF life sciences program graduates, there are several indicators of the value these graduates offer to the state of Alaska and its residents.

A McDowell Group study of UA graduates[17] showed that in 2006, two-thirds of UAF graduates (from 1989 to 2006) were still living in the state of Alaska, and 54 percent were known to be working in the state. (Note: Employment information was based on private sector, state and local government employment. Graduates working for the federal government or the self employed were not counted. Therefore, it is likely that more than 54 percent are working in Alaska.) Rural Alaskan graduates have an even higher likelihood of staying in the state after graduation.

As of 2005, nearly three-quarters (73 percent) of the UAF graduates still living in Alaska worked in a field related to their UAF education. This high retention rate is an important element in creating economic growth within the state.

UAF Graduate Careers

The tables on the following pages show a sample of some of the agencies and businesses where UAF life sciences program graduates have been employed. The tables of employers and positions were compiled informally in October 2008 by UAF faculty for UAF masters and PhD graduates. The tables do not represent all UAF graduates, undergraduates or transfers. While not complete, the tables show the variety of important positions that UAF life sciences graduates have filled. Many of these positions have direct influence on issues that affect all Alaskans.

[17] McDowell Group, *The Economic Impacts of University of Alaska, 2007 Update* pg 53.

It is of particular importance to Alaskans that decision-makers in areas such wildlife biology and fisheries understand Alaska and our unique environment. It is clearly preferable to have a UAF graduate making decisions about how and when Alaskans are able to harvest moose or salmon, rather than a biologist trained in the lower 48.

UAF Graduate Careers in Alaska

Employer	Position
ABR Environmental Research Services, Fairbanks	Senior wildlife biologist
Alaska Biological Research	Biological technician
Alaska Center for Coastal Studies, Homer	Director of Programs
Alaska Department of Fish and Game, Anchorage	Area wildlife biologist, assistant area biologist, wildlife biologist, research biologist, fisheries biologist, non-game biologist, statistician, wildlife technician
Alaska Department of Natural Resources, Fairbanks	Natural resource specialist
Alaska Sea Life Center	Research biologist
Fairbanks Christian School	Science teacher
Fairbanks North Star Borough School District	Develop curricula on invasive plants
Flint Hills, Fairbanks	Chemical technician
Hart-Crowser, Inc., Anchorage	Wildlife biologist
Juneau School District	K-12 Teacher
National Park Service, Gates of the Arctic	Research biologist
National Park Service, Denali	Ecologist
National Park Service, Glacier Bay	Research scientist
National Park Service, Wrangell-St. Elias	Biological science technician
Nature Conservancy, Anchorage	Biologist
North Pacific Halibut Commission	Research biologist, analyst,
Petersburg High School	Biology teacher
Providence Hospital	Resident, family medicine
Scenarios Network for Alaska Planning (SNAP)	Network coordinator
School of Fisheries and Ocean Sciences, UAF, Fairbanks	Assistant professor of Marine Mammalogy
US Bureau of Land Management, Glennallen	Wildlife biologist
US Fish and Wildlife Service, Anchorage and Tetlin	Wildlife biologist
US Fish and Wildlife Service, Environmental Contaminants, Fairbanks	Biologist
US Fish and Wildlife Service, Migratory Bird Management, Anchorage	Pilot-biologist
US Forest Service	Research technician, staff scientist
US Forest Service, Petersburg	Botanist
US Forest Service, Yakutat	District forester
US Geological Survey, Alaska Science Center, Anchorage	Research biologist, wildlife biologist, research geneticist

Many UAF life sciences graduates hold key positions in national and international organizations, agencies and schools such as those listed below.

UAF Graduate Careers Outside Alaska

Employer	Position
Ducks Unlimited	Biologist
Middlebury College	Affiliate Faculty
National Park Service	Research Technician, data manager
National Park Service, Painted Rocks, Michigan	Research Biologist
NOAA, National Marine Fisheries Service, CA	Analysis Specialist
Olympics National Park	Staff Scientist
Sierra Nevada Aquatic Research Laboratory, CA	Aquatic Biologist
State University of New York (SUNY) Syracuse	Assistant Professor
Syracuse University, New York	Assistant Professor
University of Oklahoma	Affiliate Assistant Professor
University of Puerto Rico	Assistant Professor
Utah Department of Natural Resources, Provo, UT	Endangered Species Specialist
Yukon Flats NWR	Biologist
Yukon Government	Caribou Biologist
Yukon River Intertribal Watershed Council	Water-quality Monitoring Technician
Yukon River Intertribal Watershed Council	Science, Research, and Mapping Technician
Zymogenetics, Inc., WA	Scientist

Benefits of a New UAF Life Sciences Building

Research Space

There is a current lack of space for researchers at UAF, and many of the facilities are not comparable to high quality labs at competing universities. High-quality research facilities (labs and equipment) are required to attract the caliber of researchers needed to enhance and expand current UAF programs. A new life sciences building will greatly increase UAF's ability to attract high-quality researchers. Adding these talented researchers will also facilitate additional staff positions for post graduates, post doctorates and lab technicians.

Academics

At UAF there is a serious need for modern classrooms that are appropriate for teaching modern science in fields such as marine biology, cell and molecular biology, and genetics. Most of the current science class rooms and laboratories were built in the 1960s. Some Alaska high schools like West Valley and Barrow have newer lab facilities for teaching than those currently available at UAF.

The Need for a New Life Sciences Facility

BIOS

The original solution to the academic and research space problem at UAF was the Biological Sciences Facility (BIOS). The BIOS facility was originally proposed in FY08 with a total square footage of 110,000 square feet. The plan called for 40,000 square feet of teaching space and 70,000 square feet of research space. The cost of the facility in FY08 was $105 million. The $105 million capital budget request was not funded by the legislature in FY08. In FY09, inflation had increased the cost of the facility to $113 million. The $113 million request was not approved in FY09.

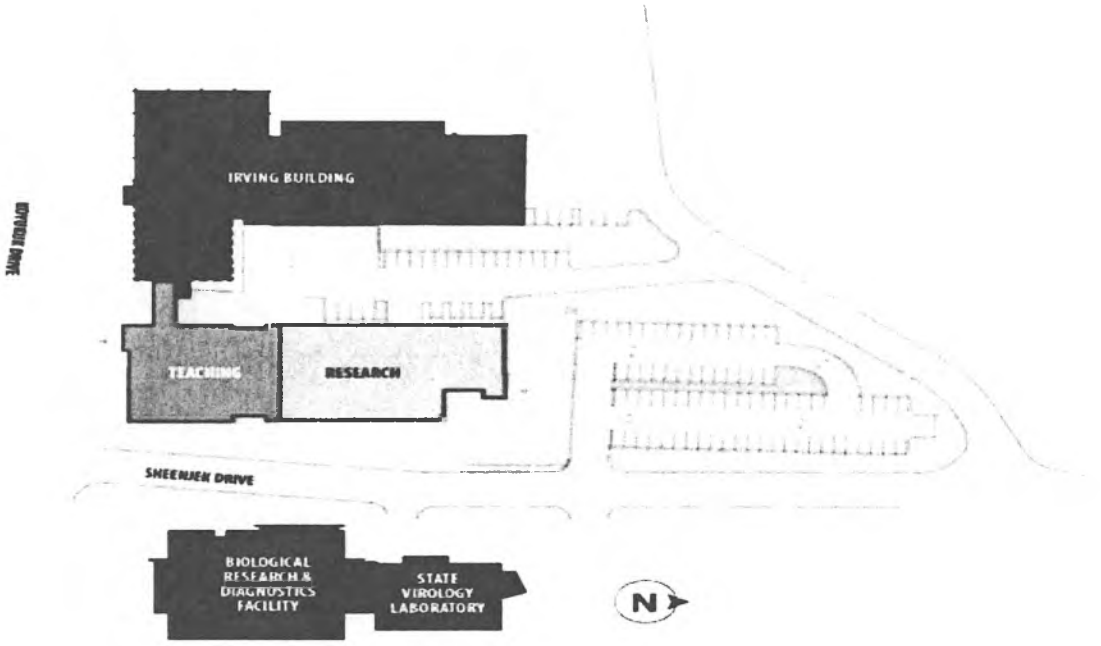
UAF Life Sciences Innovation and Learning Facility

The Life Sciences facility is the UA Board of Regents' number one new capital priority for the UA system. Because of the desperate and immediate need for a new life sciences facility, the UAF project team felt that in order to increase the likelihood of funding for a building, the facility plan should be redesigned to reduce the overall cost, and additional funding should be provided by UAF. The new facility was named the UAF Life Sciences Innovation and Learning Facility and scaled down from 110,000 to 87,000 square feet. The total cost of the new project is $102.8 million. UAF committed to non-General Fund support for 20 percent of the new facility. The FY10 capital budget requests General Funds of $82.2 million with non-General Fund support from UAF of $20.6 million for the Life Sciences facility.

The Life Sciences Innovation and Learning facility is designed to meet the critical need for updated classrooms (both instructional space and lab space) and provide much-needed space that will allow UAF's research programs to continue to grow. The facility will feature 37,000 square feet of academic space, including

approximately 40 classrooms with computer and lab capabilities and a lecture hall capable of seating 80 students. The research space, at 50,000 square feet, will provide 18 research labs and 10 support labs. Additionally, there will be lab space for 12 primary investigators, 36 graduate students and 12 post doctoral researchers.

Life sciences Innovation and Learning Facility Proposed Location



The facility is designed to be constructed in two phases. (The preferred solution is to complete the entire facility in one phase, but it can be completed in two phases if necessary.) The research portion would be constructed first. This would allow for continued growth in research revenues that are critical to UAF and the entire UA system while additional funding is sought to complete the academic portion of the building.

Interaction

As UAF works to transition from their life sciences capacity-building grant programs to seek more competitive grants, they must develop a critical mass of qualified researchers. If additional top-notch scientists can be attracted to UAF, they will in turn attract high quality research staff and students. This critical mass is important to create an atmosphere that enhances teaching and research, and stimulates intellectual growth among faculty and students. It is critical to get Alaskan students excited about research in science and health-related subjects because it will make them much more likely to stay in Alaska.

Because UAF is a small campus with exceptional scientists, undergraduates have the opportunity to work closely with them. Undergraduates actively participate in research at UAF, and their work has even been published alongside top researchers. Students usually do not find these types of opportunities on larger campuses.

Currently biology and other life sciences classes are spread all over campus (mostly away from the building where research is conducted), making logistics difficult for students and faculty – especially when there is a need for laboratory access. New classrooms, all located in the new life sciences building with close proximity to labs and faculty offices, would allow more students to come in contact with research and possibly spark an interest in a life sciences or health-related carrier.

If the new Life Sciences building is completed and UAF is able to attract new high-level research scientists to the campus, these researchers would also teach, increasing the level of academic delivery. This would bring new areas of expertise to the UAF program and build even more capacity for future research. Currently, UAF has to look outside to find top researchers to fill these high-level positions. As life sciences research and academic programs move forward with high-level teaching input from these new researchers, UAF hopes to grow more of their own future researchers.

Proximity to State Virology Lab and BiRD Building

The new Life Sciences facility will be located in the heart of the UAF research campus, on the West Ridge across Sheenjek Drive from the new Alaska State Public Health Virology lab and the Biological Research and Diagnostic facility (known as the BiRD building). Both facilities are heavily used by life sciences researchers. All three facilities would be interconnected. The Life Sciences building would be connected by an underground walkway with the State Public Health Virology lab; the BiRD building is adjacent to the virology lab.

Alaska State Public Health Virology Laboratory

The new $35.5 million Alaska State Public Health Laboratory opened in early 2009 on the UAF campus. The facility provides important routine testing for HIV, hepatitis rabies, rubella, mumps, herpes, rabies, influenza as well as testing for other potentially serious threats to public health such as SARS infections, avian flu, West Nile Virus infections, and norovirus infections. Virus detection services are provided to private and public health care providers throughout the state. The lab also monitors and reports incidents of the outbreaks of disease to national, state and local authorities, and e-mails a weekly report of recent virus disease activity to physicians, nurses, and other interested individuals around the state.

While the Alaska State Public Health Virology lab provides identification and monitoring serves that contribute to public health, to date they have not been tasked with studying what they find. Locating the new Life Sciences facility in close proximity to the Alaska State Public Health Virology lab will allow for close coordination of the virology labs' monitoring function and the high-level research functions available at UAF.

According to Dr. Bernd Jilly, Chief, Alaska State Public Health Laboratories, locating the new state lab on the UAF campus near scientists who conduct basic and applied research was extremely important. The state does not currently have a clinical virologist. They are trying to create a senior virologist position that will be co-funded by the state and UAF. By combining resources with UAF, they will enhance their ability to attract a top quality scientist. This position would run the lab, teach classes at UAF and do basic virology research.

The virology lab will be able to more closely monitor what diseases are present in the state. For example, flu strains start in China, then move east through Alaska, the US and on to Europe. If strains can be identified early, therapies can be developed in time to help prevent serious health problems in other parts of the

country and the world. Another issue of concern is norovirus. Over the last few years, bouts of norvirus have taken place in Southeast Alaska. Likely transferred from cruise ship passengers, the illness can lead to dehydration from loss of body fluids. If outbreaks can be quickly identified, the number of infected people can be reduced. By having a high-level virology scientist available, the state can likely reduce the incidence of illness in Alaska, resulting in less days of missed school and work (which can have a negative economic impact on the state).

Additionally, the state wants to develop a Level III laboratory where potentially dangerous microbes (such as rabies) can be safely studied. UAF currently has the researcher capability but not the laboratory capability to study level II microbes.

BiRD Building

Locating the new Life Sciences facility in close proximity to the BiRD building provides researchers with direct access to this state-of-the-art animal facility. The BiRD facility meets the specific needs of modern researchers by providing them with modern tools for their research. Close proximity allows researchers to better coordinate acquisition of lab animals such as rats and mice without exposure to inclement weather and potential contamination.

Economic Impacts of Life Sciences

Construction Impacts

There will be a substantial level of short-term employment and economic activity in Fairbanks and in other areas of the state related to the construction of the Life Sciences facility.

The original BIOS facility was estimated to cost $105 million[2]. The new Life Sciences facility is proposed to cost about $102.8 million. McDowell Group made slight adjustments to the BIOS impacts estimates to reflect the slightly lower Life Sciences facility cost. This resulted in an estimated $170 million in total economic output (direct, indirect and induced) that includes $80 million in labor income, and annual average employment of 370 workers (in construction and other sectors of the economy) over a four-year construction period for the new facility. A total of nearly $145 million ($102.8 million for construction, plus $42 million in indirect and induced spending) would enter the Fairbanks economy.

The economic effects of this project would benefit other areas of the state, primarily Anchorage, Mat-Su and the Kenai Peninsula. To a large degree, Anchorage is the commercial hub for all of Alaska. Construction companies, engineering firms, wholesalers and retailers, and many other types of businesses are headquartered in Anchorage. Further, large volumes of freight destined for the Interior move through the Port of Anchorage. With half of Alaska's population, the Anchorage area (in combination with the Matanuska-Susitna Borough and Kenai Peninsula Borough) is home to a large pool of skilled construction labor. Because of this, construction activity in the Interior stimulates economic activity in Southcentral Alaska.

[2] The Economic Impact of the University of Fairbanks Biosciences Facility (BIOS) McDowell Group, 2006

Total economic output (direct, indirect and induced) for the Southcentral region of the state from construction of the new Life Sciences facility would be nearly $20 million, with total annual average employment of about 50, and total payroll of about $8 million. The vast majority of these benefits would occur in the Anchorage area.

Research Spending

The new Life Sciences building will also facilitate long-term employment and spending in Alaska. The most significant UAF direct research expenditures are for wages and benefits. Other expenditures include items such as contracted services, equipment, commodities, travel, and student aid, and are purchased within the state. While UAF research spending has the greatest impact in Fairbanks and the vicinity, a significant amount of UAF research spending takes place in Southcentral Alaska. According to the McDowell Group,[18] one-third of all UAF spending takes place in the Anchorage and Mat-Su areas.

The Economic Value of Researchers

One way to estimate the economic value of a researcher to the state is to take an average of the research revenue a top-level researcher is expected to bring and look at the multiplier effect. According the economic modeling system IMPLAN, for every dollar spent on university research in Alaska, there is additional economic activity worth $0.70. [19] On average, an experienced top-level researcher would be expected to bring in annual grants worth between $300,000 and $1 million to fund research (including a portion of their salary and benefits, and the salaries and benefits of a research team).

Multiplying the average range of $500,000 to $600,000 in grants acquired per year, per researcher, by the 1.7 IMPLAN multiplier used for university research in Alaska[20] results in a range of $850,000 to $1.2 million in economic activity for the state, per researcher. Therefore, 12 research positions at UAF represents approximately $10.2 million to $12 million in economic activity for the state.

In general, the largest portion of research expenditures are for wages and benefits. Looking at just the value of wages and benefits generated by a research team provides another measure of a researcher's economic value. There is variability in the size of team that a researcher is able to assemble. Factors that can shape the content of a research team include total funding, subject matter, and availability of lab space. Currently, an average research team at IAB consists of one researcher, one graduate student and one or two technicians. Wages and benefits paid to research teams are in the range of $350,000 to $400,000 annually. For the purpose of this example we will use an average of $375,000 per team. The current facility plan has room for 12 primary investigators, as well as 36 graduate students and 12 post doctoral researchers. A dozen research teams worth an average of $375,000 in wages and benefits would result in approximately $4.5 million in direct wages and benefits.

A realistic scenario when the new facility is built will be movement of eight to ten current researchers (who need an updated facility) to the new building and the addition of two to four new researchers. As researchers move from their current space into the new facility, the space they vacate will be rehabilitated and used by

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[18] McDowell Group, *The Economic Impacts of University of Alaska, 2007 Update*

[19] Minnesota IMPLAN Group, *IMPLAN Professional Version2.* 2006: Stillwater, MN

[20] Ibid

other researchers (also increasing their potential to acquire new grants). It seems reasonable to assume that, based on a facility with space for 12 researchers plus the resulting space made available by intercampus moves, UAF could see an increase in new research-related wages and benefits in the range of about $1 million to $3 million annually. In addition to these wages and benefits, there would be increases in direct spending for goods and services. Indirect and induced impacts would have further positive effects on the Alaskan economy.

SENATE COMMITTEE REPORT
First Committee of Referral

DATE: 2/9/09

FURTHER: Finance

Date of 5-Day Notice: _____
(in accordance with Uniform Rule 23)

DATE TURNED IN TO OFFICE: 2/10/10

Education Committee considered SPONSOR SUBSTITUTE FOR SENATE BILL NO. 56

SB 56 APPROP: LIFE SCIENCES FACILITY AT UAF

"An Act making a special appropriation for a life sciences innovation and learning facility at the University of Alaska Fairbanks; and providing for an effective date."

and recommends:

[ ] be **replaced** with [ ] **SCS** or [ ] **CS** _____ (_____)

[ ] adopt **previous** [ ] **SCS** or [ ] **CS** _____ (_____)

[ ] attached amendment(s)

[ ] adopt _____Letter of Intent

[ ] further referral to _____Committee

SENATE BILL:
[ ] Same Title
[ ] New Title

HOUSE BILL:
[ ] Same Title
[ ] Technical Title Change
[ ] New Title w/ SCR #_____

NEW FISCAL NOTE(S):

Department	Date	Fiscal	Indet.	Zero	FN#

PREVIOUS FISCAL NOTE(S):

Department	Date	Fiscal	Indet.	Zero	FN#

[√] **APPROPRIATION - no fiscal note**

SIGNATURES AND RECOMMENDATIONS:	PRINTED LAST NAME	DO PASS	DO NOT PASS	NO REC	AMEND
	OLSON			✓	
	STEVENS	X			
	Meyer			✓	
	Huggins			✓	
	DAVIS	X			
CHAIR:	Thomas	✓			

WASHINGTON RESEARCH COUNCIL Economic Profile

November 2009

WASHINGTON LIFE SCIENCES ECONOMIC IMPACT STUDY

ACKNOWLEDGEMENTS

Washington Research Council has produced this report with funding from We Work for Health. The results of this analysis are the sole responsibility of the Washington Research Council, a nonprofit organization committed to objective analysis of economic and public policy issues in Washington State.

The life sciences have been a rapidly growing part of the world economy as major scientific advances in the past few decades have opened the promise of substantial improvements in health, agriculture, energy and the overall quality of life. These advances have provided cures for diseases and mitigations of a wide range of disabilities common in the industrialized world. They also hold the promise of alleviating widespread suffering and death in developing countries where infectious diseases and poor health infrastructure are common. Agricultural advances have improved crop yields and created promising new sources of renewable energy.

Significant parts of this exciting activity are happening in Washington. Important scientific discoveries are being made by both start-up and established bio-pharmaceutical companies that are turning their innovations into useful products and services. The state's research universities and not-for-profit institutions contribute immensely to the scientific exploration and innovation taking place in the field. And in a short period of time, the state has become a major center for global health, leading efforts to eradicate disease and improve the lives of billions of people.

All of this activity, which has been growing quietly for decades, adds up to an important part of the state's economy. But because it involves a diffuse group of organizations without clearly delineated markets, it is difficult to recognize. Although the life sciences may not meet the exact definition of a "cluster," this group of enterprises and institutions certainly contains many of the characteristics of a self-sustaining activity around which economic development strategies can be built. Hence, we will refer in this report to the "life sciences industry."

This industry is important not only because of its size, but also because of its potential for growth. As societies become wealthier they tend to consume healthcare services at higher rates, and science and technology keep providing new products and services that have value to consumers. The new emphasis on global health increases the need for products and services aimed at developing countries, and the push for reducing carbon emissions is leading to a gold rush for renewable biofuels.

Measuring the life sciences industry is a challenge. The data normally used to undertake economic impact analysis simply does not exist for it. Activities in the life sciences cut across various industry and employment classifications, making it difficult to quantify the industry. Therefore, this report will use a combination of quantitative methods to indicate the economic impact of the life sciences, and qualitative descriptions to show the ways in which these industries shape the economy now and how they will grow in the future.

WASHINGTON RESEARCH COUNCIL
16300 Christensen Road., Suite 207
Tukwila WA 98188
206-467-7088
fax: 206-467-6957
www.researchcouncil.org

THE LIFE SCIENCES INDUSTRY AND WASHINGTON'S ECONOMY

The life sciences industry forms an important and growing segment of Washington's economic base – that is, enterprises that bring in money from out of state and export value to the rest of the nation and the world. The earnings of the economic base are what allow us to import consumer products, such as cars or appliances or clothing, that are made elsewhere. Dollars earned by those working in industries that make up the economic base circulate within the state to create jobs in retail, construction and other local services.

Life Sciences Profile

Name:	Amgen
Location:	R&D facility in Seattle. Manufacturing facility in Bothell.
Year founded:	1980.
Structure:	Public corporation
Employees:	~900 in Washington; 16,000 worldwide .
Annual sales:	2008: $15 billion

Business. Amgen is the largest biotechnology company in the world and the largest commercial biotechnology company in Washington state.

Patients suffering from the greatest unmet medical needs are Amgen's first priority. Amgen therapeutics have changed the practice of medicine, helping millions of people around the world in the fight against cancer, kidney disease, rheumatoid arthritis, and other serious illnesses. Approximately 90 percent of the new molecules that Amgen is bringing into the clinic target pathways that have never been previously addressed in humans.

The company has facilities around the world, and its Seattle campus is the largest R&D site outside of its headquarters. Amgen's hundreds of Seattle-based scientist are dedicated to developing novel approaches to treating cancer and inflammatory disease.

Growth potential. A pioneer in biotechnology, Amgen will celebrate 30 years of helping patients in 2010. Amgen currently has eight marketed products, and 50+ molecules in development from late discovery research through phase 3. The company is pursuing programs in bone, cardiovascular disease, inflammation, metabolic disorders, nephrology, neurosciences, oncology and hematology; with nearly 300 active studies and more than 45,000 patients enrolled in Amgen clinical trials in more than 50 countries.

The analysis in this report conservatively estimates that the various segments of the life sciences industry directly employ over 22,000 people in the state. Those jobs may support as many as 55,000 additional jobs throughout the state's economy. This puts life sciences on par with the state's computer and electronics products manufacturing industries

But unlike electronic products, or other familiar industries such as aerospace, food products, software or tourism, life sciences is not an easy industry to grasp in the mind's eye. When we think of a sector of the economic base, we typically think of industries that are dominated by the private sector, such as aerospace or software, or are totally public sector, such as the military. The life sciences, by contrast, comprises private sector firms, not-for-profit research organizations, and public universities and laboratories. The work of the life sciences can move fluidly among these organizations, beginning, say, with a privately funded discovery in a university laboratory, which moves to a non-profit laboratory for further refinement, and then to a private firm for commercialization.

Making things even more complicated is that key personnel also move fluidly among the institutions. Researchers may be on the faculty at a university, hold a fellowship at a research institute, and also have a stake in a for-profit firm. Individuals can shift among these sectors as new opportunities arise.

Perhaps the best way to view the life sciences is to think of it mostly as the creation of knowledge and intellectual property. While the state does have employment in the production of products and services pro-

vided directly to the healthcare, agriculture or energy industries, the bulk of the output of the life science industry in the state is scientific discovery and the translation of discovery into the design and engineering of useful products. This means that the most important policy direction for enhancing the industry in the state is one that promotes innovation, protects intellectual property, and enhances the ability of the industry to attract and retain its most important "capital" assets, its people and the tools they need to do their work.

Life Sciences Profile

Name:	Spiration, Inc.
Location:	Redmond
Year founded:	1999
Structure:	Private corporation
Employees:	45
Annual revenue:	N/A

Business. Spiration has developed a device, the IBV Valve System, that is implanted in lungs to prevent air from getting to damaged areas of the lung. The product is intended mostly for use with patients with emphysema, redirecting airflow to healthier areas of the lungs where it can be processed. It can also be used seal lungs following surgery.

The IBV valve system has been approved for use in Europe for all applications. It received a Humanitarian Device Exemption from the FDA, allowing the device to be used on a limited basis for patients having had lung surgery. The device is still under clinical trials in the U.S. and Canada for general use.

Growth potential. Emphysema is the most common form of lung disease in the U.S., and one of the most common causes of death overall. There are no cures for the disease, and the treatments currently available can only slow progression of the disease and relieve symptoms. Around 2 million Americans suffer from the disease, although it is not clear how many of those would be at a stage where Spiration's products would be applicable. But according to company literature, The IBV Valve is the only device of its type in use today. So, once approved, the device could have wide applicability.

On this last point, one thing is critical: size. Agglomeration economics suggests that the larger the pool of people doing similar work, the more productive those people will be. Concentrations of people lead to the sharing of ideas and perspectives, and maximizes the likelihood that individuals will find the best place to use their talents. Furthermore, a large industry presence decreases risk for individuals by increasing the possibilities for employment should they need to leave their current job. Areas with larger industry concentrations tend to be more attractive place to pursue a career. We can think of the life sciences industry as increasing in quality and vitality exponentially with size. Thus, the discussion below about Washington's success along various metrics with respect to other states is not about bragging rights but about the viability of the industry.

Describing the life sciences industry

The components of the life sciences industry can be categorized in many ways. We will describe the industry in four categories, based roughly on the output or end user of the technologies being developed and sold. While there is some overlap among them, these groupings tend to be the ones within which organizations collaborate and within which individuals move throughout their careers.

Biopharmaceuticals. This category of organization works to develop and sell drugs aimed at curing or mitigating a wide range of disorders, particularly those of concern in industrialized societies. Much of the research that forms the basis for these products begins in privately funded research facilities owned and operated by the bio-pharmaceutical industry, in university laboratories, or in organizations such as the Fred Hutchinson Cancer Research Center in Seattle. Individual for-profit firms, often labeled "biotechnology" companies, can begin with discoveries from universities or laboratories, or with their own proprietary discoveries. But whatever the origins and path of the

technology, the final goal is a pharmaceutical product that gains FDA approval and has a promising market share.

The challenge in the biopharmaceutical business is that capital requirements are extremely high, along with the risk of failure. Investors must put up huge amounts of cash to fund research and clinical trials, always aware that the promised breakthrough may never arrive or that the product may be rejected by regulators. When a firm does achieve success, the outcome is frequently to sell the successful product, or the entire firm, to a large pharmaceutical manufacturer that undertakes production, marketing and distribution.

Life Sciences Profile

Name:	IsoRay Medical
Location:	Richland
Year founded:	1998
Structure:	Public Corporation
Employees:	37
Annual revenue:	'07 –'08: $7.1 million; '08 –'09: $5.4 million

Business. IsoRay Medical was founded to produce therapeutic medical isotopes and associated devices for treatment of solid tumor cancers. Its current sales are based on brachytherapy seeds for the treatment of prostate cancer. The company's major breakthrough was in developing a method of using cesium-131 isotopes which, according to company literature "are expected to decrease radiation exposure to the patient and reduce the severity and duration of side effects, while treating cancer cells as effectively, if not more so, than Iodine-125 or Palladium-103."

The firm expects to expand beyond treatment of prostate cancer and develop treatments for breast, liver, lung and pancreatic cancers. The product has been cleared for these treatments.

IsoRay obtains its radioactive materials from laboratories in the United States, and, increasingly, from laboratories in Russia. Its 15,000 square foot manufacturing facility is located in the Applied Process Engineering Laboratory, an incubator facility in Richland operated by Energy Northwest.

Growth potential. IsoRay believes that its cesium based product has the potential to become the leading seed therapy choice among clinicians. The cancers treated by IsoRay products will occur in hundreds of thousands of patients in the U.S. alone, and the firm still has relatively low market penetration for these treatments. If it can expand beyond the relatively small number of treatment facilities currently using its products, IsoRay has the potential to significantly expand production and sales.

Thus, although the state has seen its share of breakthroughs in biopharmaceuticals, it has not seen many large firms grow out of those. A pattern has emerged 30 years after the first biotech companies formed: the state's formidable talents and resources for research and development of pharmaceuticals support a robust and valuable research industry, but the state's lack of competitiveness as a manufacturing site inhibits the growth of large production and distribution facilities. From an economic development perspective this is a good-news, bad-news story. The good news is that the state continues to attract highly skilled researchers who are paid well and boost the state's average wages. The bad news is that manufacturing jobs do not follow.

Medical devices. This sector produces hardware and its accompanying software, as well as implanted devices, for use in medical diagnostics and treatment. This industry pre-dates the emergence of biopharmaceuticals in the state, with several firms growing out of technologies developed at the University of Washington in the 1970s. In particular, medical ultrasound was developed at the UW, and several firms have spun that technology out into large imaging companies.

The medical device companies face many of the same capital and regulatory hurdles that the biopharmaceutical firms do, but approvals can be shorter, especially for diagnostic equipment. FDA approval for therapeutic and implanted devices, however, can be quite complex and expensive. Manufacturing of medical devices is very complex and costly, as these devices must meet exacting standards.

There is continuing national and global consolidation in the medical device field, and medical device firms are frequently acquired once they

become successful. If the target of the acquisition is simply intellectual property, an acquired firm may lose its presence in the state. But many firms have been acquired by large multi-nationals and kept their state presence. Manufacturing operations, however, can be vulnerable to outsourcing or inter-firm consolidation.

Global health. This collection of organizations cuts across both the biopharmaceutical and medical device categories, but also includes groups that address the management and delivery of health services. Global health efforts operate at several levels. First are efforts to develop new products to prevent and treat diseases that are common in developing countries but that have been given little attention by Western pharmaceutical companies. Second is to promote the distribution of existing medications and vaccines in areas that need them, with the goal that no one should die of a disease that we already know how to cure. Third concerns the development of healthcare infrastructure in developing countries.

As one might imagine, much of the activity in global health is carried out by universities and non-profit research institutions. Washington has seen a significant expansion in such organizations, and is thought by many to be second only to Geneva in its concentration of global health assets. But with the need to produce large quantities of healthcare products destined for developing countries, there are also private firms now targeting those markets. The scale of global health efforts, however, tends to favor large, established firms rather than small start-ups. With the leadership of the Gates Foundation, the World Health Organization and other agencies, the perception that there is no money to be made in global health is changing rapidly.

In a 2007 study, "Economic Impact Assessment of Global Health on Washington State's Economy," an interdisciplinary team at the University of Washington found that global health activities aimed at developing countries produced over $700 million in direct economic activity in the state in 2005. This activity produced 3,650 direct jobs and 10,470 additional jobs throughout the economy. The study found that global health activities at the University of Washington and Washington State University are worth about $130 million per year.

Life Sciences Profile

Name:	Seattle Genetics
Location:	Bothell
Year founded:	1998
Structure:	Public corporation
Employees:	260
Annual revenue:	2007: $22 million; 2008: $35 million

Business. Seattle Genetics describes itself as "a clinical stage biotechnology company advancing a broad product pipeline of antibody-based therapies." Its technology is aimed at treating cancers and autoimmune diseases, and currently has a number of products in the pipeline.

Seattle Genetics' lead product, SGN-35, is currently in pivotal trials with patients experiencing recurring Hodgkins Lymphoma. Three other products for treatment of cancer and autoimmune disorders are also in clinical trials. Even though it has no products on the market currently, the firm does receive revenue from large pharmaceutical firms that partner with Seattle Genetics in the use of its proprietary antibody-drug conjugate (ADC) technology.

The firm has a long term strategy of leveraging its ADC technology and continuing to move new discoveries into the approval pipeline. This is a capital intensive business: in 2008, Seattle Genetics spent $111 million on research and development, and another $16 million on operations, while bringing in $41 million.

Growth potential. The cancers that are the target of Seattle Genetics' initial products affect tens of thousands of people in the United States alone each year. Although initial remission rates have been climbing, substantial numbers of patients have recurrences that would be treated by these products.

Key to the firm's strategy is to maintain an active research program that continually looks for new products and technologies that can feed into the pipeline for eventual clinical trials. Its most recent SEC filings indicate that the firm has six products in various stages of testing, in addition to SGN-35. Seattle Genetics also has six active collaborative agreements with other biopharmaceutical firms for use of its ADC technology.

Agriculture, energy and environment. The life sciences do not stop with medicine. The state has active research and industries in plant and animal sciences to improve agriculture, and, increasingly to develop sustainable biofuels. The state's two research universities are heavily involved in these areas, as is the Pacific Northwest National Laboratory in Richland.

Life Sciences Profile

Name:	Signature Genomics
Location:	Spokane
Year founded:	2003
Structure:	Private LLC
Employees:	107
Annual revenue:	N/A

Business. Signature Genomics Laboratories provides diagnostic testing for a wide range of disorders in its "state-of-the-art array-based comparative genomic hybridization (array CGH) diagnostic laboratory." The firm's testing services are based on proprietary technology embedded in its SignatureChipWG, SignatureChipOS, and Signature PrenatalChip.

Signature Genomics was formed in partnership with Pathology Associates Medical Laboratories and Sacred Heart Medical Center in Spokane. The laboratory began offering testing services directly to clinicians in2004, one year after opening the firm. The laboratory in Spokane accepts direct shipments of samples. Over 30,000 cases have been processed.

Growth potential. In just a few years Signature Genomics grew from three employees to over 100, offering its services nationally. Diagnostic testing is a competitive business, but Signature Genomics growth attests to the strength of its proprietary technology, and future growth will depend on keeping that technology current.

The nation's first attempts to radically increase the use of biofuels – ethanol and bio-diesel – did not turn out well, due to the unsustainability of the stream of feedstocks. Researchers and entrepreneurs are in a race to find ways to create feedstocks that do not compete with food sources, do not use excessive resources, and do not, themselves, result in high output of carbon during production.

This is an intensely competitive business right now, with scientists and engineers around the world looking for ways to extract fuel from various plants and algae, and it is likely that only a few technologies will emerge as winners. So, unlike biomedical industries, where there are thousands of disorders in need of attention, there are just a handful of fuels that need renewable substitutes. The risk for these businesses is very high, but given the amount of fuel that needs to be created, the corresponding rewards are very tempting.

What about healthcare? The delivery of healthcare services—hospitals, clinics, doctors, laboratories—is not included in the definition of life sciences for purposes of this report (we do count research performed at some medical institutions in the state, as specifically delineated by those institutions). The reason for omitting healthcare itself is that the vast majority of healthcare services performed in the state are consumed by residents of the state, and therefore do no constitute part of the state's economic base. It is true that patients do come to Washington from other states and nations to receive specialized care, but those exported services are not measured in any systematic way.

Very little of the output of Washington's life sciences industries is offered at the retail level. The industries, firms and organizations described in this report are in the business of scientific discovery and the translation of that discovery into useful products and services that can be "wholesaled" to healthcare and other "retailers" around the world. Often, the underlying goal of start up firms in the life sciences is to develop valuable intellectual property that can be sold, rather than to develop a viable long term business.

DIVERSE SOURCES OF REVENUE

Describing the life sciences industry is further complicated by the unusual ways in which money flows into the state to the industry: it is often quite different from other parts of the economic base. We can easily imagine money flowing into Washington to purchase aircraft or geoducks, or to pay fees for architectural services or for a hotel stay. We can also imagine money flowing in for payroll at military bases. Large parts of the life sciences industry, however, do not bring dollars into the state in traditional ways – but the dollars are just as green. Sources of revenue for the life sciences industry include:

Internal company funds. Many life sciences firms in Washington are branches of national or global firms, either under their own name or their parent company name. The research and development operations of these firms in Washington are funded by internal operating funds of the parent firm. For example, Amgen's R&D facility in Seattle is one of just four in the nation, with its payroll and operating costs paid for by revenues generated though Amgen's global sales of pharmaceutical products. Amgen reports that in 2008 it spent over $3 billion companywide on R&D, or about one third of its operating expense.

Venture Capital. Research and development activities that take place within private firms with an eye toward commercial products are funded mostly with venture capital. While the state does have a robust venture capital community that attracts investors from within the state, most venture funding still comes from out of state, and most of the investors in those funds are not from Washington. In many respects, the investors in these venture funds are paying firms in the life sciences industry of the state to produce intellectual property that will eventually be sold at a large profit.

Figure 1
Venture capital in Washington

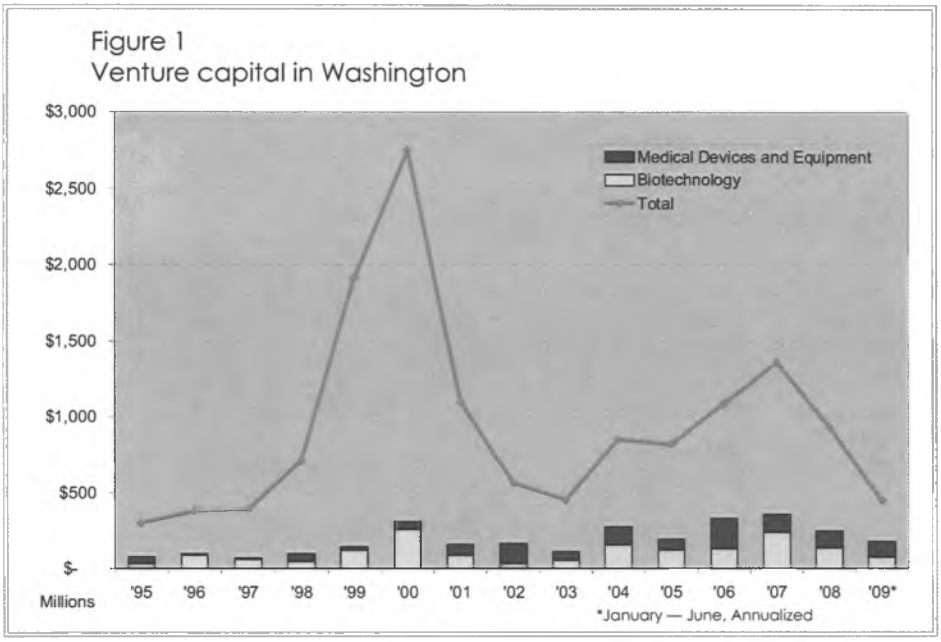


Figure 1 shows venture capital placements in Washington since 1995. The bars show funds going to life sciences, firms, both biotechnology and medical equipment. The line shows the trend in total venture capital investments in the state, reflecting the very high rate of investment during the dot-com boom of 2000. Investments in the life sciences have been more steady, if not as spectacular. Investments in the life sciences now account for about 40 percent of venture capital invested in the state. Figure 2 shows the venture capital deals in the life sciences in Washington that were placed in the second quarter of 2009. In that quarter, three times as much funding went into biotechnology firms as went into medical devices.

Federal research grants. The state's two research universities, the Pacific Northwest National Laboratory, the Fred Hutchinson Cancer Research Center and other non-profit research centers attract billions of dol-

Figure 2
2nd Quarter 2009 VC Deals in Washington

Biotechnology firms	Location	Product	Stage	Amount
Calistoga Pharmaceuticals	Seattle	Treatment of Cancer and inflammatory diseases	Early stage	$15 million
Immune Design Corporation	Seattle	Vaccine development	Early stage	$1.7 million
NanoString Technologies	Seattle	Bar coding system for single molecules	Expansion	$14 million
XOR! Corp.	Seattle	Platform for antibody discovery	Start up	$2.1 million
Medical device firms				
EndoGastric Solutions	Redmond	Device to treat gastro esophageal reflux disease	Later stage	$3.8 million
Generic Medical Devices	Gig Harbor	Production of medical devices	Expansion	$5 million
Pathway Medical Technologies	Kirkland	Devices for treatment of arterial disease	Later stage	$2.3 million

Source: PricewaterhouseCoopers

Figure 2
Largest Washington recipients of funding from the National Instutes of Health

	FY 2007	FY 2008	Total 2007-2008
University of Washington	448,379,740	394,928,665	843,308,405
Fred Hutchinson Cancer Research Center	227,438,213	218,711,483	446,149,696
Children's Hospital And Regional Medical Ctr	15,187,100	22,704,592	37,891,692
Washington State University	18,557,867	16,878,535	35,436,402
Center for Health Studies	16,789,559	18,353,195	35,142,754
Seattle Biomedical Research Institute	17,920,044	9,832,725	27,752,769
Battelle Pacific Northwest Laboratories	11,619,361	16,105,920	27,725,281
Institute for Systems Biology	11,055,471	7,816,623	18,872,094
Benaroya Research Institute At Virginia Mason	8,786,320	7,401,877	16,188,197
Decode Biostructures	3,908,215	3,853,482	7,761,697
Seattle Institute for Biomedical & Clinical Research	3,285,843	3,569,505	6,855,348
Program for Appropriate Technology in Health (PATH)	3,947,675	2,542,638	6,490,313
Puget Sound Blood Center	3,105,525	2,693,252	5,798,777
Axio Research, LLC	4,554,322	416,474	4,970,796
Talaria, Inc.	1,680,004	3,165,222	4,845,226
Pacific Northwest Research Institute	2,191,934	2,215,371	4,407,305
Infectious Disease Research Institute	1,352,157	2,295,697	3,647,854
Swedish Medical Center, First Hill	1,146,511	1,700,489	2,847,000
Behavioral Tech Research, Inc.	514,246	1,974,912	2,489,158
Geneva Foundation	1,171,119	1,170,346	2,341,465
Syntrix Biosystems, Inc.	1,569,056	657,348	2,226,404
Firsthand Technology, Inc.	-	2,090,845	2,090,845
Vpdiagnostics, Inc.	991,848	1,028,641	2,020,489

Source: National Institutes of Health

Figure 3
Ten largest NIH grants in Washington in 2008

Organization Name	Project Title	Award
Fred Hutchinson Cancer Research Center	Leadership Group for a Global HIV Vaccine Clinical Trials Network	$26,907,84 6
Fred Hutchinson Cancer Research Center	HVTN Laboratory Program	$15,927,91 8
Fred Hutchinson Cancer Research Center	Leadership for HIV/AIDS Clinical Trials Networks; HIV Vaccine Trials Network	$14,380,61 7
University of Washington	National Primate Research Center	$12,480,37 3
University of Washington	The WWAMI RCE for Biodefense and Emerging ID	$11,401,04 7
Fred Hutchinson Cancer Research Center	Cancer Center Support Grant (Comprehensive)	$9,979,93 2
University of Washington	Institute for Translational Health Science (UL1)	$9,919,95 4
Fred Hutchinson Cancer Research Center	Leadership for HIV/AIDS Clinical Trials Networks; Microbicide Trials Network	$7,116,10 0
Fred Hutchinson Cancer Research Center	Leadership for HIV/AIDS Clinical Trials Networks; HIV Prevention Trials Network	$6,867,62 0
University of Washington	EMS Network Data Coordinating Center	$5,008,79 6

Source: National Institutes of Health

lars in research funding for the life sciences. Most of these grants are competitive, so in many respects, these institutions compete for customers like any service business.

The federal government has long made a commitment to basic research that is not directed at solving any particular problem. Thus, much of what is discovered is not tied to any product or immediately usable outcome, but simply advances knowledge in certain areas. We can think of the state's life sciences research capacity as an industry in itself, rather than as simply a stop on the path toward commercialization.

The vast majority of federal research funding for the life sciences comes through the National Institutes of Health (NIH). In 2008, NIH awarded 1621 separate grants in Washington, totaling $761 million, for an average grant of $470,000. Figure 3 shows the recipients of NIH funding in Washington that received at least $2 million during 2007 and 2008. Figure 4 provides brief descriptions of the top ten grants awarded in 2008.

Foundation grants. The research organizations that receive federal grants also receive grants from private foundations. The largest of these,

Figure 3
Major Washington recipients of Gates Foundation grants in 2007

	Grants	Total funds
Program for Appropriate Technology in Health	25	90,150,712
University of Washington	9	35,253,851
Seattle Biomedical Research Institute	5	12,784,754
Infectious Disease Research Institute	2	12,110,881
Fred Hutchinson Cancer Research Center	3	5,550,276

Source: Bill and Melinda Gates Foundation

Life Sciences Profile

Name:	Pacific Northwest National Laboratory (PNNL)
Location:	Richland
Year founded:	Current contract with Battelle signed in 1965
Structure:	Owned by U.S. Department of Energy. Operated by Battelle.
Employees:	4,600 (all scientific areas)
Annual volume:	$880 million

Services. PNNL is one of ten laboratories owned by the U.S. Department of Energy (DOE). Its mission is to conduct basic research for the department, as well as other federal agencies and private entities. The laboratory is operated by the Battelle Memorial Institute, which operates three other national laboratories.

As would be expected by its ownership, PNNL has a heavy concentration in research on energy, and within this concentration, the lab does extensive work in the area of sustainable biofuels. Current projects include efforts to convert biomass into usable substitutes for gasoline and diesel fuel. PNNL also has an extensive practice in environmental remediation and protection.

PNNL's biological sciences division has a staff of 200 and receives substantial funding from both DOE and NIH.

The laboratory's size and scope make it a natural partner for researchers across the Northwest. Recently, a partnership between PNNL and Washington State University resulted in the opening of the new Bioproducts, Sciences, and Engineering Laboratory, a 57,000-square-foot, $24.8 million facility in Richland.

Growth potential. Because of its diverse funding sources it is difficult to estimate the growth potential for PNNL. It did see 20 percent growth in volume between 2005 and 2008, so the institution is clearly meeting the needs of its federal and private sponsors. In the life sciences, the new partnership with WSU should yield significant growth results in the coming years as that facility hits its stride.

the Gates Foundation, is located in the state, but because its assets are largely held outside the state and it operates on a global basis, its grants are not the same as other money that circulates within the state. Figure 3 shows the five largest recipients of Gates Foundation grants for the life sciences in Washington. At over $150 million in grants for these five institutions alone in 2007, the Gates Foundation is clearly a major influence on the region's life sciences industry.

Licensing and partnership revenue. Most life sciences start up firms are built around proprietary technology that is used to produce innovative pharmaceutical or agricultural products. These new technologies are often of great interest to larger firms elsewhere in the country that see the applicability to their own products. Some of the state's life sciences firms engage in licensing agreements or develop partnerships with out-of-state firms through which they collect fees for the use of their proprietary technology.

Product and service sales. The most basic form of revenue generation in the economy is often the least available source for life sciences companies in Washington. The state has never had a significant presence of pharmaceutical manufacturing firms, so the production, marketing and sales operations that generate direct revenue for these products and services do not occur very much in the state. The state does still have a significant number of manufacturers of medical devices, so revenue from sales of those products will flow into the state.

Life sciences employment in Washington

An economic impact analysis of an industry generally begins with the employment in that industry, and uses an economic model to determine how many additional jobs are generated by the export activity of the industry. The additional employment generated by the industry comes from two sources. "Indirect" employment is generated through purchases made by the industry in the local economy, such as supplies, utilities, financial and legal services. "Induced" employment is generated by the spending of households who are employed either directly or indirectly in the industry. The combination of the three employment sources

– direct, indirect, induced – yields a "multiplier" which, when applied to the direct employment, yields the total employment created by the industry.

Life Sciences Profile

Name:	Seattle Biomedical Research Institute (SBRI)
Location:	Seattle
Year founded:	1976
Structure:	501-c-3 Not-for-profit corporation
Employees:	250
Annual budget:	$40 million

Services. SBRI is an independent research organization that concentrates on finding ways to eliminate infectious diseases, especially those prevalent in developing countries. While infectious disease is not a primary cause of death in industrialized countries, it is by far the leading cause of death in Africa and parts of Asia, and, in all, is the leading cause of death in the world.

SBRI is currently addressing the "unholy trinity" of malaria, HIV/AIDS, and tuberculosis, as well as lesser-known diseases such as African Sleeping Sickness and Leishmaniasis. The institute conducts basic research at its Seattle facility and its field laboratory in Tanzania, often partnering with researchers around the world. The institute is also involved with the development and testing of vaccines.

SBRI began as a small independent research organization, but soon developed strong ties with the University of Washington School of Public Health and Community Medicine. Today, most of the senior research staff at SBRI also hold professorships at the UW, many in the new Department of Global Health.

Growth potential. SBRI is one of the world's leading research institutions in a field that has seen rapid and accelerating growth. It already has a close partnership with the Gates Foundation, the leader in private funding of global health research, and has successfully partnered with organizations around the world. Furthermore, its headquarters is in the center of what may be the second largest global health cluster in the world. All signs point toward continued growth for SBRI

There are two basic ways to collect employment data. The first is to use administrative records that capture data as part of compliance with employment law. The most commonly used employment data is collected through unemployment insurance programs, and measures all individuals who are covered under the program. "Covered employment statistics" are quite accurate in terms of the count of individuals, but are only as useful as the categories into which the employees are placed. This report uses covered employment data, supplemented by other sources. Covered employment data was also used in recent national studies of the life sciences conducted by Battelle (2008) and Archstone Consulting (2009).

The second way to collect employment data is to survey the universe of employers. This method was used in a 2002 study of Washington's biotechnology and medical device industry (Chase 2002), which used employment numbers from a survey by Lifesciences.com. Similarly, the Community Attributes study of biomedical devices (2008) and the UW study of global health (2007) used survey data.. This method is more transparent than using administrative records, but is accurate only to the extent that the surveyor correctly identifies the universe of employers and that these employers respond to the (voluntary) survey. The Lifesciences.com survey has not been updated since 2005.

For purposes of this report, the covered employment data from the Washington State Department of Employment Security (ESD) has some problems, stemming from the categorization available in the North American Industrial Classification System (NAICS). ESD uses NAICS codes for detail on employment in the medical device and pharmaceutical manufacturing sectors, and for the past two years ESD has used a new NAICS code called "biotechnology." But the rest of the private sector life sciences research employment, including most of the employees of the state's non-profit research institutions, are included in a broad NAICS category called "research and development in the physical, engineering, and life sciences." To address this shortcoming, we employ a methodology used by Battelle. For its 2008 State Biosci-

ences Initiatives report, Battelle estimated that 43 percent of those working in the larger five-digit NAICS category (which includes biotechnology) do their work in the life sciences. (In similar studies, the Milken Institute simply ignores the larger NAICS R&D category and only uses the biotechnology category begun in 2007.)

ESD data does not break out two important life sciences employers. Researchers who are on the faculty or staff of a university are listed under "education" and no attempt is made to break them out by research focus. Finally, researchers who work in a hospital are categorized under healthcare. For these categories not broken out in ESD data we use various estimating methods.

Employment impacts of the life sciences are determined as follows:

Manufacturing. The NAICS system provides detailed data on employment in manufacturing operations of all kinds. Figure 8 shows employment in ten categories of manufacturing related to the life sciences, for a 2008 total of 8,930 jobs. The largest of these, electromedical devices, covers the state's substantial industry in medical imaging devices.

Private sector research and development. This category will consist mostly of not-for-profit research institutions, along with some for-profit firms that are strictly engaged in research (as opposed to doing research associated directly with the manufacture of a product or provision of a service). ESD provides two NAICS codes for R&D. The first, 541711, is the category created two years ago to break out R&D in "biotechnology" specifically. ESD reports that in 2008, 2,679 people worked in that category at an average annual wage of $87,482.

The second NAICS code for R&D, 541712, contains all other scientific work in "engineering, physical and life sciences." So, life sciences research work that is not specifically associated with the molecular manipulations that usually define biotechnology, will be found in this category, along with all other kinds of research that have little or nothing to do with life sciences. To find the life sciences component, we revert back to NAICS 54171, which includes both 541711 and 541712. ESD reports that in Washington in 2008, 18,271 people worked in all of NAICS 54171, so, applying Battelle's ratio, we can estimate that 8,039 worked in the life sciences. Then, subtracting the 2,679 people who worked in biotechnology (541711), we arrive at an estimate that 5,360 people worked in non-biotech life sciences R&D.

Figure 6
2007 R&D expenditures in the life sciences at universities and colleges

	All life sciences	Agricultural sciences	Biological sciences	Medical sciences	Other life sciences
University of Washington	513,821	13,479	85,218	405,409	9,715
Washington State University	129,984	60,532	57,728	6,164	5,560
Western Washington University	1,963	0	1,963	0	0
Eastern Washington University	334	0	334	0	0
University of Puget Sound	251	0	231	0	20
Heritage University	210	0	190	20	0
Central Washington University	185	0	185	0	0
Pacific Lutheran University	121	0	121	0	0
Evergreen State College	65	0	65	0	0
Seattle University	63	0	0	0	63
Seattle Pacific University	56	0	32	12	12
Total	647,053	74,011	146,067	411,605	15,370

Thousands of current dollars

Source: National Science Foundation

Figure 7
Research at medical institutions

	Total 2008 research funding
Children's Hospital And Regional Medical Center	36,977,801
Benaroya Research Institute At Virginia Mason	24,543,000
Puget Sound Blood Center	5,600,654
Swedish Medical Center, First Hill	2,439,000
Tacoma General Hospital	691,655
Seattle-King County Public Health Dept	456,240
Total	70,708,350

Sources: NIH, institutions

University faculty and staff. ESD reports none of the state's R&D employment within the public sector, so all university faculty and staff who are working in R&D in the life sciences will appear in the larger "education" category (we assume that faculty and staff at private universities do as well). To estimate the number of jobs attributable to life sciences R&D, we begin with the total value of R&D activity at the state's institutions of higher education. Figure 6 shows that in 2007 the state's higher education institutions performed $647 million worth of life sciences research. Using the ratio of spending to employment from some large institutions we estimate that every $1 million in research spending produces 7.5 jobs (ECONorthwest 2009). Thus, life sciences R&D spending at the state's higher education institutions results in approximately 4,850 jobs.

Figure 8
2008 Employment in the life sciences in Washington

Sector of the life sciences industry	NAICS Code	Employment	Average Annual Wage
Medicinal and Botanical Manufacturing	325411	317	$39,162
Pharmaceutical preparation manufacturing	325412	1,166	$92,520
In-Vitro Diagnostic Substance Manufacturing	325413	429	$60,792
Biological Product (except Diagnostic) Manufacturing	325414	578	$59,782
Electromedical and electrotherapeutic apparatus manufacturing	334510	3,619	$92,088
Analytical laboratory instrument manufacturing	334516	508	$97,977
Surgical and medical instrument manufacturing	339112	454	$71,883
Surgical appliance and supplies manufacturing	339113	1,387	$40,089
Dental Equipment and Supplies Manufacturing	339115	117	$34,082
Ophthalmic Goods Manufacturing	339116	355	$34,699
Research and development in biotechnology	541711	2,679	$87,482
Estimate of research and development in life sciences	541712	5,360	N/A
Estimate of university faculty and staff working in life sciences	N/A	4,850	N/A
Estimate of hospital staff in research activities	N/A	530	N/A
Estimated total direct life sciences employment		22,349	

Sources: Washington State Department of Employment Security, National Science Foundation

Hospitals and institutions. Six medical institutions in the state received grants from the NIH in 2008. Further research finds that these hospitals had additional sources of research funding, with the total shown in Figure 7. Using the same ratio of spending to jobs that we used for university research, we can conclude that hospital research generated about 530 direct jobs in the state.

Figure 9
Major industries in Washington

	2008 Employment
Transportation equipment manufacturing	94,973
Agriculture	63,445
Food and beverage manufacturing	38,240
Computer and electronic product manufacturing	22,366
Life sciences	***22,349***
Fabricated Metal Product Manufacturing	19,867
Wood products manufacturing	16,708
Mineral and primary metal manufacturing	15,951
Chemical and plastics manufacturing	15,626
Machinery Manufacturing	15,198
Paper products manufacturing	10,418

Source: Washington State Department of Employment Security

Figure 8 summarizes employment in the life sciences in Washington, based on data from ESD and estimates from other sources. A base of over 22,000 jobs makes the life sciences industry an important part of the state's economy. Figure 9 shows 2008 employment for the life sciences in Washington along with employment in other major industries that contribute importantly to the economic base of the state. Life sciences has surpassed basic industries such as wood products and paper products, replacing employment as those industries have matured.

ESTIMATING THE ECONOMIC IMPACT OF THE LIFE SCIENCES IN WASHINGTON

With reasonable estimates of life sciences employment in the state we can estimate the additional jobs that are produced in the economy as a result of spending by life sciences institutions and firms, and the spending of households. We use a model constructed for the Research Council by Regional Economic Models Inc. (the WRC-REMI model) to derive the multipliers for the various sectors. The REMI model provides multipliers for each of the NAICS codes except the new biotechnology code. We have only one multiplier to use for all of the R&D in the sciences.

Figure 10-a shows the results of applying the multipliers to the employment estimates. We can estimate that the direct employment in the life sciences results in nearly 55,000 additional jobs throughout the state, for a total economic impact of 77,000 jobs. It is worth noting that the 2002 study of the state's biotechnology and medical device industries arrived at a combined multiplier of 3.23, which is very close to the average multiplier of 3.44 derived by dividing the total employment impact by the total direct jobs identified in this study. Figure 10-b shows the impact of these jobs on the state's GDP and personal income.

THE LIFE SCIENCES INDUSTRY AROUND THE STATE

The life sciences industry tends to respond to clustering effects, with the largest concentrations of firms and institutions near the University of Washington. Activity is, however, spread around many other areas of the state. Figure 11, based on employment data from the Puget Sound

Figure 10-a
2008 Economic impact of the life sciences in Washington: Employment

Sector of the life sciences industry	Direct Employment	Multiplier*	Indirect/induced employment	Total employment impact
Pharmaceutical and medicine manufacturing	2,490	5.41	10,981	13,471
Electromedical and electrotherapeutic apparatus manufacturing	3,619	4.06	11,073	14,692
Analytical laboratory instrument manufacturing	508	5.00	2,032	2,540
Surgical and medical instrument manufacturing	454	3.14	971	1,425
Surgical appliance and supplies manufacturing	1,387	2.63	2,261	3,649
Dental Equipment and Supplies Manufacturing	117	2.62	190	307
Ophthalmic Goods Manufacturing	355	2.13	401	756
Research and development in life sciences (including biotechnology)	8,039	3.08	16,721	24,760
Estimate of university faculty and staff working in life sciences	4,850	3.08	10,088	14,938
Estimate of hospital staff in research activities	530	3.08	1,102	1,632
Total	22,349	3.44	54,570	76,919

*Multipliers derived from WRC/REMI model; totals less than sums of industry effects due to adjustment for intraindustry impacts

Sources: Washington State Department of Employment Security, National Science Foundation

Figure 10-b
2008 Economic impact of the life sciences in Washington: GDP and personal income

Sector of the life sciences industry	Direct Employment	GDP (2000$, millions)	Personal Income (Current$, millions)
Pharmaceutical and medicine manufacturing	2,490	$1,105	$991
Electromedical and electrotherapeutic apparatus manufacturing	3,619	$1,283	$892
Analytical laboratory instrument manufacturing	508	$199	$135
Surgical and medical instrument manufacturing	454	$118	$83
Surgical appliance and supplies manufacturing	1,387	$301	$179
Dental Equipment and Supplies Manufacturing	117	$24	$14
Ophthalmic Goods Manufacturing	355	$55	$337
Research and development in life sciences (including biotechnology)	8,039	$1,629	$1,683
Estimate of university faculty and staff working in life sciences	4,850	$983	$1,015
Estimate of hospital staff in research activities	530	$107	$111
Total	22,349	$5,712	$5,353

Impacts derived from WRC/REMI model; totals less than sums of industry effects due to adjustment for intraindustry impacts

Regional Council and ESD, shows the distribution of employment in the readily identifiable segments of the life sciences industry in the Puget Sound region and elsewhere in the state. (Data suppression—not providing data that could lead to disclosure of proprietary information about firms – makes it difficult to calculate employment distribution at a finer grain than this.)

Figure 11
Life sciences employment in Washington

	Biotech R&D + Biopharma Manufacturing	Medical Device Manufacturing
Total Employment	4,951	5,293
Seattle	46.5%	6.8%
I-90 & I-405 corridors	18.4%	66.8%
Balance of Puget Sound region	11.9%	6.4%
Balance of state	23.2%	20.0%

Source: Puget Sound Regional Council, ESD

Figure 12 shows the distribution of life sciences businesses and institutions in cities around the state. Figure 13 shows the distribution of grants from the NIH around the state. Both figures indicate that, while most firms want to be near the major research institutions and laboratories, researchers can locate themselves well outside these centers.

Economic drivers of the life sciences industry

Washington has among the strongest life sciences industries in the nation, relative to its size. According to a 2008 study by Battelle, on a per capita basis, Washington ranks sixth among the states in research funding from the National Institutes of Health, eighth in biosciences employment, sixth in the awarding of biosciences degrees and seventh in placement of biosciences venture capital. The states that consistently ranked higher than Washington in these per capita measures were Massachusetts, Maryland and Connecticut.

But how can we ensure that the state remains strong in the life sciences? The Battelle study lists a number of key "success factors of biosciences industry growth." Among them are:

Engaged research institutions with active leadership. The report states that "without major research stature, reputation and standing within given fields, no region can succeed with a biosciences-driven strategy for its economic growth." Washington certainly has excellent research institutions, with its two major research universities and non-profit institutes.

Available risk capital covering all stages of the business cycle. Washington consistently ranks among the top states in the placement of venture capital funding. In addition to the Battelle ranking of seventh in the placement of biosciences venture capital, the Milken institute ranks Washington third in overall per capita venture capital placement. A persistent concern in the state, however, has been the reliance on venture funds from out of state: of the 60 venture capital firms that completed at least five financing deals in the second quarter of 2009, only two were from Washington. Another concern has been the challenge of finding "angel" capital for very early stages of firms.

Workforce and talent pool. The pool of talent that feeds the life sciences industry requires specialized training that is not widely available. Washington's universities graduate individuals in these fields, but not

Figure 12
Numbers of firms and non-profit organizations by city, 2009

	Biotech/ pharma	Medical Device	Non-Profit Research
Arlington		3	
Auburn	1	4	
Bainbridge Island	2		
Battle Ground	1		
Bellevue	8	13	1
Bellingham	3	4	
Black Diamond		2	
Boistfort		1	
Bothell	20	15	
Burien		1	
Burlington		1	
Camas		1	
Carnation		1	
Centralia		1	
Chehalis		1	
Eastsound		1	
Edmonds			1
Enumclaw		1	
Everett	2	9	
Federal Way	1		
Ferndale		2	
Gig Harbor		2	
Glacier		1	
Goldenadle		1	
Issaquah		2	
Kenmore	1		
Kennewick	1	2	
Kent	1	8	1
Kirkland	3	3	
Lacey	2	1	
Lakewood	1		
Leland		1	
Liberty Lake		1	
Longview		1	
Lynnwood	1	3	
Marysville		1	

	Biotech/ pharma	Medical Device	Non-Profit Research
Mercer Island		1	
Mount Vernon		1	
Mountlake Terrace		2	
Mukilteo	1	3	
North Bend	1		
Port Gamble		1	
Port Ludlow		1	
Port Orchard		1	
Poulsbo		6	
Pullman	4	1	
Puyallup		2	
Redmond	17	18	
Renton		2	1
Richland	1	3	1
Sammamish	2		
Seattle	87	37	18
Sedro Woolley		1	
Sequim		1	1
Shoreline	1		
Silverdale		2	
Snoqualmie	1	1	
Spokane	5	7	4
Spokane Valley		3	
Stanwood	1		
Sumas		2	
Sumner		1	
Tacoma	1	2	
Tukwila		1	
University Place		1	
Valleyford	1		
Vancouver	2	7	
Vashon	1	1	
Washougal		1	
Wenatchee		1	
Woodinville	1	5	
Yakima		1	
Total	175	205	28

Sources: biotech/pharma and nonprofit research, Lifesciences.com; medical device, Canon Communications

Figure 13
NIH grants in Washington by city

	2007	2008
Seattle	778,580,373	710,548,701
Bellevue	2,048,599	1,764,612
Bothell	2,222,036	1,719,983
Kirkland	822,374	937,751
Redmond	968,104	99,431
Auburn	1,569,056	657,348
Bainbridge Island	3,908,215	3,853,482
Burien	39,150	-
Edmonds	-	100,000
Gig Harbor	756,989	739,555
Kenmore	558,673	628,910
Lakewood	1,171,119	1,170,346
Maple Valley	299,916	268,590
Mountlake Terrace	198,167	803,348
Newcastle	50,932	60,249
Shoreline	100,000	-
Stanwood	100,000	6,000
Tacoma	1,068,994	1,081,975
Vashon	-	520,467
Bellingham	779,906	354,989
Ellensburg	65,459	70,909
Friday Harbor	871,788	-
Granger	-	32,400
Olympia	99,928	939,960
Pullman	18,557,867	16,878,535
Richland	12,237,855	16,777,365
Sequim	500,000	500,000
Spokane	329,871	517,631
Vancouver	1,271,897	368,510
Woodinville	105,213	-
Total	829,282,481	761,401,047

Source: National Institutes of Health

nearly enough to meet the needs of the state's life sciences industry. A glance through the backgrounds of the leading scientists in the state's research institutions and biotech firms indicates that we import the majority of the talent working in the life sciences in the state.

There is perhaps no more important factor for the future of Washington's life sciences industry that our ability to attract and retain top scientific and technical talent from around the world. While Washington is an attractive place to live, we do need to be mindful that we are competing with states such as Massachusetts, California and New Jersey that offer outstanding career prospects for talented scientists and engineers. While impressive, Washington's life sciences industry does not yet offer as many career paths for scientists such that they will move to the state confident that if their current employment ends they will be able to find new employment easily.

Stable and supportive business, tax and regulatory policies. In the past decade Washington has made some progress in becoming friendly to technology businesses, but barriers do remain. The state's tax breaks for R&D equipment are favorable for start-up businesses building or expanding laboratory space and a sales and use tax deferral for life sciences manufacturing. The state also offers a B&O tax credit for a portion R&D expenses for firms that for the most part are still in the unprofitable start-up phase. However, employment taxes in the state are among the highest in the country, which can be a burden for labor-intensive research. Life sciences businesses may be concerned about the stability of the state's tax regime, given the regular calls to eliminate tax preferences such as the B&O tax credit.

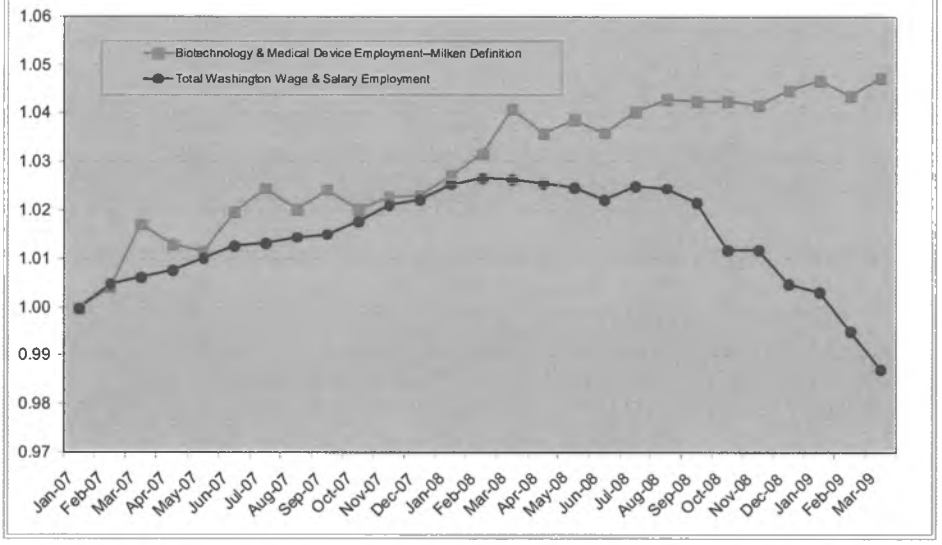
Patience and a long term perspective. The Battelle report notes that such well-known life sciences centers as Route 128 in Massachusetts and North Carolina's Research Triangle took decades to develop. Similarly, Washington's life sciences industry has built slowly over decades. The University of Washington built its research and medical capacity over many years. The Fred Hutchinson Cancer Research Center has been steadily growing since the 1970s. The Seattle Biomedical Research Institute began as a three-person laboratory in Issaquah in the 1970s and now employs hundreds of people in its Seattle and Tanzania laboratories.

In some ways, the necessity of this report, documenting the life sciences industry, is a testament to its almost unnoticed growth. While individual institutions have executed growth strategies, and county-level economic development organizations have promoted the life sciences, the industry has grown largely without any high profile, long term strategic actions on the part of government.

Although not mentioned specifically in the Battelle report, another critical factor in the growth of the life sciences industry is the presence of support services. Of particular interest is the legal and accounting ser-

vices required for investors and for intellectual property protection. The steady growth of a range of technology-based businesses has been accompanied by strong growth in the state's related services sector.

Figure 14
Growth in life sciences employment versus total employment



Recent Performance

Figure 14, which is based on a relatively conservative measurement of life sciences employment in the state (the estimating method used by the Milken Institute, as discussed above, which excludes non-biotech life sciences R&D, universities and hospital R&D), shows that in the past two years, while general employment in the state has fallen, employment in the life sciences has expanded. Since this chart shows just employment in private for-profit businesses, many of which are in the research phase, this trend indicates the optimism with which the financial community views the life sciences. Investors are willing to stick with their bets on the future of the life sciences.

Conclusion

The life sciences industry has grown to be an important part of Washington's economy. In employment it has passed many of the traditional resource based industries on which the state's economy was founded, and is in the same range of importance as some of the new, technology-based industries of the state. It is, however, difficult to recognize the importance of the life sciences industry because it is comprised of a diffuse array of organizations and firms, its "product" consists of everything from scientific papers to surgical instruments, and its "revenue" comes from all manner of public and private sources. Describing the life sciences industry is not as easy as describing the production and sale of lumber.

The growth of the life sciences industry is good news for the state. Demand for the products and services generated by the industry will continue to grow rapidly, in three principal areas: domestic healthcare, global health and sustainable biofuels. The state's life sciences industry has a good position in the first of these, is the national leader in the second, and has promise in the third.

The economic potential of the life sciences has, of course, not gone unnoticed in the rest of the country and the world. The competition for talent and investment capital is intense, and in spite of its excellent assets, Washington is still not among the top regions for the life sciences, but perhaps near the top of the second tier. Massachusetts, with its complex of leading universities, the San Francisco Bay area, with its universities and huge technology industry base, and New Jersey, with its large phar-

maceutical industry, all have larger life sciences industries than Washington.

Washington has developed its niches in the areas of research and development and global health, and will not likely be a major area for manufacturing of pharmaceutical products. These are, however, very valuable and lucrative niches which depend primarily on one input: talent. Washington may not have the largest life sciences industry in the nation, but it still competes at the highest level to attract and retain the best scientific and technical minds in the world. The future of Washington's life sciences industry will continue to be tied to the quality of talent in the state.

There are many complex factors that determine success in the life sciences industry, but none more important than ensuring that the state's universities, research institutions and businesses have the highly skilled people they need working in an environment that encourages innovation.

APPENDIX: ABOUT THE WRC-REMI MODEL

The Washington Research Council uses a model of the Washington State economy constructed especially for WRC by Regional Economic Models, Inc. Because it allows supply and demand to respond to changes in prices and wages, and permits substitution among factors of production, the WRC-REMI model is more elaborate than the standard input-output models commonly employed to estimate regional economic impacts (Treyz 1993).

The core of the standard input-output model is a catalog of interindustry purchases for the region in a base year, arrayed in an input/output matrix. The model assumes that as a specific industry's production increases or decreases, its purchases from the region's other industries will change proportionately. Likewise, the industry's employment will change by the same proportion that its output changes.

Based on these assumptions, the model traces the cascading effects as one industry's increase in output stimulates an increase in the output of other industries (and its own). These effects are distilled in multipliers that measure how a change in the demand for the output of one industry will affect the total output of the local economy, or how a change in the employment of one industry will affect the total output of the local economy (Chase, Bork, and Conway 1993).

But the standard input-output model is incomplete. It fails to model the numerous capacity constraints within the economy, the processes that set prices for goods and services and the responses of consumers and producers to changes in these prices. In the input-output model, industry and labor supply are perfectly elastic—so prices and wage rates do not matter.

Prices and wages do matter in the WRC-REMI model. The model divides the state into two subregions: the four central Puget Sound counties (King, Kitsap, Pierce, and Snohomish) and the balance of the state. There are 53 industrial sectors within each subregion. Within each subregion the model tracks interindustry transactions, much as an input output model would.

Unlike an input-output model, however, the WRC-REMI model incorporates a number of significant behavioral responses to changes in prices and costs: The wage rate depends on the supply and demand for labor, migration and labor force participation rates respond to changes in wage rates, and consumer purchases of specific goods and services respond to changes in relative prices and personal income. In addition, producers substitute among production factors in response to changes in relative factor costs, market shares respond to changes in regional production costs, and investment rises in response to increases in output.

This report uses version PI $^{+}$ 1.0.114 of the WRC-REMI model.

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print

Clear vision

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Competition between University of Alaska campuses for state construction money is nothing new or surprising, but legislators this year have something new and surprising to consider: The unanimous support of the UA Board of Regents for a single project.

The competition was on full display last week in Juneau with the comments of Eagle River Rep. Bill Stoltze, who characterized investment in the Fairbanks campus as an imbalanced anachronism.

This view contrasts with that of the regents and the university's president.

With regard to the alleged imbalance, President Mark Hamilton noted that four-fifths of construction spending during his dozen years at the helm has gone to Anchorage.

After an extensive review and discussion in the fall of 2009, the board decided that the highest construction priority for the university system this year is the proposed life sciences building at the Fairbanks campus. To emphasize the point, the board shed mention of all other projects in its annual budget request.

Gov. Sean Parnell agreed with the board and placed funding for the building in the budget he proposed to the Legislature.

This money would not prop up a failing anachronism; it would support a thriving, modern research and teaching program.

The UA Fairbanks life sciences program is succeeding despite relatively ancient facilities. To continue this success, though, those facilities need an update.

The university regents understand this. They understand this despite their geographical origins. The 11-member board has just three regents from Fairbanks, one of them a student. Five regents are from Anchorage, yet every one of them endorsed the board's recommendation.

These regents saw what legislators are also capable of seeing: The moment has come to invest in a new life sciences building, not for Fairbanks but for the entire state of Alaska.