Wyoming Governor's
UW Top-Tier Science Programs & Facilities Task Force

MEMORANDUM

TO: Elected Officials of the State of Wyoming, State and Federal offices
University of Wyoming Trustees
Members of the Wyoming Governor's UW Top-Tier Science Programs and Facilities Task Force
University of Wyoming President's Executive Council
University of Wyoming Deans & Academic Directors

FROM: Co-Chairs Governor Dave Freudenthal and Carol Brewer

RE: Report of the Wyoming Governor's UW Top-Tier Science Programs and Facilities Task Force

DATE: January 6, 2015

We write to share our enthusiastic endorsement for the attached response to the opportunity offered by the 2014 Wyoming Legislature, which asked that we develop a plan to address outdated science laboratories at the University of Wyoming and improve the quality of instruction and research in the sciences at UW. In the span of a few months, the Wyoming Governor's University of Wyoming Top-Tier Science Programs and Facilities Task Force, working with a Campus Leadership Team made up of representatives of the core sciences at UW, believes it has met that challenge.

The enclosed report features:

- An Executive Summary which begins on page 9
- Governor Mead's Charge Letter begins page 1
- A listing of Task Force members begins on page 3
- A listing of the UW faculty Leadership Team on page 8
- The Legislative charge language on page 9
- An introductory overview to the overall report begins on page 14
- The detailed report begins on page 17

This plan proposes to change the way UW has taught the sciences to students through "Active Learning" methodologies and classroom spaces, offering quantifiable impacts that would allow thousands of students a year to learn more, retain more of what they have learned, and be more likely to succeed in the marketplace. For students and instructors alike, the central element is integrated and interactive learning that will transform science education.

For researchers, today's scientific problem solving - whether that be finding an answer to cheatgrass or exploring the genes and processes associated with cancer in humans - occurs in settings involving researchers from multiple disciplines. The Task Force proposal outlines steps toward achieving these research opportunities (while reducing duplication and inefficiencies) by assembling researchers into a single complex with shared instrumentation, technical support and multiple collaboration spaces.

Specifically, the Task Force proposes two distinct capital construction phases as well as integral programmatic opportunities. The first phase involves the construction of a new university teaching and research facility in the space now occupied by a nondescript courtyard between the Biological Sciences Building and the Physical Sciences Building. The facility, roughly estimated to be completed in 2019, will include active learning classrooms, a chemistry, physics and biological imaging core, and centralized biological research facilities for plant growth and laboratory animal

rearing. Recognizing this opportunity, UW's faculty representing the core sciences propose to give up elements of the traditional academic silos and individual programs in order to move to the new structure. A second and distinct "follow up" phase of capital construction would support the Phase I construction with limited renovations of existing science facilities in three campus buildings.

The bedrock of this proposal is formed by existing faculty and the collaborative scientific culture that has been created at UW, and demonstrated by the Campus Leadership Team assembled to work with the Task Force in the development of this response. The Task Force was exposed to faculty working with a collaborative spirit on the challenge posed by the Legislature, while also witnessing remarkable research accomplishments being made in existing, cramped, and very substandard research facilities. In addition to programmatic opportunities associated with Active Learning, the Task Force and Campus Leadership Team propose to enhance research opportunities for undergraduates through enhanced faculty mentoring, student training programs and internships. A PhD Fellowship Program would provide opportunities to attract top-flight postgraduate scientists who would be intimately involved in teaching and research. Finally, a Competitive Research Innovation Program will facilitate the hiring of top-tier faculty through enhanced startup funding for equipment, as well as providing an ongoing funding source for the replacement of scientific instruments that have reached the end of their productive and competitive lives. The program would also fund modest seed grants for faculty researchers in order to encourage the development of higher numbers of competitive, externally funded research proposals. In total, funding needs for these programmatic enhancements are estimated at $5.41 million per year when fully implemented in the FY2017-18 biennium.

The preliminary Phase I Capital Construction cost estimate is $100 million. Recognizing the difficulty of a single appropriation, the Task Force suggests a three year period of set-asides, beginning with $30 million in FY2016.

The Task Force endorses the proposal to include $750,000 of initial programmatic funding for the Science Initiative in the FY2016 Supplemental Budget recommendations, as well as $3 million in facilities planning funding through the Capital Construction budget.

After examining funding options for the capital projects which are being recommended, the Task Force has determined that neither private fundraising, grants, nor bonding options provide sufficient resources for projects of this magnitude. General Fund appropriations are the most realistic and appropriate means of moving forward with this important initiative.

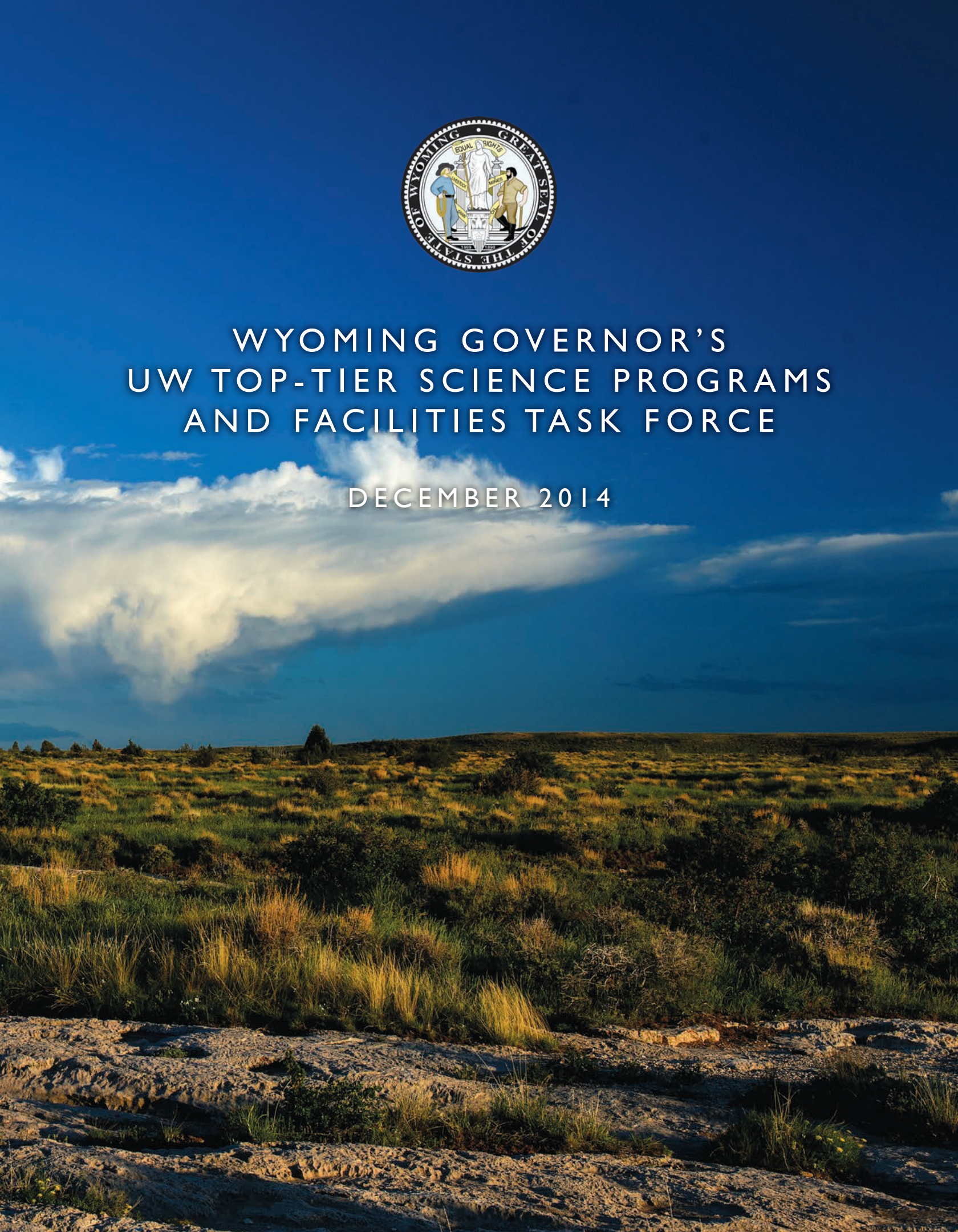
The Task Force wishes to express its appreciation for the efforts of the Campus Leadership Team, whose enthusiastic dedication to the creation of an innovative and reasonable plan serves as a model of how - absent rivalries - challenges such as the one proposed by the Legislature can be successfully addressed. As a result of the team's willingness to craft and refine this plan, the members of the Task Force were able to review and develop confidence in the attached report after only three meetings in the second half of 2014.

Please do not hesitate to contact either of us with questions regarding the proposal, its funding recommendation, or in regards to our endorsement of this worthwhile response to the Legislative charge.

Sincerely,

Dave Freudenthal, Co-Chairman

Carol Brewer, Co-Chairwoman



WYOMING GOVERNOR'S UW TOP-TIER SCIENCE PROGRAMS AND FACILITIES TASK FORCE

DECEMBER 2014

MATTHEW H. MEAD
GOVERNOR

THE STATE OF WYOMING

STATE CAPITOL
CHEYENNE, WY 82002

Office of the Governor

Governor Dave Freudenthal
Senior Counsel
Crowell & Moring, LLP
205 Storey Blvd.
Cheyenne, WY 82009

Dear Governor Freudenthal:

Thank you for agreeing to serve on the Wyoming Governor's University of Wyoming (UW) Top-Tier Science Programs and Facilities Task Force. Your participation is a remarkable commitment to both the State and UW.

It is a priority to work with UW in building a "Tier I academic and research institution within areas of excellence." I look forward to recommendations that address both the short- and long-term steps to achieve this goal.

Thank you for committing to be the co-chairman of this effort. I have let the members know that we are in agreement about the importance of this undertaking and the benefits that will accrue to Wyoming.

The action items and recommendations from this Task Force when fully implemented will be transformational in the science programs (Botany, Zoology, Physiology, Molecular Biology, Chemistry, Physics and Astronomy) at UW. The Task Force needs to chart a clear course for these science programs to penetrate their respective national rankings and build on STEM initiatives (the relocation of the National Center for Atmospheric Research supercomputer to Wyoming, construction of the Michael B. Enzi STEM teaching facility, and the recent Wyoming Governor's Energy, Engineering STEM Integration Task Force).

The Task Force is charged with developing a plan that addresses:

1. The renovation and construction of science laboratories and instructional areas at UW, which shall be designed in cost and approach to lead the University toward a top-quartile academic and research institution in areas of science pertinent to the economies of Wyoming and the nation, and other elements related to Wyoming's quality of life. The plan shall include the science labs and instructional areas in the Biological Science and Physical Science Buildings, the facilities in the Aven Nelson Building, and consideration of a structure that would provide space for temporarily displaced programs due to the renovation and consideration of a new location for the programs in the Aven Nelson Building.

2. Improve the quality of instruction and research in the various fields of science that supports the goal of being a top-quartile science program that prepares students for successful careers in the sciences. Emphasis shall be placed on the retention and recruitment of high-performing faculty and graduate and undergraduate students, encouraging innovative research, and educational partnerships with employers of science graduates. The goals shall be improving the prestige and quality of teaching and research in the sciences, enhancing employability of UW's graduates in the sciences, fostering opportunities for the creation of sustainable jobs in Wyoming, and furthering economic development.

3. A means to finance the building renovation and program improvements through a combination of sources, including state funds, private contributions and grant funding in conjunction with the UW Board of Trustees and the UW Foundation.

A final report needs to be received by November 1, 2014, allowing time for me to prepare my recommendations for funding the work to the Joint Appropriations Committee.

Thank you again for you commitment to UW.

Sincerely,

Matthew H. Mead
Governor

Dave Freudenthal

Co-Chairman
Former Governor, State of Wyoming

University of Wyoming –
J.D. 1980

Dave Freudenthal, a Wyoming native, served two terms as Wyoming's 31st governor. In 2002, as a Democrat and first-time candidate, he won an upset victory in one of America's most overwhelmingly Republican states. After his first term, he was re-elected in 2006 by the greatest percentage in the state's history. By the end of his tenure, Wyoming was ranked as the "Best Run State in America" by 24/7 Wall St., based on a review of hundreds of data sets and a variety of metrics ranging from debt rating agency reports to median income. When he left office in 2011, his approval rating was over 80%—at the top among all U.S. governors—and he left his successor with a balanced budget and a billion dollar surplus.

Dave's eight years as governor were marked by a constructive bi-partisan relationship with a Republican dominated legislature. This working relationship moved Wyoming forward on many fronts. As the nation's least populous state, Wyoming maintains a resource-based economy, relying primarily on mineral and energy extraction, tourism, and agriculture for its economic livelihood. Recognizing the strengths and opportunities that this economic base represents for the state, Dave's administration focused on balancing resource extraction and preservation with regulatory approaches designed to enhance long-term growth.

Carol A. Brewer, Ph.D.

Co-Chairwoman

California State University, Fullerton –
B.A. Biology 1981

University of Wyoming –
B.S. Biological Sciences
Secondary Education 1985;
M.S. Zoology and Physiology 1986;
Ph.D. Botany 1993

Carol A. Brewer, Ph.D., joined the faculty at the University of Montana in 1993. Today she is a professor emerita of Biology and retired associate dean of the College of Arts and Sciences at UM and founder and principal of the Prairie Ecotone Research Group, LLC, a firm that provides consulting, assessment, and research services for scientists and educators in the life sciences.

As a graduate student at the University of Wyoming, she received both the Ellbogen Award for a Graduate Teaching Assistant (1990) and the Outstanding Dissertation Award (1993). After graduating from UW, she conducted research and mentored graduate students at the University of Montana in both physiological plant ecology and ecological education.

Her major areas of research and collaboration included studying the functional morphology and physiological ecology of plants from the northern Rockies in the United States to the southern Andes of Patagonian Argentina; exploring how film and television programs influenced science literacy; cofounding a citizen science campaign called Project BudBurst to monitor plant phenology nationwide; and training teachers to use their schoolyards to lead ecological investigations. Over the past 25 years, Carol has led dozens of workshops on teaching, assessment, and mentoring.

TASK FORCE MEMBERS

Tom Botts

University of Wyoming –
B.S. Civil Engineering 1977

Tom was born in 1955 and grew up on a ranch near Riverton, Wyoming. He earned a civil engineering degree in 1977 from the University of Wyoming and joined Shell Oil Company in the same year in Ventura, California, as a production engineer in the upstream. After various onshore and offshore engineering assignments, he became division engineer in 1982 and then completed assignments in staff planning and corporate economics. In 1987, Tom became division engineering manager for Shell's onshore U.S. production. In 1990, he became division operations manager and later assumed responsibility for both engineering and operations as division production manager.

In 1993, Tom was appointed manager of corporate planning for Shell Oil, a role that also covered the oil products and chemicals businesses. In 1995, he was appointed treasurer of Shell Oil while retaining his corporate planning responsibilities. Tom moved to London in mid-1998, and then to Scotland in 2001, holding positions as UK gas director, UK oil director and UK managing director in Royal Dutch Shell. During his various roles in the UK he was also chairman of step change in safety, and a member of the Industry Leadership Team and PILOT (the Industry/Government cooperative body in the UK). In October 2003, Tom moved to the Netherlands and became executive vice president for EP Europe, leading Shell's largest upstream unit with activities across Europe. In March 2009, he moved back to the U.S. and was appointed executive vice president for Shell's Global Manufacturing portfolio, responsible for all of Shell's refineries and chemical plants globally. Tom retired at the end of 2012.

Tom is currently on the Board of Directors for EnPro Industries based in the U.S. and Wood Group based in Scotland. He is co-chairman of the Governor's Energy, Engineering, STEM Integration Task Force as well as a member of the Energy Resources Council at the University of Wyoming. Tom is also a long standing member of the Society of Petroleum Engineers.

Greg Brown, Ph.D.

Colorado State University –
B.S. Botany 1973;

Arizona State University –
M.S. Botany 1978,
Ph.D. Botany 1980

Greg Brown, task force member and head of the campus Leadership Team, is associate dean of the UW College of Arts and Sciences, where he oversees biological sciences, fine arts, humanities, mathematical sciences, research support, and the Wyoming Survey and Analysis Center.

He is also former head of the Department of Botany and former director of the Robert and Carol Berry Biodiversity Conservation Center. His research focuses on plant systematics and the morphology, chromosomes, and breeding systems of select members of the tropical Bromeliaceae or the bromeliad family, which includes pineapples and Spanish moss. He teaches plant form and function, and plant diversity and systematics.

He earned his bachelor's from Colorado State University in 1973, his master's from Arizona State University in 1978, and his doctorate from Arizona State University in 1980.

Lowell J. Burnett, Ph.D.

University of Wyoming –
M.S. Physics 1967;
Ph.D. Physics 1971

Portland State University –
B.S. Physics and Mathematics 1964

In 2005, Dr. Lowell Burnett joined Quasar Federal Systems as an officer and director. He currently serves as chief technology officer for the company, which is a member of the privately-owned Quasar Group. Quasar Federal Systems develops high-performance electromagnetic (EM) sensors and commercializes new applications for EM sensing technology with an emphasis on defense, intelligence, and security.

Earlier, Lowell co-founded Quantum Magnetics, Inc. (QM) and served as president and CEO from 1987 to 2005. QM is a high-tech R&D company specializing in the development of advanced systems for the detection of explosives, narcotics, and concealed weapons. Applications for QM's technologies include aviation security, mine detection, and military force protection. As CEO, he guided QM through a period of sustained growth, with revenues expanding at a compounded rate in excess of 25% per year. In 1997, QM became a wholly owned subsidiary of InVision Technologies, the world leader in security applications of computed tomography X-ray technology. In December 2004, General Electric purchased both companies for $900 million.

In his career, Lowell has published widely and served as principal investigator on numerous grants and contracts. He served as a consultant to the Office of Technology Assessment, U.S. Congress, and was invited to address the House Armed Services Subcommittee on Military R&D. Lowell served as a physics professor and department chair at San Diego State University, and was appointed a presidential postdoctoral fellow at the Los Alamos National Laboratory. He was honored by the University of Wyoming as an Arts and Sciences Exemplary Alumni in 1993, and by Portland State University as an Outstanding Alumnus in 2003.

Dr. Jeffrey Cummings

University of Wyoming –
B.S. Zoology and Physiology 1970,
Honorary Degree 2011

University of Washington
School of Medicine – M.D. 1974

Boston University –
Fellowship in Behavioral Neurology 1979

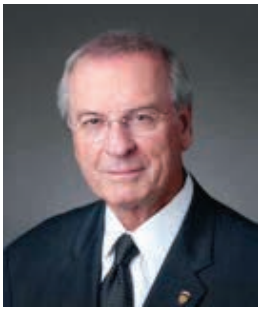
National Hospital for Nervous Diseases,
London – Fellowship in Neuropathology
and Neuropsychiatry 1980

Jeffrey L. Cummings, M.D., Sc.D., is director of the Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Nevada, and Cleveland, Ohio. He is the Camille and Lary Ruvo Chair for Brain Health of the Neurological Institute of Cleveland Clinic. Dr. Cummings is an experienced clinical trialist with expertise in clinical trial design and analysis, global trial implementation, and trial outcome measures.

Dr. Cummings was formerly professor of neurology and psychiatry at UCLA, director of the Mary S. Easton Center for Alzheimer's Disease Research at UCLA and director of the Deane F. Johnson Center for Neurotherapeutics at UCLA.

Dr. Cummings is the past president of the Behavioral Neurology Society and of the American Neuropsychiatric Association. He has also authored or edited over 30 books and published 600 peer-reviewed papers. Dr. Cummings has been the recipient of a number of awards including the American Association of Geriatric Psychiatry Distinguished Scientist Award in 2010.

TASK FORCE MEMBERS



Dr. A. Brent Eastman

University of Wyoming –
B.S. Zoology and Physiology 1962

University of California, San Francisco –
M.D. 1966

Dr. Eastman, M.D., FACS, a general, vascular and trauma surgeon, served as the 93rd President of the American College of Surgeons (ACS) from 2012 -2013. He also recently retired as chief medical officer of Scripps Health and director of trauma services at Scripps Memorial Hospital, La Jolla (1984–2014).

He is also an associate clinical professor of surgery and trauma at the University of California, San Diego (1994 to present). Dr. Eastman was the chair of the Board of Regents for the American College of Surgeons (ACS) from 2009–2010 where he played a key role in the college's efforts to provide care to the victims of the earthquake that struck Haiti in 2010.

During his time as the chair for the Committee on Trauma with ACS, Dr. Eastman helped create the COT Trauma System Consultation Committee. One of Dr. Eastman's proudest moments was when he led the ACS Trauma Systems Consultation Team to Wyoming. Furthermore, he served as an instructor for the internationally acclaimed Advanced Trauma Life Support course since 1982.

Dr. Brent Eastman is a former member of the UW College of Art and Sciences Board of Visitors. He was the recipient of the UW Distinguished Alumni Award in 1997 and the UW Arts and Sciences Exemplary Alumni in 1993.

Fred Eshelman, Pharm.D.

University of North Carolina –
B.S. Pharmacy 1972

University of Cincinnati –
Pharm.D. 1974

Fred Eshelman founded Pharmaceutical Products Development in 1985 and served as CEO and executive chairman until retirement. Fred is the current owner of Iron Bar Holdings, Elk Mountain Ranch, where he operates the properties as a cattle and hay operation.

Earlier in his career, Fred was senior vice president of development and a director at Glaxo, Inc. (now GlaxoSmithKline), a multinational pharmaceutical, biologics, vaccines, and consumer healthcare company. He is a former adjunct assistant professor at the UNC-Chapel Hill School of Pharmacy and former clinical assistant professor at the University of Illinois School of Pharmacy.

Fred is founding chairman of Furiex Pharmaceuticals. He has served as a member of the American Society for Clinical Pharmacology and is a former Chairman of the Association of Clinical Research Organizations in Washington D.C. He is also the president of the Board of Directors of RightChange.com, Inc., a conservative nonprofit political organization with the mission of holding America's elected leaders accountable for their actions. He also served on the Pharmacy Deans Advisory Council for the University of Wyoming.

Robert B. Grieve, Ph.D.

University of Wyoming –
B.S. Molecular Biology 1973;
M.S. Molecular Biology 1975

University of Florida –
Ph.D. 1978

Bob Grieve, a fourth-generation Wyoming native, was born in Torrington, Wyoming and raised on family ranches. He has experienced two distinct careers, one in academic science and one in business.

Dr. Grieve developed extramurally funded programs across four academic institutions over a span of about 15 years where he researched immune responses to parasitic diseases and taught undergraduate, graduate and professional students. He generated over 90 scientific publications and was an inventor or co-inventor on more than 50 issued patents. Bob received various awards, most notably the Henry Baldwin Ward Medal the top research award from the American Society of Parasitologists. In parallel with his research and teaching, Bob served editorial functions for three scientific periodicals and in advisory roles with the National Institutes of Health, United States Department of Agriculture, U.S. Food and Drug Administration and the World Health Organization.

In 1994 Bob left his tenured professorship to work as Vice President of Research and Development and then Chief Scientific Officer at Heska Corporation, a company that he co-founded in 1988. In 1999 he assumed the role of CEO, a position he retained for over 15 years. As CEO he accomplished a business turnaround, positioning the Company for growth, then moved to the role of Executive Chair of the Board of Directors in 2014.

Philip A. Nicholas

Oregon State University –
B.S. Microbiology

University of Wyoming –
J.D. 1979

Phil Nicholas first clerked for a Wyoming District Court Judge, then served for two years as an assistant attorney general for the State of Wyoming. Phil entered into general practice in Laramie in 1982, representing individual, corporate, and government clients. He also has extensive experience with business matters including contract and planning issues, along with administrative matters involving safety, environmental, personnel and natural resources concerns. Phil is a member of the Wyoming, Colorado, and Oregon State Bar Associations, the Wyoming Trial Lawyers Association, the American Bar Association, and the National Association of Bond Lawyers.

Phil has served 18 years in the Wyoming Legislature consisting of ten years in the Senate and eight years in the House of Representatives. He has served on numerous committees including Appropriations, Judiciary, Revenue, Travel and Recreation, and Wildlife Committee. Locally, Phil previously served on the Albany County Hospital Board of Trustees, the Laramie Area Chamber of Commerce Board, the Albany County Planning Commission and the Laramie Economic Development Corporation. He is presently co-chairman of the Laramie Beautification Committee.

UW SCIENCE INITIATIVE ADVISORY LEADERSHIP TEAM

WYOMING GOVERNOR'S UW TOP-TIER SCIENCE PROGRAMS AND FACILITIES TASK FORCE

THE LEADERSHIP TEAM, ENDORSED BY THE TASK FORCE, HAS DEVELOPED NOVEL IDEAS TO ACHIEVE THE TOP QUARTILE OF ACADEMIC INSTITUTIONS IN THE USA. THIS WILL BE INITIATED WITH AN EXISTING CORE OF WORLD-CLASS FACULTY WHO HAVE ALREADY CREATED A FUNDAMENTAL CULTURE OF SELFLESS COLLABORATION.

Dr. Greg Brown, Professor of Botany; Associate Dean, College of Arts & Sciences

Dr. Keith Carron, Professor and Head, Department of Chemistry

Dr. Danny Dale, Professor and Head, Department of Physics and Astronomy

Dr. Brent Ewers, Professor of Botany, Director, UW EPSCOR Program

Dr. Chip Kobulnicky, Professor of Physics and Astronomy

Dr. Krista Laursen, Project Manager, Office of the President

Dr. Mark Lyford, Director, UW LIFE Program

Dr. Bryan Shader, Professor of Mathematics, Special Assistant for Research Computing

Dr. Dean Roddick, Professor of Chemistry

Dr. Donal Skinner, Professor and Head, Department of Zoology and Physiology

Dr. Mark Stayton, Professor and Head, Department of Molecular Biology

Dr. Cynthia Weinig, Professor of Botany

Dr. Dave Williams, Professor and Head, Department of Botany; Director, UW Stable Isotope Facility

UNIVERSITY OF WYOMING TOP-TIER SCIENCE PROGRAMS AND FACILITIES. Section 317.

(a) In consultation with legislative leadership and the University of Wyoming board of trustees, the governor shall appoint a task force which may include successful University of Wyoming graduates and employers in the pertinent fields of science that will develop a plan regarding:

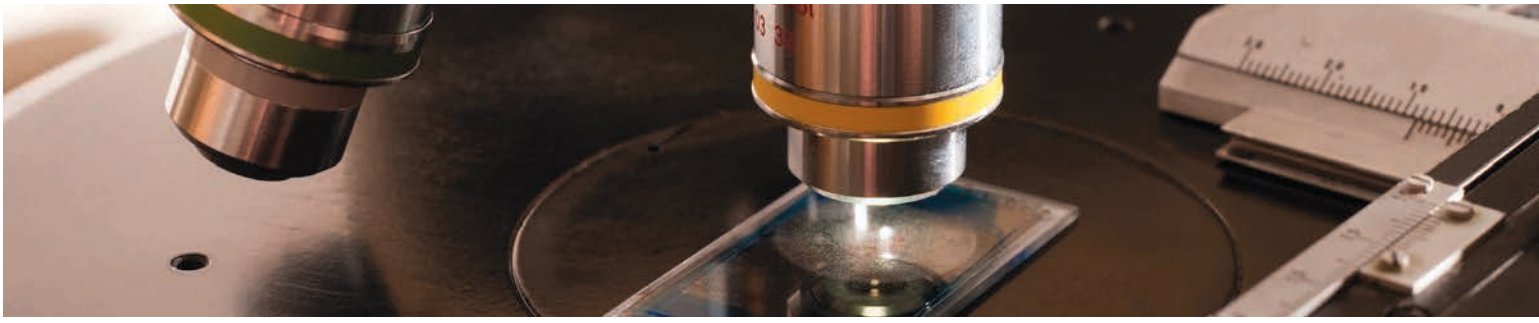
(i) The renovation and reconstruction of science laboratories and instructional areas at the University of Wyoming, which shall be designed in cost and approach to lead the university toward a top quartile academic and research institution in areas of science pertinent to the economies of Wyoming and the nation, and other elements related to Wyoming's quality of life. The plan shall include the science labs and instructional areas in the biological science and physical science buildings, the facilities in the Aven Nelson building, and consideration of the construction of a structure that would provide space for temporarily displaced programs due to the renovation and consideration of a new location for the programs in the Aven Nelson building;

(ii) Improving the quality of instruction and research in the various fields of science that supports the goal of being a top-quartile science program that prepares students for successful careers in the sciences. Emphasis shall be placed on the retention and recruitment of high-performing faculty and graduate and undergraduate students, encouraging innovative research, and educational partnerships with employers of science graduates. The goals shall be improving the prestige and quality of teaching and research in the sciences, enhancing employability of University of Wyoming's graduates in the sciences, fostering opportunities for the creation of sustainable jobs in Wyoming, and furthering economic development;

(iii) A means to finance the building renovation and program improvements through a combination of sources, including state funds, private contributions and grant funding in conjunction with the University of Wyoming board of trustees and the University of Wyoming foundation.

(b) The task force shall periodically report to the legislature on its progress in developing the plan and shall submit a final draft of the plan to the governor by November 1, 2014. The governor shall submit his recommendation for funding the renovation work and program improvements to the joint appropriations interim committee by December 1, 2014.

EMPHASIS SHALL BE PLACED ON THE RETENTION AND RECRUITMENT OF HIGH-PERFORMING FACULTY AND GRADUATE AND UNDERGRADUATE STUDENTS, ENCOURAGING INNOVATIVE RESEARCH AND EDUCATIONAL PARTNERSHIPS WITH EMPLOYERS OF SCIENCE GRADUATES.



EXECUTIVE SUMMARY

THE WYOMING GOVERNOR'S UW TOP-TIER SCIENCE PROGRAMS AND FACILITIES TASK FORCE'S RECOMMENDATIONS WILL ELEVATE UW'S CORE SCIENCE DEPARTMENTS TO TOP-QUARTILE STATUS THROUGH DEVELOPMENT OF TRANSFORMATIONAL INTEGRATED RESEARCH AND TEACHING FACILITIES TO SUPPORT STUDENT AND FACULTY SUCCESS.

THE WYOMING GOVERNOR'S UW Top-Tier Science Programs and Facilities Task Force and the University of Wyoming Science Initiative Leadership Team propose a strategic investment to build on emerging growth areas in scientific imaging and integrative biology that will elevate UW's core science disciplines to nationally recognized top-quartile status, otherwise known as UW's Science Initiative.

Unique world-class science facilities increase national profile, federal funding, and statewide service. They also connect science disciplines within the state—and the nation—allowing UW researchers and students to address tomorrow's challenges.

Wyoming's science education will be transformed using active learning, which will boost student success and career prospects and better prepare Wyoming's K–12 teachers. Wyoming's economy will be strengthened and diversified. The Science Initiative will create a technically trained workforce in healthcare, technology, energy, and natural resource management. It will enhance the value of Wyoming's agriculture, energy, and technology. All of this, in turn, will assure Wyoming's natural heritage and promote a high quality of life.

The Science Initiative involves three central elements:

1. modern state-of-the-art research centers to house new facilities for imaging; advanced biological, chemical, and physics research; and astronomical exploration;
2. active learning classrooms and programs to fundamentally transform science education in the state; and
3. programs to stimulate research innovation and student training in emergent areas of science relevant to the Wyoming's economy.

We have identified two phases for the development of the Science Initiative. Development of both phases is essential to move the core sciences at UW to top-quartile status. The transformational impacts of Phase I are not dependent upon full implementation of Phase II. However, Phase II greatly magnifies the value, depth, and breadth of Phase I impacts.

In Phase I, we propose to develop two new research centers, to build active learning classrooms and a teaching and mentoring program, to implement three core innovation and training programs, and to significantly enhance UW's astronomy research potential.

In Phase II, we plan to renovate vacated spaces in the Biological Sciences and Physical Sciences buildings, the Aven Nelson building, and the east wing of the Animal Sciences-Molecular Biology building and to develop a new 4.3-meter telescope center on Jelm Mountain.

GOALS AND METRICS – UW SCIENCE INITIATIVE

The following goals metrics will be used to measure the progress of the Science Intiative.

Metric 1 – Increase the number of undergraduate students involved in a high-quality productive research experiences by 100% after full implementation of the Science Initiative.

Metric 2 – Improve the quality of UW undergraduate education, including students going into the K–12 teaching profession. All science and pre-service teaching graduates will have an active-learning classroom immersion after full implementation of the Science Initiative.

Metric 3 – Increase the 5-year undergraduate graduation rates for core science majors by 100% after full implementation of the Science Initiative.

Metric 4 – Increase the number of doctoral students graduated in each Science Initiative department by 25% after full implementation of the Science Initiative.

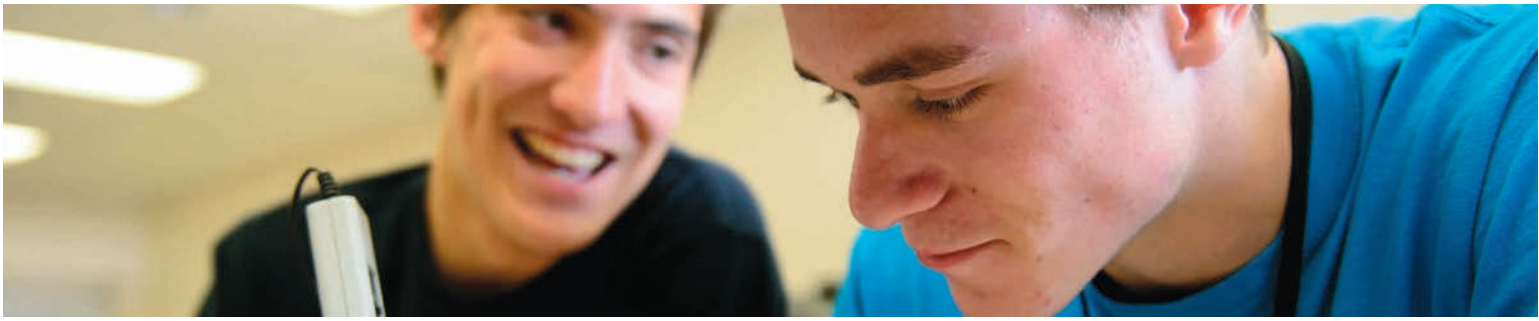
Metric 5 – Increase the number of published peer-reviewed manuscripts by Science Initiative faculty and students by 25% after full implementation of the Science Initiative.

Metric 6 – Increase dollar value of grants and contracts by 25% indexed to federal research funding levels after full implementation.

Metric 7 – Achieve top-quartile status in publication rate per full-time equivalent (FTE) and number of Ph.D.s per FTE relative to peer institutions after full implementation.

These goals and metrics are relevant to the full implementation of both Phases I and II as outlined in this report. Data collection to establish baseline status for these metrics will commence in 2015, with full annual updates thereafter.

WE MEASURE WHAT WE VALUE. THE SCIENCE INITIATIVE HAS ESTABLISHED A SERIES OF FOUNDATIONAL GOALS AND METRICS THAT WILL COLLECTIVELY LEAD THE UW CORE SCIENCES INTO THE TOP QUARTILE.



PHASE I

TRANSFORMATIVE RESEARCH CENTERS

Two new research centers—the Center for Advanced Scientific Imaging and the Center for Integrative Biological Research—will form an innovation nexus to stimulate external funding and research productivity and to train the next generation of Wyoming science scholars, teachers, and researchers. Equipped with strategically placed collaboration spaces, the centers will be housed in a single science complex, which will serve to develop interdisciplinary research activities involving chemists, physicists, astronomers, and biologists. Collaborative research activities across disciplines in the core sciences will transform the way UW investigates and teaches science.

- *A Center for Advanced Scientific Imaging* (CASI) will co-locate UW's elite imaging scientists, their student teams, and unique instrumentation in a state-of-the-art staffed laboratory, allowing them to achieve unprecedented sensitivities and efficiencies in probing the fundamental interactions among atoms, molecules, and cells that underlie all next-generation technologies. The center will rank among the world's best, attracting faculty and students from across the globe as it spotlights Wyoming's commitment to the sciences that serve state and national needs.
- *A Center for Integrative Biological Research* (CIBR) will bring together UW's world-recognized biologists into a single collaborative space to foster innovation and convergent research activities addressing some of Wyoming's most pressing environmental and health-related challenges. The center will be organized around state-of-the-art plant growth and laboratory animal research facilities specially designed for studies using model and transgenic organisms with appropriate safeguards. The facility will include modern research laboratories and collaboration spaces for faculty-led research teams conducting new and convergent studies in strategic areas of life sciences.

ACTIVE LEARNING CLASSROOMS AND PROGRAMS

- *Active Learning Classrooms*. New facilities will include a suite of active learning classrooms that will enable all UW science majors—including future science teachers and 72% of students university-wide—to participate in highly interactive laboratory and classroom environments. UW will surpass peer institutions in the fraction of students educated in such an immersive pedagogical setting in order to ensure their success in a 21st century technological society. These transformative classrooms will be fully leveraged with instructors appropriately trained in their use.
- *Learning Actively Mentoring Program* (LAMP). We will develop and implement a program to train UW faculty, students, and future K–16 teachers on the most effective use of active learning techniques in science.

RESEARCH INNOVATION AND TRAINING PROGRAMS

More top-quality faculty and students are ultimately required to elevate UW's science programs to top-quartile status. New innovative programs to recruit, train, and retain top-tier students and faculty include the following.

- *Wyoming Research Scholars Program* (WRSP) matriculates top high school students from Wyoming and gives undergraduates early research involvement.
- *Ph.D. Fellowship Program* (PhDFP) draws the best doctoral students from the U.S. and worldwide, augmenting their training with strong research and teaching components.
- *Competitive Research Innovation Program* (CRIP) will enable UW to attract and retain the nation's best faculty in emergent areas of science relevant to the state of Wyoming.

PHASE II

TRANSFORMATIVE RESEARCH CENTERS – RENOVATIONS IN SUPPORTING SCIENCE BUILDINGS

- Undergraduate teaching labs and teaching support rooms vacated in the Biological Sciences building (5,670 ft^2) and Physical Sciences building (24,568 ft^2) will be renovated to provide new research spaces and small active-learning studio classrooms for upper-division and undergraduate biology, chemistry, and physics courses.
- Complete abovegrade building transition features will be constructed between the new CASI-CIBR center and the existing Biological Sciences and Physical Sciences buildings.
- The Aven Nelson building (34,294 ft^2) will be fully renovated to accommodate the nationally prominent Rocky Mountain and Solheim herbaria with room to accommodate future collection growth, labs for faculty and students engaged in herbarium-based research, and the UW Herbarium Library.
- The vacated molecular biology wing of the Animal Science-Molecular Biology building (25,291 ft^2) will be renovated to accommodate needed expansion for the Animal Science department, with its use dedicated to the Department of Animal Science.
- A transformative research center—the Wyoming Astronomical Observatory (WAO)—will be constructed. By hosting a 4.3-meter telescope, WAO would rank as the 4th largest in the country and among the 20th largest in the world. The observatory would generate instant recognition as a national facility and catapult UW into the top five U.S. institutions capable of conducting long-term astrophysical research. The observatory simultaneously serves as a research, teaching, fundraising, and public education centerpiece, inspiring young scientists to pursue higher education and careers in science, technology, engineering, and mathematics (STEM) fields.

These initiatives satisfy the requirements for addressing future challenges noted in the 2014 National Research Council report *Furthering America's Research Enterprise*. These requirements include: 1) **a talented, interconnected workforce**, 2) **adequate, dependable resources**, and 3) **world-class basic research in all major areas of science**. This Science Initiative positions UW to play a leading role in producing the knowledge and the scholars that will drive the information-based economy of our state and nation. Together, they will utilize rich opportunities in technology, environmental, health science, energy, education, and science literacy and promote broad understanding of our planet and universe. This is a **critical moment**, a once-in-a-generation opportunity, to place Wyoming's sole public research institution into the top quartile of U.S. science programs.

The Science Initiative includes programs that ensure success for all students, including many first-generation students at UW and students from other groups underrepresented in STEM fields. Active learning classrooms and one-on-one mentoring in research as proposed within the Science Initiative will improve learning outcomes for all students. By providing different perspectives, diversity in the student body contributes positively to educational experiences while diversity in the workforce contributes to strategic problem-solving with broad economic benefits to the state. Also, with the elevation of our programs and facilities to the top quartile, we will be able to better recruit the best faculty from diverse groups. These new faculty from underrepresented groups will bring new ideas and directions to the research enterprise and be able to mentor our diverse student body.

"WYOMING RESIDENTS WILL SEE BENEFITS THAT IMPACT CROPS, LIVESTOCK, FORESTS, WATER, AND LAND USE."

ROBERT GRIEVE, Founder & Executive Chairman of the Board, Heska Corporation

"THE BEDROCK OF THIS PROPOSAL IS FORMED BY EXISTING FACULTY AND THE COLLABORATIVE SCIENTIFIC CULTURE THAT HAS BEEN CREATED AT UW AND DEMONSTRATED BY THE CAMPUS LEADERSHIP TEAM ASSEMBLED TO WORK WITH THE TASK FORCE IN THE DEVELOPMENT OF THIS RESPONSE. THE TASK FORCE WAS EXPOSED TO FACULTY WORKING WITH A COLLABORATIVE SPIRIT ON THE CHALLENGE POSED BY THE LEGISLATURE, WHILE ALSO WITNESSING REMARKABLE RESEARCH ACCOMPLISHMENTS BEING MADE IN EXISTING, CRAMPED AND VERY SUBSTANDARD, RESEARCH FACILITIES."

PROFESSOR CAROL BREWER AND FORMER GOVERNOR DAVE FREUDENTHAL, co-chairs

UW CORE SCIENCES OVERVIEW AND CONTEXT

THE FIVE CORE sciences addressed by this initiative are *fundamental sciences,* meaning that their purpose is to understand *what exists in nature* and *how it works* according to the precepts of biology, chemistry, and physics.

Fundamental discoveries emerging from the physical and biological sciences become the foundations of future technology, engineering, and medicine. Transistor theory, developed in the 1930s and 1940s, produced the computer revolution of the 1980s. The discovery in the 1950s that DNA molecules were the source of inherited genetic information is now starting to yield gene-derived therapies for human, wildlife, and plant diseases.

Similarly, the fundamental discoveries from today's scientific imaging and integrative biology programs will uncover even more basic workings of the natural world that will arm coming generations of engineers, doctors, naturalists, and agriculturalists with the raw materials needed to promote a productive and sustainable planet Earth. This initiative aims to stimulate the knowledge and development of young scholars responsible for the future of the state and nation.

In science, like in business or real estate, *location matters*. Investments in facilities that bring together core capabilities and provide fertile ground for collaboration lead to fundamentally new and convergent approaches for tackling complex scientific problems and thereby forge opportunities for faculty to be competitive nationally for research dollars.

The creation of state-of-the-art core facilities centralized within a new science complex at the University of Wyoming, coupled with programs for research plus active learning classroom spaces is key. Interactions within a common unique facility will propel programs in astronomy, physics, chemistry, molecular biology, zoology, and botany to top-quartile status. A recent model for this level of success at UW is found in the UW Stable Isotope Facility (Box 1).

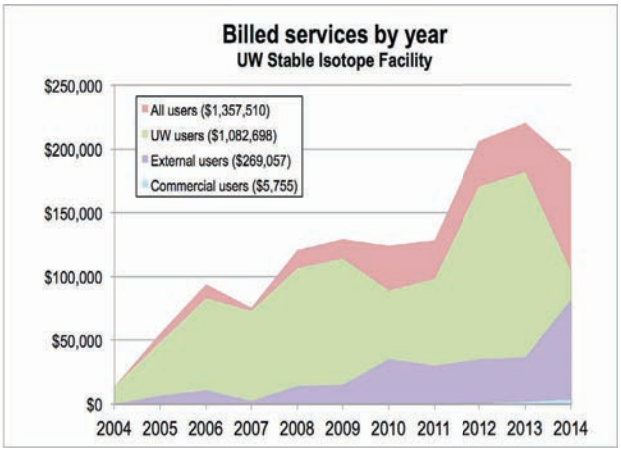
BOX 1. THE UW STABLE ISOTOPE FACILITY — A MODEL FOR THE SCIENCE INITIATIVE

The University of Wyoming Stable Isotope Facility (UWSIF) (www.uwyo.edu/sif/) was established in 2003 through a cooperative arrangement between the University Research Office and colleges of Arts and Sciences and Agriculture and Natural Resources. The UWSIF specializes in stable isotope ratio measurements on environmental samples such as water, animal and plant tissue, air, soil, and rock. Isotope ratios record and trace the origin and history of events that shape an organism's life and its surrounding environmental conditions.

Centralization of the facility within modern and purpose-built laboratory space in the Berry Biodiversity Conservation Center has stimulated research innovation, cross-disciplinary programming, and national recognition. The facility is now one of the top stable isotope laboratories in the country, supporting ecology and environmental research. The UWSIF was recently awarded the sole contract with the National Science Foundation National Ecological Observatory Network (NEON) for isotopic and chemical analysis of soil samples from this national network of sites. In 2014, the UWSIF provided analyses and research consulting for 17 research groups at UW from six departments in three colleges; 32 university research groups across the U.S. outside of UW; two university research groups outside the U.S.; two non-academic research agencies (the U.S. Department of Agriculture and NEON); and two private companies. The four key ingredients that explain the success of the UWSIF are: 1) commitment and collaboration among a core group of faculty researchers from across the university; 2) a supportive university administration; 3) modern laboratory infrastructure within the Berry Biodiversity Conservation Center; and 4) the presence of highly trained staff scientists and technicians within the facility.

TIMELINE OF SUCCESS

2003 – Recruitment of faculty leadership and founding as a university core facility
2004 – First National Science Foundation instrumentation award for new isotope ratio mass spectrometers
2006 – Academic Professional Research Scientist position created with leverage from NSF EPSCoR
2009 – Second NSF instrumentation award for highly specialized isotope ratio mass spectrometers
2011 – Move to the Berry Biodiversity Conservation Center
2013 – UW Research Office support for instrumentation required for analysis of NEON samples
2014 – NSF NEON award



BUILDING ON EXISTING STRENGTH. EACH ACADEMIC YEAR, UW'S FIVE CORE SCIENCE DEPARTMENTS SECURE OVER 25% OF UW'S TOTAL RESEARCH DOLLARS, AWARD 20% OF THE INSTITUTION'S PH.D.S, PUBLISH MORE THAN 250 PEER-REVIEWED SCIENTIFIC ARTICLES, AND TEACH NEARLY 10% OF UW'S TOTAL STUDENT CREDIT HOURS. THE SCIENCE INITIATIVE WILL FURTHER ELEVATE UW'S ELITE STUDENTS AND FACULTY.

The core science departments at the University of Wyoming (Botany, Chemistry, Molecular Biology, Physics and Astronomy, and Zoology and Physiology) comprise 91 of the University's 750 faculty, roughly 210 of the 1,000 graduate students on campus, and 800 of the UW undergraduate students. These departments produce about 13 of the university's 60 Ph.D. degrees each year—65 Ph.D.s in total over the last 5 years. In fiscal year 2012, these five departments generated $22 million of external funding, which is 25.7% of total research dollars awarded to UW. This amounts to approximately $254,000 per year per full-time faculty member. Research faculty in these five departments published 1,261 articles in peer-reviewed international journals between 2010 and 2014 (252/yr), including a number of papers in the top science journals in the world. These five departments provide the foundational science coursework for all majors in the colleges of Agriculture and Natural Resources, Arts and Sciences, Education, Engineering and Applied Science, and Health Sciences, which is roughly 8% of all student credit-hours taught at UW each semester—roughly the same as each of the colleges of Agriculture and Natural Resources, Business, or Engineering and Applied Science.

Several examples demonstrate how targeted strategic investments and construction of new state-of-the-art building spaces have led to national competitiveness and expanded external funding for the sciences at UW. One clear example involves the creation and growth of the University of Wyoming Stable Isotope Facility. This facility received UW Research Office and National Science Foundation support, was placed in the Berry Biodiversity Conservation Center in 2012, and now ranks among the top facilities in the country. See the highlight box below for more details on the world-class UW Stable Isotope Facility (Box 1).

PHASE I – TRANSFORMATIVE RESEARCH FACILITIES

THE CENTER FOR ADVANCED SCIENTIFIC IMAGING (CASI)

Currently, UW researchers in the core sciences operate $9 million worth of sensitive imaging and microscopy instrumentation, which is scattered across campus in 50-year-old and older buildings. At UW, researchers in the core sciences seek to understand and view the properties and interactions of single atoms, molecules, physical material surfaces, and complex biological structures and their functions in viruses, microbes, plants, and animals.

Our understanding of physical and biological structures at the atomic and molecular scale will become the basis for new generations of solar cells, nano-computers, genetic-therapies, solutions in agriculture and the environment, and as-yet-unanticipated inventions. These same technologies will be used in remote sensing applications to reveal the presence of organisms or pathogens in locations inaccessible to humans, such as ocean depths, volcanic basins, and other planets.

It is essential that Wyoming supports and participates in this burgeoning area of basic science. The center will host 10 configurable state-of-the-art rooms for existing and new microscopy and imaging instruments that require vibration-free radiation-free climate-controlled environments. Common needs include cooling with liquid helium or nitrogen and stable electrical power supply for a co-location of these instruments. Lack of suitable lab space has prevented UW's elite faculty from competing with peer institutions for funding and has demonstrably caused these faculty to seek employment elsewhere. The center, staffed by dedicated technicians, will spur cutting-edge research results that will bring UW to national prominence while helping to attract and retain the nation's best scientists.

Co-location of CASI in a proposed life science complex building, which would also host the Center for Integrative Biology Research, would be ideal. This center would bring together the departments of Chemistry and Physics and Astronomy in the Physical Sciences building, the Department of Zoology and Physiology in the Biological Sciences building, and the department of Molecular Biology and part of Botany in a new building within the footprint of the space between the existing Biological Sciences and Physical Sciences buildings. Some of Botany would remain in Aven Nelson. The new building would also include CASI, CIBR, and the active learning classroom suite. The combination of these three facilities and the connections among the biological sciences and physical sciences within one complex are at the heart of this functional interdisciplinary facility.

TOP-QUARTILE FACULTY AND PROGRAMS ARE SUPPORTED BY TOP-QUARTILE FACILITIES.

THE SCIENCE INITIATIVE WILL DEVELOP STATE-OF-THE-ART RESEARCH FACILITIES WHERE STUDENTS AND FACULTY CAN ENGAGE IN CROSS-DISCIPLINARY RESEARCH TO ADDRESS CURRENT AND FUTURE CHALLENGES TO BENEFIT THE STATE AND NATION.

Chemistry and Physics Imaging Core

Future advances in critical technologies such as selective fossil fuel conversion/upgrade, fuel cell design, and photovoltaics (solar energy) all rely on the design of nanoscale materials and catalysts with atomic-scale control. The critical tipping point between molecular and macroscopic engineering has arrived in just the past decade: we now have the ability to design, control, and exploit nanoscale materials and devices. Instruments such as atomic force microscopes (AFMs), Transmission Electron Microscopes (TEMs), and X-Ray Photoelectron Spectrometers (XPSs) are essential in modern nanomolecular materials research.

Noise, vibrations, changes in temperature or humidity, and electronic signals all interfere with the ability to measure and manipulate single atoms. Antiquated campus structures housing today's multi-million dollar instruments are inadequate and present a serious barrier to achieving world-class results from UW's laboratories.

Biological Imaging Core

Instrumentation for biological imaging in the proposed CASI will provide cutting-edge capabilities to researchers across several disciplines and departments at UW, including Zoology and Physiology, Molecular Biology, Botany, Microbiology, Veterinary Science, Animal Science, Pharmacy, Chemistry, and Chemical Engineering. These instruments will allow for new imaging modalities and capacity that will greatly expand the scientific frontier for UW researchers, ultimately yielding new discoveries, greater prestige for the University of Wyoming, and increased external funding. The fact that related discoveries in biological sciences were deemed worthy of the 2008 Nobel Prize in Chemistry (for the discovery of green fluorescent protein) and the 2014 Nobel Prize in Chemistry (for the generation of super-resolution microscopy) is a testament to the critical importance of microscopy and material imaging to biological and health-related research. The model for the Biological Imaging Core in the center will be particularly cost-effective and is well-suited as a component of centralized life-sciences on campus.

Sustainability

The Leadership Team will adopt a cost-recharge break-even financial model for daily operation of CASI. Nonetheless, equipment replacement and expansion into new imaging technologies and capabilities require some level of continued external investment. Here, the center will compete for external funding from federal sources, such as the National Science Foundation, and internal funds provided through the Science Initiative Competitive Research Innovation Program proposed in this document. Staff support for the center is critical to its success, as the expensive, complicated, and delicate instruments require professional expertise for proper

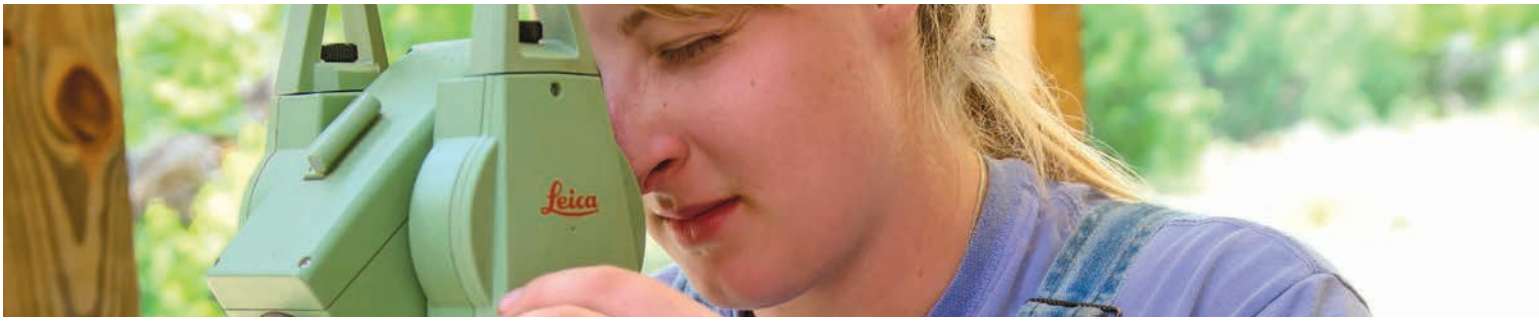
operation and maintenance. We propose to add six staff positions to the existing six research scientists already supported by UW for the activities of the center.

CASI will be a locus for private and corporate investment in the imaging science groups. Like the Stable Isotope Facility, this collection of advanced imaging technology will facilitate UW research collaborations and attract outside contract-based users. Faculty will partner with the Office of Research and Economic Development and the UW Foundation to engage with potential corporate sponsors for maintenance of the equipment and may create opportunities for collaboration with researchers from other institutions.

The Chemistry and Physics Imaging Core and Biological Imaging Core in the center will co-locate a suite of existing and new imaging equipment:

- **Scanning Tunneling Microscopes and Atomic Force Microscopes** – capable of imaging and manipulating matter at the atomic level (*existing*)
- **Nuclear Magnetic Resonance Imagers and Spectrometers** – for probing atomic nuclei (*existing*)
- **Super-resolution microscope** – to resolve molecular localization in cells with nanometer resolution (*proposed, $800,000*)
- **Transmission Electron Microscope and an X-Ray Photoelectron Spectrograph** – for mapping structures just a few atoms in size (*existing*)
- **New Transmission Electron Microscope** (TEM) – with the capacity of corrective microscopy that combines imaging modalities, thereby enabling investigators to identify structures at the light microscopy level and then study the structure at the electron microscopic level (*proposed, $900,000*)

- **High-Pressure Freezing and Freeze-Substitution** – for TEM sample preparation; this has become the gold standard for TEM sample preparation, replacing chemical fixation (*proposed, $400,000*)
- **Multi-photon excitation microscope** – to visualize structures at the subcellular and cellular levels at penetration depths currently unachievable with any other system at UW (*proposed, $1.2 million*)
- **Laser scanning confocal microscope** – for 3-D imaging and reconstruction of fixed specimens (*existing*)
- **Spinning disk confocal and FRAP microscope** – for high throughput 4-D imaging of molecular localization and dynamics in living cells (*existing*)
- **Scanning electron microscope with 3-D capacity** – allows efficient high-resolution imaging of larger tissues (such as brain tissue) at 3-D level (*proposed, $800,000*)
- **Imaging flow cytometer** – allows quantitative analysis in conjunction with microscopy imaging (*proposed, $500,000*)
- **High-resolution dissecting microscope** – allows high-resolution imaging of large intact tissues or animals three-dimensionally (*proposed, $100,000*)
- **Environmental chambers** that fit to the current/new microscopes – allow long-term live cell imaging (*proposed, $200,000*)



CENTER FOR INTEGRATIVE BIOLOGICAL RESEARCH (CIBR)

The areas of biological research holding the greatest promise for addressing future challenges in the environment and medicine occur at disciplinary boundaries with integration across genetics, molecular biology, physiology, and ecology. Major advances in biological understanding and technological innovation also rely heavily on tools and approaches from physics, chemistry, and computation. We aim to establish a center for research innovation in the core biological sciences by creating a nationally recognized facility where UW's world-renowned faculty in botany, molecular biology, and zoology can conduct research jointly with collaborators from chemistry and physics using a suite of advanced tools and facilities.

Core facilities within CIBR will include state-of-the-art plant growth and laboratory animal research facilities; shared research laboratories optimized for studies in molecular biology, physiology, genetics, and ecology; and office suites for faculty, research staff, and graduate students from the departments of Botany, Molecular Biology, and Zoology and Physiology.

Advanced research and training in the biological sciences rely heavily on precisely controlled environment facilities where animal rearing and plant growth can be carefully manipulated. Laboratory animal and plant growth facilities are ideally centralized and positioned near other core research infrastructure. Such proximity is especially important for studies requiring measurements and image analysis on living specimens so that the responses of cells, tissues, and organs to experimental manipulation can be observed. Laboratory animal and plant growth facilities must also have dedicated staff and areas for research support, and a modern animal care facility further requires secure access to ensure proper quarantine, security, and safety. The building will include strategically arranged incubation or "collision" spaces where faculty and students from all the core science departments can work on new ideas, share novel findings, and communicate their work to their peers and the public in an open environment.

Laboratory Animal Facility

We request a modern core facility for rearing laboratory animals used in fundamental biological and biomedical research. Suitable facilities for laboratory animal care have become a limiting factor for research at UW. This resource is crucial to allow UW scientists access to state-of-the-art organisms and animal strains. Such a space will need to meet the stringent new Association for Assessment and Accreditation of Laboratory Animal Care standards that will be required of all future facilities and researchers. The proposed facility will include 1) quarantine facilities to meet Biosafety Level 2 requirements, 2) rigorous control systems to ensure constancy of internal environments, 3) separate entrances for receipt of new animals and egress of resident animals to research labs, and 4) separate spaces for housing and care of mice, birds, and aquatic species.

Plant Growth Facility

The University of Wyoming can readily achieve national significance and become a leader in plant biology with a modern plant growth facility. We propose to establish a centralized shared facility with state-of-the-art greenhouses, growth chambers, and teaching and research laboratories. Our proposed facility will enable precise and independent control of humidity, air temperature, light, and CO_2 concentration. These spaces will be ideal for study of plant genetics and development, as well as physiological and growth responses to environmental stresses, such as drought.

"WE ARE PROPOSING BUILDINGS TO MATCH OUR EXCEPTIONAL WYOMING MEN AND WOMEN."

DR. A. BRENT EASTMAN, M.D., FACS, former president of American College of Surgeons

PHASE I – ACTIVE LEARNING CLASSROOMS AND LEARNING ACTIVELY MENTORING PROGRAM

ACTIVE LEARNING CLASSROOMS

A transformative element of the Science Initiative will be construction of four Active Learning Classrooms (ALCs) for core science courses in biology, chemistry, and physics. Intended to complement the new laboratory instructional spaces in the Enzi STEM building, these active learning classrooms will replace the large theater-style lecture halls with single-level layouts that promote collaborative work among students and instructors during highly interactive and engaging "lecture" sessions. Working groups of 6-9 students will gather throughout these classrooms at round tables supported by computers and video displays that can be connected and shared across the class. Through active learning approaches, traditional lectures are replaced with a variety of learning opportunities facilitated by the instructor (e.g., short interactive lectures, small group discussions, problem sets, case studies), further supported by rich web-based learning opportunities offered outside of class (e.g., short mini-lectures on focused concepts, video animations of these concepts, questions and quizzes to gauge student comprehension before coming to class). Together, this allows students to explore concepts more deeply and engage in higher-level thinking, discussions, and analysis during class. All core science department courses enrolling more than 40 students will be accommodated by these four ALCs (one 200-person, one 150-person, one 100-person, one 50-person), **which will serve over 3,750 UW students each semester**.

The benefits of active learning are supported by a meta-analysis of 225 research studies on active learning recently published in the Proceedings of the National Academy of Sciences, which reported two key findings:

- students in traditional classrooms are **1.5 times more likely to fail** a class than students in active-learning classrooms and
- students score significantly higher on in-class exams and concept inventories with active learning, leading to increased understanding and, consequently, higher course grades.

UNDERGRADUATE SCIENCE EDUCATION IS A PRIMARY MISSION. NEW ACTIVE LEARNING CLASSROOMS AND FACULTY MENTORING PROGRAMS WILL TRANSFORM UNDERGRADUATE SCIENCE EDUCATION AT UW TO IMPROVE STUDENT LEARNING, SUCCESS, AND ENGAGEMENT. OVER 72% OF ALL UW STUDENTS, INCLUDING ALL FUTURE K–12 TEACHERS, WILL LEARN THROUGH THESE HIGHLY INTERACTIVE AND COLLABORATIVE LEARNING APPROACHES.

"THE TIER I ENGINEERING TASK FORCE AND THE SCIENCE INITIATIVE HAVE A GROWING COLLABORATION ESTABLISHED ON ACTIVE LEARNING. THIS WILL HAVE A STRONG IMPACT ACROSS UW."

TOM BOTTS, Co-chairman of the Tier-1 Engineering Task Force, vice president (retired) of Shell Oil Company

Commenting on this analysis, Nobel-winning physicist Carl Wieman remarks, "In undergraduate STEM education, we have the curious situation that, although more effective teaching methods have been overwhelmingly demonstrated, most STEM courses are still taught by lecture—the pedagogical equivalent of bloodletting."

Both the UW Physics department and Life Sciences Program have conducted research in several courses, demonstrating the positive impacts of active learning on UW students. Active learning "studio-style" physics classes taught at the 1000-level reported the following:

- average semester-long class attendance exceeding 90% compared to 74% in traditional formats,
- learning gains of 45% compared to 22% in traditional lecture settings,
- retention of 95% compared to 80% averages across entry-level science classes, and
- significantly higher levels of student satisfaction on end-of-semester evaluations.

Pre- and post-survey results from students enrolled in a freshmen-level science class in the Life Sciences Program showed statistically significant increases in the following:

- student interest in science and willingness to enroll in another science class,
- confidence in their ability to study science,
- interest in reading popular science books and science news stories, and
- confidence in discussing science topics with family and friends.

These UW studies support increased student success and engagement for both science majors and non-science majors. Importantly, the core sciences courses also **touch every K–12 pre-service teacher at UW**, many of whom remain in Wyoming as teachers. National research indicates K–12 teachers tend to teach the way they were taught in school. If we continue to utilize a lecture-only model, that instructional practice will continue to propagate across our K–12 system. Training college instructors in the best active learning practices will create a positive feedback loop that will transform not only the campus teaching culture but also K–12 education statewide.

Collectively, the core science departments will touch over 72% of all UW students in coursework delivered via these Active Learning Classrooms.

LEARNING ACTIVELY MENTORING PROGRAM (LAMP)

Comphrehensive, sustained mentoring, and professional development programs will be implemented to fully realize the potential of the ALCs. LAMP will hire two full-time APL Instructional Facilitators (2 x $100,000/yr, including benefits) who have advanced degrees in a STEM field, extensive experience and demonstrated success teaching with active learning approaches, and a strong publication record on research in active learning. These two individuals will provide training, mentoring, and sustained support for Science Initiative faculty, graduate students, and undergraduate students involved in teaching Science Initiative courses in the ALCs. The overall goal is to train all new Science Initiative faculty and graduate students and most of the existing Science Initiative faculty in Active Learning Strategies by 2022. Eventually, all Science Initiative faculty will be trained in these strategies.

Each year, LAMP Instructional Facilitators will initiate an intensive training and mentoring program for a new cohort of five Science Initiative faculty (partially support at $10,000 per faculty per year) and five Science Initiative graduate students (5 x $4,000/yr). During Year 1 of LAMP, mentorship activities will include the following:

- a week-long immersive LAMP Summer Institute,
- a weekly faculty development program where participants will learn about active learning and developing teaching materials,
- a weekly seminar series for graduate students where participants will learn about active learning and developing teaching materials,
- a bi-weekly brown bag reading series for faculty and graduate students, and
- weekly visits to ALCs in courses instructed by LAMP Instructional Facilitators with post-debrief and discussion.

During Years 2-3 of LAMP, faculty and graduate students will continue to be supported in the following ways.

- LAMP Instructional Facilitators will visit faculty and graduate student classes bi-weekly to provide feedback on active learning practices and provide suggestions on how to convert traditional lecture material into active learning opportunities (i.e., they will help design activities and help identify existing activities such as case studies).
- LAMP Instructional Facilitators will work with faculty and graduate students to develop and implement research studies in their classrooms on active learning and then take the lead on writing research articles for publication with faculty and graduate student collaborators. Under this model, we can use our ALCs as educational research spaces with the potential of making UW a national leader in science education research (in collaboration with similar work in the new Enzi STEM building).

LAMP Instructional Coordinators will also provide training for undergraduate students (40 x $1,000/yr) who will be hired to help facilitate active learning strategies in the larger ALCs (100- to 200-person rooms). Pre-service teachers will be sought for these positions, as this would provide them with additional mentoring in active learning approaches before they enter their teaching career. Undergraduates will be mentored through the following:

- weekly seminars built upon the pre-existing Practicum in Teaching Course (LIFE 4975) currently offered at UW and learn about active learning approaches and assessment practices and how to facilitate active learning in large classes,
- individual coaching as they help facilitate active learning strategies in ALCs, and
- individual opportunities to develop and implement their own active learning activity in one of the Science Initiative classes.

LAMP Budget: $310,000/yr

"STUDENTS GRADUATING FROM THE UNIVERSITY OF WYOMING WILL BE COMPETITIVE IN THE SCIENCE JOB MARKET AND, WITH GREATER LIKELIHOOD FOR SCIENCE-BASED COMPANIES FORMED IN WYOMING, THOSE STUDENTS WILL BE ABLE TO STAY IN WYOMING MORE FREQUENTLY."

ROBERT GRIEVE, Founder & Executive Chairman of the Board, Heska Corporation

PHASE I – RESEARCH INNOVATION AND TRAINING PROGRAMS

WYOMING RESEARCH SCHOLARS PROGRAM (WRSP)

UW will implement a university-wide program to pair undergraduate students with faculty mentors to participate in cutting-edge research starting as early as the freshman year. The majority of practicing scientists, as well as corporate and civic leaders, credit an early research opportunity in college as having a profound effect on affirming their career path and on their personal growth. Research internships demonstrably build confidence and competence in young scholars at a formative stage in their training (Box 2).

The Wyoming Research Scholars Program will do the following:

- attract top Wyoming high school graduates, including home-schooled individuals, to UW;
- retain promising students in sciences at UW through early involvement in science research, department seminars, and public outreach events;
- pair talented college students with a faculty mentor who can model the scholarship, teaching, service, and outreach activities of a professional scientist; and
- teach science writing and presentation skills to undergraduates via regular participation in UW's Annual Undergraduate Research Day and public outreach events (e.g., UW Planetarium, Biodiversity Institute).

Students continue to be eligible for WRSP funding provided they maintain a 3.3 grade point average and make consistent progress as a full-time student toward a degree. The WRSP cohort will participate in a 1-credit seminar class each year to learn the scientific process, ethics, public speaking, and writing. Junior and senior students will collaborate with the Science Initiative Ph.D. fellows and faculty mentors in research and spend one semester as a peer instructor in active-learning classrooms. Twenty-five students per year will be funded under the program, for a total of 100 UW students at any time. Students would receive a stipend (about $3,000/yr) and an allocation for student travel and research ($1,500/yr). There also will be a stipend for the faculty mentor ($1,000/yr). The program will be overseen by two full-time academic professional lecturers (one per 50 students; 2 x $100,000/yr, including benefits).

Total Program cost: $900,000/yr

BOX 2. EXAMPLE OF THE VALUE OF STUDENT RESEARCH LAB TRAINING TO EMPLOYERS

A few years ago, our company hired two freshly graduated B.S. level physicists. One came from an excellent school with a rigorous program that emphasized theoretical understanding. The other came from a very good school that required laboratory experience and a senior thesis, along with a core theoretical understanding.

Not long after their introductory periods were over, we assigned them to a team that was scheduled to carry out a very important field test of a new technology that we were developing. Success in this field test, in a very remote location, was critical to the company.

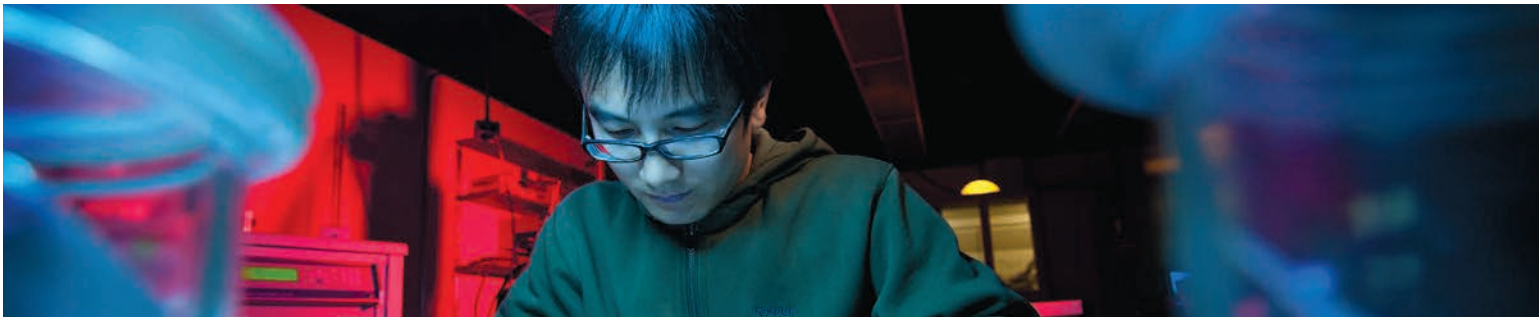
Shortly after the test began, we encountered problems with a piece of equipment. The equipment was essential to acquiring the data we needed, and we had no back-up.

Presented with this problem, the first junior physicist immediately tried to contact the company that manufactured the equipment to get the assistance of customer service. This was a reasonable course of action but unlikely to succeed due to, among other things, the time difference between the equipment supplier and our location.

Almost immediately, however, the second junior physicist grabbed his tool box, took out some tools, and started dismantling the outer housing. In very short order, he encountered (and resolved) the problem which, as I recall, was a loose cable connecting two circuit boards, probably jarred loose during transit. With the housing reinstalled, the equipment worked like new.

We acquired the data we needed, and the field test was a genuine success.

L.J. BURNETT, CEO, QUASAR Federal Systems Inc.



SUSTAINED PROGRAMS SUPPORT TRANSFORMATIONAL FACILITIES. THE SCIENCE INITIATIVE WILL GREATLY ENHANCE RESEARCH PRODUCTIVITY; STUDENT LEARNING OPPORTUNITIES; FACULTY HIRING, SUCCESS, AND RETENTION; AND ECONOMIC DEVELOPMENT FOR THE STATE THROUGH CREATION OF SUSTAINED RESEARCH SUPPORT PROGRAMS.

PH.D. FELLOWSHIP PROGRAM

Successfully addressing complex societal problems requires rigorous and creative scientific investigation using modern tools and methods and the capability to translate scientific findings and knowledge for policy makers, students, and the general public. One of the most critical functions of universities is to train the next generation of leaders in core scientific disciplines to meet future global challenges. The Science Initiative Ph.D. Fellowship Program will train the next generation of scientists by providing access to the newest and most advanced scientific facilities in the region with mentorship by some of the top faculty scientists in the world. The Ph.D. Fellowship Program will do the following:

- attract high-quality graduate students to the University of Wyoming,
- increase the number and quality of Ph.D. students graduating from UW to bring programs to top-quartile status in Science Initiative programs,
- train the next generation of leading scientists with skills: 1) to address challenging and relevant interdisciplinary problems, 2) to pursue successful careers in business and industry, governmental, and non-governmental organizations, and academia, and 3) to conduct effective outreach to citizens of the state and nation,
- stimulate an increase in successful research grant proposals from interdisciplinary researchers,
- provide hands-on mentorship for Science Initiative undergraduate research scholars (Wyoming Research Scholars Program), and
- reduce average time-to-degree for a UW Ph.D.

The Ph.D. Fellows Program will provide funding for 20 prestigious Ph.D. Fellowships within the core five science departments. Each Ph.D. student will undergo training and demonstrate competency in outreach and will perform one semester of active learning classroom teaching and/or undergraduate research mentorship (via the Wyoming Research Scholars Program), in addition to performing doctoral research. Fellowships would be awarded on a competitive basis to the most outstanding graduate applicants and last for 5 years, contingent on the recipient making adequate progress toward the Ph.D. Student support includes the Ph.D. stipend ($30,000/yr); tuition, fees, and health insurance ($8,100/yr); and $1,500 to be used for travel to professional meetings.

Total Program cost: $800,000/yr

COMPETITIVE RESEARCH INNOVATION PROGRAM (CRIP)

The central purpose of the Science Initiative CRIP is to elevate the stature of STEM research at UW by 1) providing the infrastructure to ensure top-tier science programs and 2) increasing total grant funding at UW for principal investigator-initiated research projects. Hiring top-tier faculty in the sciences now requires that UW supply upwards of $500,000 in startup funding that allows the new hire to construct a laboratory that can compete with the nation's other top-tier programs. Yet, $500,000 is only half the going rate at competitor institutions where startup packages routinely reach $1,000,000 or more. UW faculty hires in the sciences are currently bottlenecked by the ability to provide a competitive startup package, with departments currently taking turns on 3-year cycles. This is a systemic barrier that UW science departments face in reaching their potential to be top-tier programs.

The Science Initiative Competitive Research Innovation Program will provide $1.1 million per year to be used to supplement startup funding for the five core sciences where a major piece of equipment (e.g., an Atomic Force Microscope or a Nuclear Magnetic Resonance Device) can cost $500,000 to $1,000,000. This will help UW attract and hire the promising faculty and ensure success for them and their students, who require world-class equipment to compete against other top-tier institutions. This kind of success will also elevate the pool of high-quality students who are drawn to UW by the rich research opportunities in facilities like the Center for Integrative Biological Research and the Center for Advanced Scientific Imaging.

Despite the cost of modern laboratory equipment, most pieces have a functional life of perhaps 8-12 years, necessitating the replacement of these core facility instruments on a regular basis. The Science Initiative CRIP will provide an additional $700,000 per year to replace instruments that have reached the end of their functional life. Proposals from departments will be evaluated annually to determine the areas of greatest need. This funding could also be used by the college to retain faculty who have been offered positions elsewhere.

The program will also reserve $600,000 per year for a faculty innovation grant program to be used to encourage competitive grant proposals to federal and private agencies. Seed grants would provide 1- to 2-year funding at the levels of $30,000–$60,000 in order to allow faculty to jumpstart new or innovative research streams that are not yet mature enough to win extramural funding. These seed grants will encourage faculty to submit not only more proposals but more competitive proposals for extramural funding, especially in emerging cross-disciplinary areas that are ripe for rapid growth. Recipients of a seed grant would be expected to submit a competitive full multi-year proposal to the National Science Foundation, Department of Energy, National Institutes for Health, or similar federal agency within 2 years of receiving a seed grant.

Total cost: $2,400,000/yr

"THIS REPORT REFLECTS CONSIDERABLE THOUGHTFUL INPUT FROM MANY SOURCES. IT IS A GREAT FIRST STEP TOWARD REALIZATION OF THE UNIVERSITY'S ADVANCE IN THE SCIENCES AND WILL HOPEFULLY BE RECEIVED WARMLY BY THE GOVERNOR AND OTHERS."

FRED ESHELMAN, founder and CEO of Pharmaceutical Products Development and Senior VP for Glaxo, Inc.

PHASE II — RENOVATIONS IN SUPPORTING SCIENCE BUILDINGS AND TRANSFORMATIVE RESEARCH CENTER

A top-tier research university requires sustained investment in the people and infrastructure that is used to define top-quartile status. While Phase I addresses the initial part of this overarching plan, replacing and upgrading the remaining aging basic science infrastructure at UW requires a second phase of investment over an additional 4-year period. This second phase will serve to greatly magnify the effects of Phase I.

In Phase II, the undergraduate instructional labs in the Biological Sciences and Physical Sciences buildings, vacated due to the opening of the Enzi STEM Building, will undergo renovation to accommodate new research spaces in-line with goals central to the Center for Advanced Scientific Imaging and the Center for Integrative Biological Research. Renovation and a refined repurposing of the Aven Nelson Building is also included, as is the light-remodeling needed in the current Molecular Biology department wing of the Animal Science department to accommodate the critically needed new space for Animal Science. Finally, Wyoming and the university will recapture national prominence and national leadership status in astronomy with the construction of the Wyoming Astronomical Observatory on Jelm Mountain.

BIOLOGICAL SCIENCES AND PHYSICAL SCIENCES BUILDINGS RENOVATIONS

These buildings were commissioned in 1968 and, along with the original Science Library in the basement-level under the separating plaza, constituted a "sciences complex." The four-story Physical Sciences building houses the departments of Chemistry and Physics and the Division of Research Support, which consists of machine shops, electrical shops, and chemical storerooms that serve the entire university. The four-story (plus animal-rearing penthouse) Biological Sciences building houses the departments of Zoology and Physiology and Psychology. The Science Library has become "low-use storage" for the UW Libraries.

The construction of the Enzi STEM Building will make available 30,238 ft^2 of freshmen- and sophomore-level teaching labs and supporting adjacent rooms (e.g., prep, storage) in the old buildings, and so these spaces in

the Biological Sciences and Physical Sciences buildings will receive appropriate renovation, resulting in needed research, upper-division and graduate teaching, small meeting/seminar, and collaboration spaces that will augment and enhance the visions for the new centers in Advanced Imaging and Integrative Biological Research.

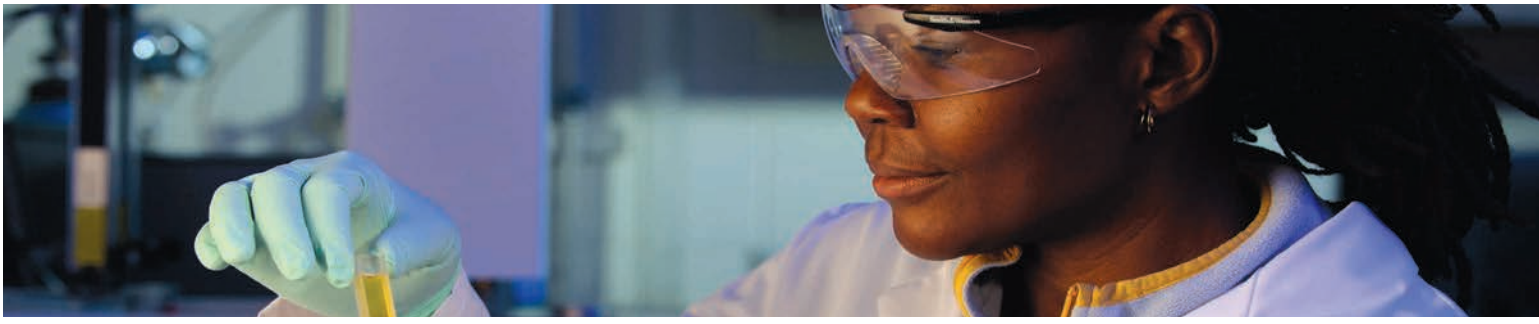
AVEN NELSON AND ROCKY MOUNTAIN HERBARIUM RENOVATION

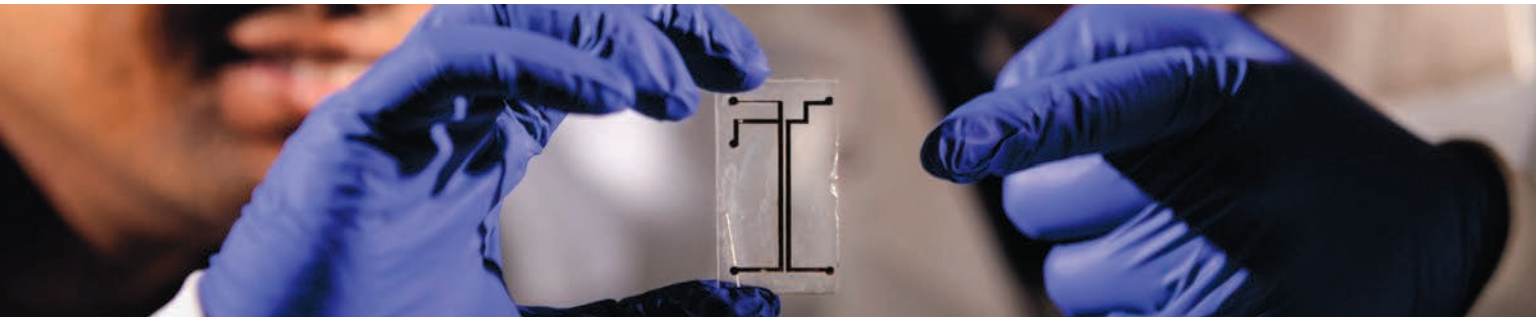
The Aven Nelson Building is currently the home for the world-renowned Rocky Mountain Herbarium (over 1.2 million specimens) and the Solheim Mycological Herbarium (50,000 specimens). When opened in 1922, the Aven Nelson Building served as the first library building for the University of Wyoming. In 1959, the building was renovated, including insertion of a full second floor on the south half. In 1960, the Botany department and Rocky Mountain Herbarium were moved from the Engineering Building to the second and third floors of Aven Nelson. In 1976, the Botany department became sole occupant of the building.

The Aven Nelson Building was not designed—nor renovated in 1959—to house a modern high-technology science department, and the building presents serious facility challenges for modern wet laboratory work. In contrast, the Rocky Mountain Herbarium, which Aven Nelson established in 1893, has flourished in the building and is perfectly suited for it. Because the Aven Nelson Building has heat only and no HVAC system, the year-round ambient environment is exceptionally dry. This naturally provides the ideal environment for herbarium collections (i.e., no insecticide use needed), as insects are the major threat to these collections.

The Rocky Mountain Herbarium is the crown jewel of natural history collections in the state. Nationally, it ranks 10th in size. With just over 750 herbaria in the U.S., the Rocky Mountain Herbarium ranks in the 98th percentile. It is the dominant herbarium in the interior western United States, and in the past 5 years, projects out of the herbarium have secured over $1 million in extramural grants and contracts. Botany master's degree students in the floristics program based in the herbarium are highly sought after for positions in government agencies like the U.S. Forest Service and Bureau of Land Management, non-governmental organizations like the Nature Conservancy, and environmental consulting agencies and as professional staff at other herbaria in the U.S.

ENHANCING EXISTING FACILITIES COMPLEMENTS NEW FACILITIES. THE FINAL "LIFT" TOWARD TOP-QUARTILE STATUS WILL BE ACCOMPLISHED THROUGH RENOVATION AND REINVIGORATION OF THE EXISTING RESEARCH FACILITIES THAT HELPED BUILD THE CORE UW SCIENCES THAT EXIST TODAY.





Nearly all of the assignable square footage on the third floor of the Aven Nelson Building is dedicated to the Rocky Mountain Herbarium—collections and work areas, 5,130 ft^2; collections support and storage, 865 ft^2; 400 ft^2 dedicated to the Herbarium Library, a branch of the University Libraries system—with the Mycological Herbarium (collections and work areas) assigned 892 ft^2. Both collections, but especially the Rocky Mountain Herbarium, desperately need expansion space for the herbarium cabinets that are necessary for safe museum-grade appropriate specimen storage.

The Aven Nelson Building would become the University of Wyoming Herbarium Building with the 3rd floor consisting of the herbarium and the second and first floor renovated to provide areas for the following:

- new space for the Mycological Herbarium and Herbarium Library,
- offices for curators, herbarium managers, and graduate students involved in herbarium research,
- a 30-seat active learning studio lab for plant and fungal taxonomy (teaching function for these collections),
- a public display area to showcase the functions and significance of research/teaching herbaria, and
- storage for the large volumes of field gear for ecological research.

EAST-WING – ANIMAL SCIENCE-MOLECULAR BIOLOGY RENOVATION

One goal of Phase II is to co-locate the Department of Molecular Biology, a key foundational science department, with the biological foundational departments of Botany and Zoology and Physiology. Co-locating the Molecular Biology department with the other foundational sciences on campus will provide east-wing expansion space for the Animal Science department—space needed to enhance the research capabilities and productivity of that department.

WYOMING ASTRONOMICAL OBSERVATORY (WAO) – A TRANSFORMATIVE RESEARCH CENTER

Wyoming scientists have been leaders in digital imaging and instrument design at the forefront of astrophysics since 1975 when UW constructed its 2-meter telescope to exploit the nascent field of infrared astronomy. Initially the world's 12th largest telescope and the first to be fully computer-controlled, the WAO has garnered more than $11 million in grants, returning 11-fold the $975,000 state investment. It has produced 45 Ph.D. students, hundreds of master's and undergrad students, and 115 professional publications as it helped to understand the formation of stars and planets. At an elevation of 9,700 feet, it is the second highest observatory site in the continental U.S., motivating the U.S. Air Force to fund studies of the infrared sky there to support its strategic defense operations.

Regular public open houses and tours have brought an estimated 12,000 Wyoming citizens to the facility's science education and outreach events. Every citizen of Wyoming is welcome to visit this science facility. It has served to inspire countless youth to pursue big dreams through higher education during science camp visits to Jelm Mountain.

In the 21st century, computationally intensive investigations using large data sets are at the cutting edge of astrophysics and demand high-precision imaging techniques unavailable on the previous generation of telescopes. We are in a period of burgeoning astronomical discovery in which many institutions are starting new graduate programs to reap the rich yield of cosmological and planetary science now accessible through modern imaging and spectroscopic techniques on research telescopes. Now is the time to rebuild this iconic facility so UW can once more compete with the new generation of advanced imaging instruments located elsewhere in the nation and world and to prepare the future generations of Wyoming students for careers in these competitive fields.

The Science Initiative will build a next-generation Wyoming Astronomical Observatory 4.3-meter telescope that will instantly elevate the university to elite status by placing it among the five U.S. institutions holding a less than 50% share of a research telescope, thereby allowing Wyoming to undertake world-class long-term investigations. About 40 U.S. institutions have some dedicated access (5-15%) to a research-grade 4-meter class telescope. UW is currently among the 158 Carnegie "high- and very highly research-active" universities that do not have such access. Wyoming's new telescope would be the 4th largest in the continental U.S. and among the top 20 worldwide. UW would elicit national recognition as a science powerhouse while allowing its scientists to build on existing expertise to harness the power of advanced imaging methods.

Key projects would detect and characterize planets orbiting other stars, answering some of humanity's oldest questions about the existence of planets and possibly life elsewhere in the universe. Searching for chemical signatures of life in the cosmos would unite astronomers with chemists, molecular biologists, and geologists, sparking a truly interdisciplinary endeavor. The telescope will serve as a focal point for outreach, education, scholarship, and fundraising. The observatory will do the following:

- foster instrument exchanges with other observatories, multiplying UW's science output and raising its national competitiveness,
- incubate university partnerships and perform contract-based programs, generating $10,000/night,
- attract and train students in image processing, time series analysis, and scientific instrumentation, and
- enable astrophysical discoveries that will feature UW prominently in national media.

Physics and Astronomy students, by virtue of their work at the observatory, will learn vital skills in instrumentation design, scientific programming, time-series analysis, image processing, optics, and motion-control algorithms that will prepare them for challenging careers in technological fields of science, engineering, computers, medicine, and more. Inclusion of this observatory as a prominent component in UW's research infrastructure enables Wyoming's collaboration of physicists and chemists to form a complete "atomic-to-cosmic" research paradigm spanning all 39 orders of magnitude in physical size within our universe.

CONCLUSION

The 2014 Wyoming Legislature asked us, the Wyoming Governor's University of Wyoming Top-Tier Science Programs and Facilities Task Force, to develop a plan to address outdated science laboratories at the University of Wyoming and to improve the quality of instruction and research in the sciences at UW. Working with a Campus Leadership Team made up of representatives of the core sciences at UW, we believe we have met that challenge.

Direct and Indirect Impacts for Phase I Programs

	✔ = Direct Impact ✔ = Indirect Impact	Active Learning Classrooms and LAMP	Wyoming Research Scholars Program	Ph.D. Fellowship Program	Competitive Research Innovation Program
Undergraduate student success	Recruit higher quality undergraduates	✔	✔		
	Improved student learning and performance	✔	✔	✔	✔
	Improved retention and graduation rates	✔	✔	✔	✔
	More competitive market-ready undergraduates	✔	✔	✔	✔
Ph.D. student success	Recruit higher quality graduate students			✔	✔
	Improved graduate student training	✔		✔	✔
	Increased production of Ph.D. graduates			✔	✔
	More competitive, market-ready graduate students	✔		✔	✔
Faculty success	Recruit higher quality faculty			✔	✔
	Better retention or higher performing faculty		✔	✔	✔
	Increase competitive funding potential for faculty		✔	✔	✔
	Increased faculty success in research funding				✔
	Increased research productivity faculty and students		✔	✔	✔

WYOMING GOVERNOR'S UW TOP-TIER SCIENCE PROGRAMS AND FACILITIES TASK FORCE

DECEMBER 2014