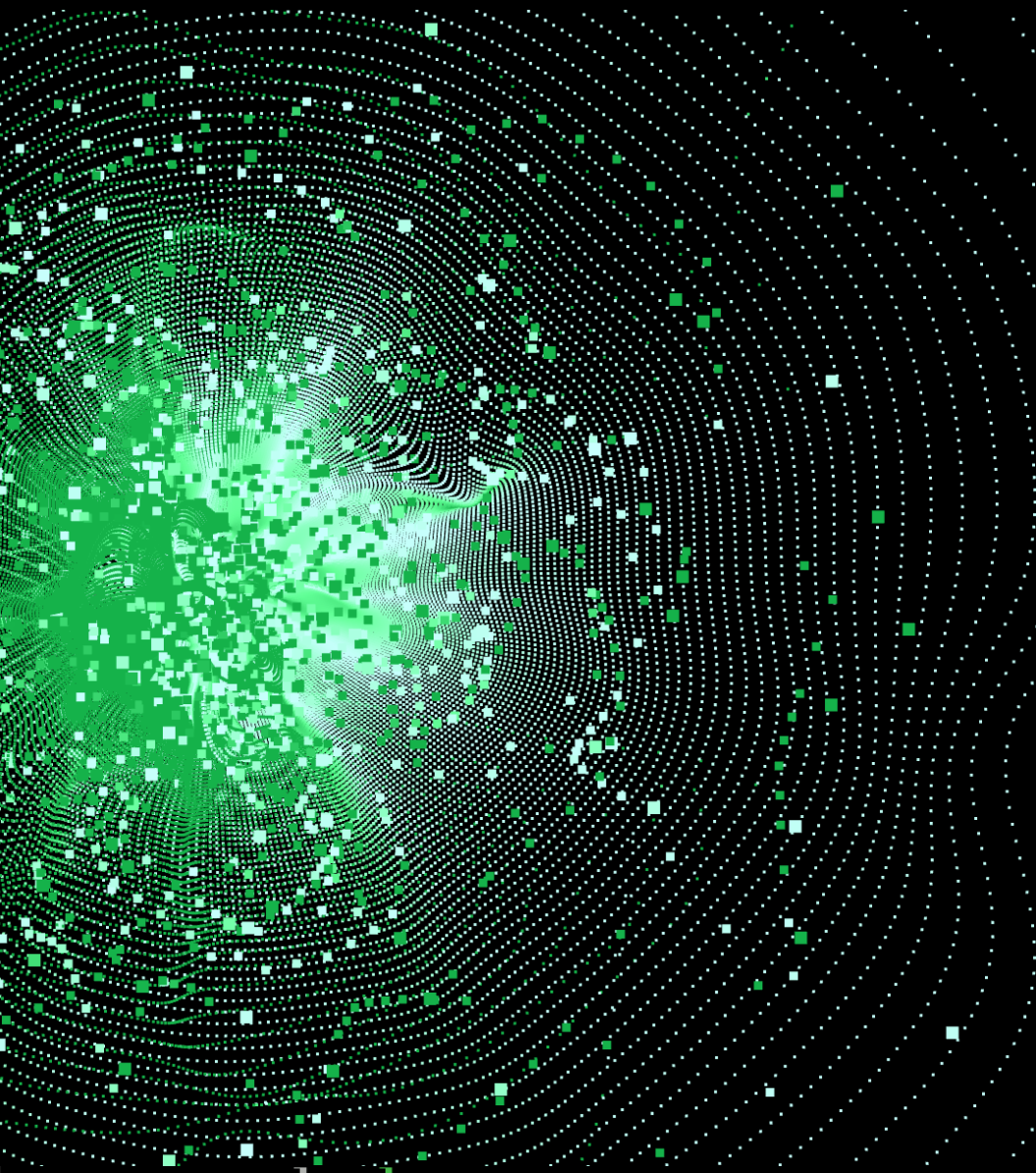
UNT UNIVERSITY OF NORTH TEXAS
Discover the power of ideas.



researchclusters

visionary collaborations across disciplines

We are committed to expanding UNT's research contributions in order to grow our identity as a national Tier One university. A guiding precept for the research clusters is that interdisciplinary collaborations generate new approaches to problem-solving that can lead to breakthrough discoveries. The clusters are funded through a $25 million commitment by the university as part of a long-term effort to bolster research, strengthen the state's economy and develop technology vital to addressing today's most pressing needs. The clusters initiative will attract premier research faculty to UNT and allow us to dramatically improve our already significant contributions to advances in knowledge as well as our research funding.

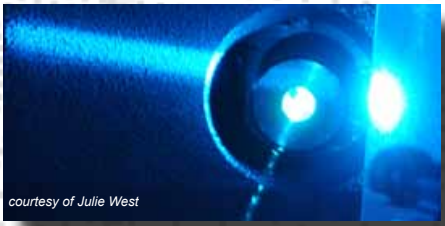
Wendy K. Wilkins, *Provost and Vice President for Academic Affairs*

Vish Prasad, *Vice President for Research and Economic Development*

The **University of North Texas** research clusters are collaborative, cross-disciplinary teams composed of leading researchers, faculty, students and institutions engaged in seminal research and the synergistic exchange of ideas and resources. Scientists, engineers, artists, philosophers and other scholars join strategies "outside the box" in visionary enterprise.

Hybrid thinking yields innovative solutions. By investing in diverse expertise and cutting-edge facilities within an interdisciplinary framework, UNT promotes creative, competitive methodologies that will transform applications across the sciences and humanities. In keeping with its goal to advance excellence in education, new knowledge and technologies as a leading research university, UNT actively recruits new talent for its clusters. For more information, visit **research.unt.edu/clusters** or any of the links on the following pages.

cluster teams


courtesy of Julie West

Bio/Nano-Photonics

Revolutionizing photonics-based solutions for medical, energy and other fields based on nano, molecular and macromolecular optoelectronic materials and devices

www.phys.unt.edu/photonics

Developmental Physiology and Genetics

Expanding the physiology and genetics of development as a base for pure and applied health-related research

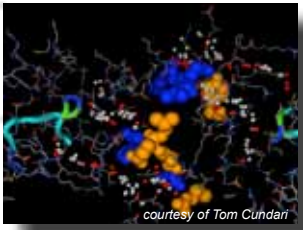
www.biol.unt.edu/dpgr


courtesy of Joshua Lawton

Initiative for Advanced Research in Technology and the Arts

Exploring emerging technologies and new media for novel interactions between the arts, engineering and sciences

iarta.unt.edu



Materials Modeling

Advancing the theory and design of materials through modeling and simulation across length and time scales to produce solutions in medicine, energy, the environment and other disciplines

mmrc.unt.edu

Renewable Bioproducts

Creating green solutions for the life cycle of consumer and industry products using plants, bacteria and other bioagent materials

www.mtse.unt.edu/bioproducts

Signaling Mechanisms in Plants

Harnessing the ways plant cells communicate to find solutions for energy, agriculture, nutrition and medicine

www.biol.unt.edu/signaling

Sub-Antarctic Ecosystems and Biocultural Conservation

Integrating ecological sciences and environmental philosophy to preserve and understand the biocultural diversity of the sub-Antarctic ecoregion

www.chile.unt.edu/cluster

courtesy of Julie West

Bio/Nano-Photonics

Revolutionizing photonics-based solutions for medical, energy and other fields based on nano, molecular and macromolecular optoelectronic materials and devices
www.phys.unt.edu/photonics

Bio-photonics, nano-photonics and bio-nano-photonics are contemporary fields that draw upon the expertise of research from physics, materials science, chemistry, electrical engineering, biology and medicine to form the basis for a whole range of novel technologies. Highly trained **Bio/Nano-Photonics** researchers examine how light can be used to develop new materials and devices with significant applications in medicine, telecommunications, energy and other fields, from using nano-prisms and metal atoms in cancer research to designing new sustainable lighting sources for homes and businesses. Central to the implementation of these studies is a new, state-of-the-art clean room facility that can synthesize new materials and fabricate devices, ranging from nano and micro to macro scales. Industry partners such as Texas Instruments, L3 Communications, Raytheon, DRS and the Center for Commercialization of Fluorescence Technology increase the total available brainpower, utility of facilities and analytical tools.

UNT researchers include:

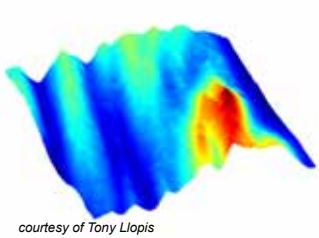
Tae-Youl Choi, assistant professor of mechanical and energy engineering
nanofabrication
Zhibing Hu, Regents Professor of physics
biopolymer research
Arup Neogi, professor of physics
semiconductor photonics
Mohammad Omary, professor of chemistry
molecular photonics
Douglas Root, associate professor of biological sciences
bioimaging

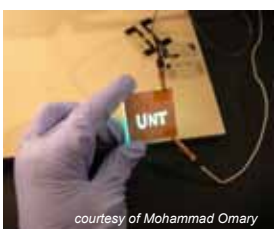

courtesy of URCM / UNT

Researchers use the Center for Advanced Research and Technology (CART), a facility that currently maintains and operates 27 state-of-the art instruments for the characterization and analysis of materials and nano/microdevices. CART is funded through a Department of Defense grant of $15 million plus local funds and includes a dual focused ion beam instrument (FIB), a scanning electron microscope (SEM), a high-resolution transmission electron microscope (TEM), and a 3-D local electrode atom probe (LEAP). UNT is one of only a few public universities in the U.S. with this unique complement of instruments.

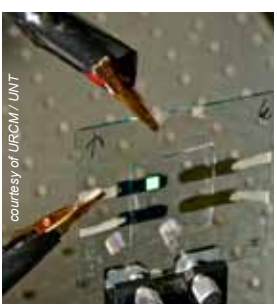
Ongoing, collaborative research projects:

- Diagnosis of oral cancer tissues using photodynamic therapy sensitizers
- Conjugation of quantum dots into polymer crystals
- Single molecule imaging and manipulation of myosin
- Nanofabrication using micro-electro-mechanical systems (MEMS) technology and focused ion-beam lithography
- Biomedical engineering using nanophotonics
- Custom molded biopolymers
- Drug delivery and cancer photothermal therapy
- Bio-molecular imaging: live single cell imaging using nonlinear optical spectroscopy
- Single photon source: photon engineering using metal nanoparticles in light emitting diodes
- Acoustical metamaterials: cloaking in hypersonic and ultrasonic regime
- Organic and inorganic light-emitting diodes, photovoltaics, and field-effect transistors


courtesy of Tony Llopis



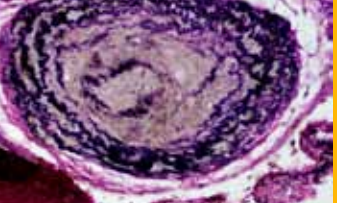
courtesy of Mohammad Omary


courtesy of URCM / UNT

The **Bio/Nano-Photonics** cluster is composed of a vibrant group of graduate students and highly multidisciplinary senior and junior researchers representing a spectrum of departments, schools and industries.

External cluster participants:

UNT Health Science Center at Fort Worth
University of Texas at Arlington, College of Engineering



Developmental Physiology and Genetics

Expanding the physiology and genetics of development as a base for pure and applied health-related research
www.biol.unt.edu/dpgr

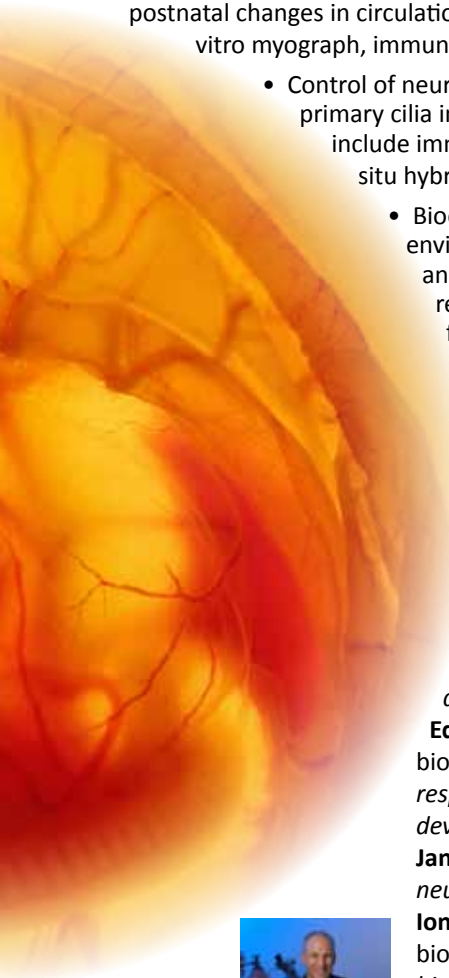
The study of how organisms develop, from gene to environment, is widely viewed as one of the most exciting and promising fields of contemporary biology. Focusing on developmental integrative biology, the **Developmental Physiology and Genetics** research (DPGR) cluster employs a highly collaborative approach to explore developmental physiology from the molecular to organismal levels, the relationship between physiological genomics and developmental processes, and interactions between genes and the environment as they influence cellular, physiological, morphological and behavioral development. New methodologies at the cellular and molecular level, combined with a burgeoning interest in physiological development and environmental biology, enable the **DPGR** cluster to explore a mechanistic understanding of the developing organism. The **DPGR** cluster also expands on its foundation in comparative animal physiology and genetics to conduct research to better understand development and associated human disease such as heart disease, blood clotting disorders and tissue trauma. Through the use of diverse animal models, the cluster collectively aims to identify major unifying principles of developmental integrative biology.

courtesy of URCM / UNT

courtesy of Perkins+Will

Representative research:

- Physiology of embryonic heart, lungs and kidneys, and their integrated regulation using lower vertebrate, avian and mammalian embryos
- Bioinformatics and biological data analysis
- Developmental cardiovascular and respiratory physiology, focusing on perinatal and postnatal changes in circulation and respiration in birds; techniques include in vitro myograph, immunohistochemistry, immunoblotting
- Control of neural stem cell proliferation and differentiation, role of primary cilia in neuron survival, using mouse mode; techniques include immunohistochemistry, cell culture, morphometry, in situ hybridization
- Bioenergetics of growth and development, effects of environmental change on metabolism using marine and freshwater fishes; techniques include respirometry, microcalorimetry, quantitative fluorescent microscopy
- Developmental genetic responses to anoxia and hypoxia; embryogenesis and gonad function using *C. elegans* and zebrafish models
- Physiology and genetics of adult and developmental homeostasis and thrombosis, using zebrafish model



courtesy of Juli Black

courtesy of URCM / UNT

UNT researchers include:

Warren Burggren, dean of the College of Arts and Sciences and professor of biological sciences
respiratory and cardiovascular developmental physiology

Edward Dzialowski, associate professor of biological sciences
respiratory and cardiovascular developmental physiology

Jannon Fuchs, professor of biological sciences
neurobiology

Ione Hunt von Herbing, associate professor of biological sciences
bioenergetics of growth and development

Pudur Jagadeeswaran, professor of biological sciences
hemostasis

Pamela Padilla, associate professor of biological sciences
developmental genetics

Initiative for Advanced Research in Technology and the Arts

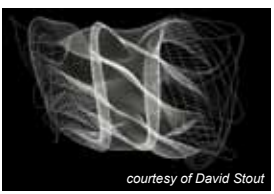
Exploring emerging technologies and new media for novel interactions between the arts, engineering and sciences

iarta.unt.edu


courtesy of Mary Lynn Babcock


courtesy of Shane Mecklenburger


courtesy of Jenny Vogel


courtesy of David Stout

Technology and the arts come together in this innovative research cluster. Faculty across the arts, engineering and sciences explore new media applications based on shared expertise and evolving technologies. Concepts from diverse disciplines partner to create compelling expressions: dancers wired with sensors perform an interactive concert; media artists incorporate robotics and surveillance hardware in a social context; musicians compose complex scores based on math equations; computer-artists animate visual models from biological data. Experimental process and inquiry energize research and lead to new frontiers. The use of new technologies in art often acts as a laboratory for subsequent industrial and commercial applications. **iARTA's** affiliate journal, *Moebius*, gives critical insight to these emerging interdisciplinary practices in an international context.


courtesy of Nitya Kandukuri

Specialized facilities, rehearsal and performance spaces, and computer labs facilitate research. The Center for Experimental Music and Intermedia is a suite of six, single-user computer music studios optimized for the generation and manipulation of digital audio, multichannel sound diffusion, live interactive music and intermedia integration. Dance and theatre technology labs accommodate dance and new media performance. The Department of Electrical Engineering houses a Wireless Systems and Sensor Networks (WSSN) Research Laboratory with various hardware, instruments and software.


courtesy of Kenneth Verdugo


courtesy of Shane Mecklenburger


courtesy of Mike Akinwolemiwa and David Jackson


courtesy of Nitya Kandukuri

Representative research:

- Network performance, live cinema, interactive/immersive audiovisual installations and robotics
- Use of sensor networks for speech and visual signal processing, pattern recognition and environmental applications
- Use of data from genetic algorithms, astronomical math equations and ocean current patterns to create adaptive, audio-visual, synthetic ecosystems
- Exploration of the intersection between experimental music and theatre using live performance, video, staging, music technology and improvisation
- New media work based on live stream video, webcam broadcasts, Google searches, blogs and the Internet

UNT researchers include:

Mary Lynn Babcock, associate professor of dance and theatre
choreography, interactive media
David Bithell, assistant professor of music composition studies
experimental music and theatre
Oscar Garcia, professor of electrical engineering
speech/music/sound
Shane Mecklenburger, assistant professor of studio art
intermedia art
David Schwarz, associate professor of music theory
psychoanalysis, culture, music
David Stout, professor of music composition studies
audio-visual installation/performance
Jenny Vogel, assistant professor of studio art
new media art

courtesy of David Bithell

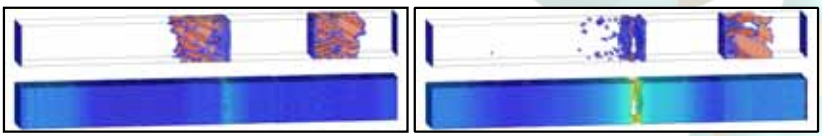
Materials Modeling

Advancing the theory and design of materials through modeling and simulation across length and time scales to produce solutions in medicine, energy, the environment and other disciplines

mmrc.unt.edu

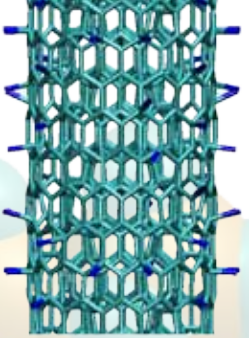
courtesy of URCM / UNT

Faculty from the **Materials Modeling** research cluster (MMRC) collaborate with colleagues from chemistry, engineering, materials science and other disciplines to develop and apply advanced modeling and simulation techniques in order to improve the design and performance of new and existing biological and man-made materials. Human tissue, jet engine metals and greenhouse gases are examples of materials studied under various conditions, which are sometimes extreme, such as temperature, oxidation and environmental stress. Computational modeling can yield accurate, fast predictions with a significant savings in time and costs compared to traditional laboratory methods of developing new materials and processes. Cutting-edge technology coupled with expertise from leading experimental researchers positions MMRC to lead the field in fully integrated, multi-scale modeling research and to expedite solutions for the technological challenges that face our country and global society.

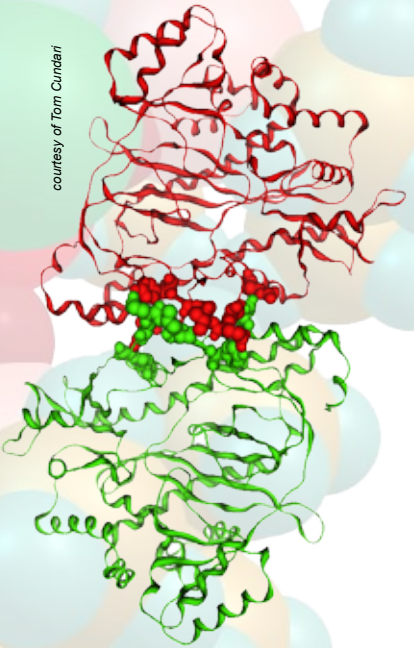


courtesy of Niraj Gupta

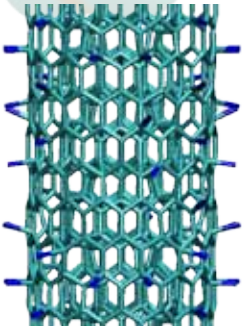
Current MMRC faculty and researchers have specializations in integrated computational chemical/materials engineering, multiphysics modeling, condensed matter theory and fluid/particle dynamics, as well as atomistic, mesoscale and continuum level modeling of advanced materials, alloys, industrial and defense systems, catalysis, alternate energy, and chemical, physical and biological systems. Faculty bring additional funding from the National Science Foundation, Department of Energy, Welch Foundation, Air Force Research Laboratory, and other private and industrial sponsors, and participate in grants totaling $30 million. Affiliated national centers include an NSF Chemical Bonding Center and a DOE Energy Frontier Research Center. UNT also is the home of TALON, a new high-performance computing facility, and the Center for Advanced Scientific Computing and Modeling (CASCaM), an interdisciplinary center of excellence in advanced scientific computing and modeling with its own dedicated facility (cascam.unt.edu).



courtesy of Jamal Uddin



courtesy of Tom Cundari



UNT researchers include:

Paul Bagus, research professor of chemistry
surface and cluster modeling
Sandra Boetcher, assistant professor of mechanical and energy engineering
computational fluid dynamics
Wes Borden, Robert A. Welch Professor of chemistry
computational organic chemistry
Thomas Cundari, Regents Professor of chemistry
computational inorganic chemistry
Qunfeng Dong, assistant professor of biological sciences, and computer science and engineering
bioinformatics
Jincheng Du, assistant professor of materials science and engineering
atomistic simulations of materials
Alan Needleman, professor of materials science and engineering
continuum mechanics
Yuri Rostovtsev, assistant professor of physics
condensed matter theory
Srinivasan Srivilliputhur, assistant professor of materials science and engineering
large scale molecular dynamics
Zhiqiang Wang, assistant professor of materials science and engineering
mesoscale modeling
Angela Wilson, professor of chemistry
ab initio quantum chemistry

courtesy of URCM / UNT

courtesy of Philip Baczewski

Renewable Bioproducts

Creating green solutions for the life cycle of consumer and industry products using plant, bacteria and other bioagent materials
www.mtse.unt.edu/bioproducts

A new discipline of engineering is emerging based on green chemistries. Plant scientists and other biologists in the **Renewable Bioproducts** research cluster forge intellectual partnerships with academic colleagues, industries, government agencies and international colleagues. They design, develop and implement sustainable, multifunctional biosolutions and discover how to harness the unique chemical properties of plants, bacteria and various bioagents to achieve ecologically safe, green solutions that outperform their non-renewable counterparts. Traditional "cradle-to-grave" products serve some use and then require disposal or waste-management. Newly developed bioproducts have the potential not only to be recycled for a single purpose but also to be genuinely renewed and re-used for multiple applications. Research spans development and deployment, with sustainable applications including alternative motor oils, solar cells, biodegradable consumer packaging and composite fibers used in the construction of buildings.

courtesy of URCM / UNT

UNT researchers include:

Michael Allen, assistant professor of biological sciences
microbial genetics and biotechnology
Witold Brostow, Regents Professor of materials science and engineering
polymeric materials design
Kent Chapman, professor of biological sciences
lipid metabolism and function
Nandika D'Souza, professor of materials science and engineering
engineered polymers and composites

courtesy of Amanda Burgess

Representative research:

- Develop eco-conscious bioplastics from corn, bacterial microorganisms and natural fibers, such as jute, hemp and kenaf for biodegradable packaging and other products
- Create lubricants and organic semi-conductors
- Research biopolymer materials for medical applications, such as arterial stents, collagen and cornea prostheses

External participants:

Collaborations extend beyond the UNT community to include researchers from the State University of Campinas-UNICAMP in Brazil, the UNT Health Science Center at Fort Worth, the U.S. military and other institutions.

Materials are tested using state-of-the-art facilities, such as the Polymer, Mechanical and Rheology Laboratory, and sophisticated equipment, such as the Leistritz twin screw extruder for biopolymer blending, the high-resolution scanning electron microscope and transmission electron microscope. Nanoscale studies yield detailed information about the architectural integrity of materials, which informs engineering decisions for the next generation of "green" designed products.

courtesy of Nandika D'Souza

courtesy of URCM / UNT

Signaling Mechanisms in Plants

Harnessing the ways plant cells communicate to find solutions for energy, agriculture, nutrition and medicine
www.biol.unt.edu/signaling

The **Signaling Mechanisms in Plants** research cluster draws upon existing expertise and emerging research strengths in cell biology, biochemistry, genetics, metabolomics and informatics to study how plants use cellular communication — a complex network of molecular signals — in their growth, development and defense responses to stress. Understanding these signaling processes can help regulate crop yield and resistance to pathogens, insects and other adverse environmental conditions. Manipulating signaling mechanisms in plants also will lead to new technologies in agriculture, human nutrition, phytoremediation of environmental toxicants and sustainable energy. The interdisciplinary exchange of ideas guides these advances: cutting-edge cell biology makes use of new imaging techniques, and metabolomic modeling draws upon research from analytical chemistry, genetics and computational sciences. This "systems biology" approach dramatically expands our understanding of living organisms and their environments.

Cluster researchers are recognized as national and international leaders within their respective fields. Collectively, they serve on numerous agency advisory panels and boards and are invited speakers at high-profile research conferences around the world. Annual external research funding includes grants from the National Science Foundation, the U.S. Department of Agriculture, the National Institutes of Health, the U.S. Department of Energy, and various corporations and foundations. Plant science research at UNT will address some of the most important challenges facing the world and, as such, will enhance the national reputation of UNT as an emerging research university.

courtesy of URCM / UNT

courtesy of URCM / UNT

courtesy of Charlene Case

Representative research:

- Engineering oil accumulation in vegetative tissues of plants
- Regulation of plant growth-yield enhancement
- Natural fibers and new composite materials from kenaf (Hibiscus cannabis)
- Engineering seed value in cotton plants
- Abiotic and biotic stress tolerances in cotton
- Mechanisms to control flowering in domesticated cotton and wild progenitors
- Targeted biomass partitioning to harvested organs
- Regulation of crop resistance to phloem-feeding insects
- Activators of systemic immunity in crops
- Engineering wheat for resistance against diseases
- Support for developing world agriculture and land use; introduce low cost monitoring technologies
- Natural sources of plant lipids for therapeutic modulation of the human endocannabinoid system
- Engineering symbiotic nitrogen metabolism in legumes

courtesy of UNT Department of Biological Sciences

External cluster participants:

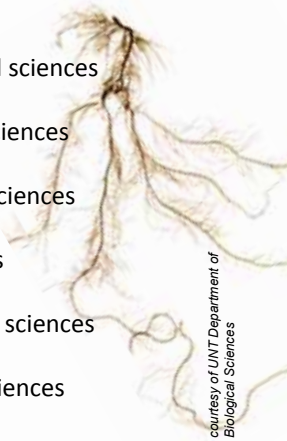
Samuel Roberts Noble Foundation

University of Missouri Medical Center

The Center for Plant Lipid Research is a laboratory resource for the coordination and exchange of cluster research activities: www.biol.unt.edu/~chapman.

UNT researchers include:

Brian Ayre, associate professor of biological sciences
carbon transport in plants
Kent D. Chapman, professor of biological sciences
lipid metabolism and function
Rebecca Dickstein, professor of biological sciences
symbiotic nitrogen fixation
Ron Mittler, professor of biological sciences
stress signaling in plants
Jyoti Shah, associate professor of biological sciences
plant responses to environmental stress
Vladimir Shulaev, professor of biological sciences
metabolomics and signaling
Barney Venables, associate professor of biological sciences
environmental chemistry and toxicology
Guido Verbeck, assistant professor of chemistry
analytical instrument development



courtesy of UNT Department of Biological Sciences

courtesy of Ricardo Rozzi

Sub-Antarctic Ecosystems and Biocultural Conservation

Integrating ecological sciences and environmental philosophy to preserve and understand the biocultural diversity of the sub-Antarctic ecoregion
www.chile.unt.edu/cluster

A fundamental premise of biocultural conservation is that cultural and philosophical perspectives must be combined with empirical scientific research to achieve viable conservation and sustainable development practices. The **Sub-Antarctic Ecosystems and Biocultural Conservation** research cluster is at the forefront of this precept and a key player in a project of international importance: the preservation of the rich biological and cultural attributes of the Cape Horn Archipelago, located at the southern tip of South America in the sub-Antarctic ecoregion — one of the world's last remaining pristine wilderness areas and the closest continental region to Antarctica. As such, the UNT-based cluster contributes additional research opportunities to projects initiated by the broader alliance of institutions that constitute the Sub-Antarctic Biocultural Conservation Program, coordinated by UNT in the United States and the University of Magallanes and the Institute of Ecology and Biodiversity in Chile. The cluster integrates ecological sciences with environmental philosophy and the arts in a context of collaborative research, international partnerships, interdisciplinary education and public outreach. Its work spans borders as well as disciplines, and a field station in Omora Ethnobotanical Park serves as an important research hub and laboratory where scholars collaborate with participants ranging from local communities to internationally renowned institutions, including UNESCO.

Representative projects:

- **Environmental philosophy, ethno-ecology and biocultural conservation:** the study of relationships between regional culture, ecosystems and biota
- **Long-term socio-ecological research:** the implementation of bird banding and monitoring programs; the study and control of harmful species to address the rapid loss and homogenization of biological and cultural diversity
- **Freshwater ecology and watershed conservation:** the study of streams, particularly the ecology and natural history of aquatic insects, and the relationship of local communities with watershed ecosystem services
- **Ecotourism with a Hand Lens:** the development of novel models that link research with policy and sustainable tourism, including educational activities surrounding the exploration of the "Miniature Forests of Cape Horn"
- **Interdisciplinary opportunities for students:** experiences in research and field courses, including art exhibitions, film and study abroad programs such as "Tracing Darwin's Path"

courtesy of Alexandria Poole

courtesy of Christopher Anderson

courtesy of Alexandria Poole

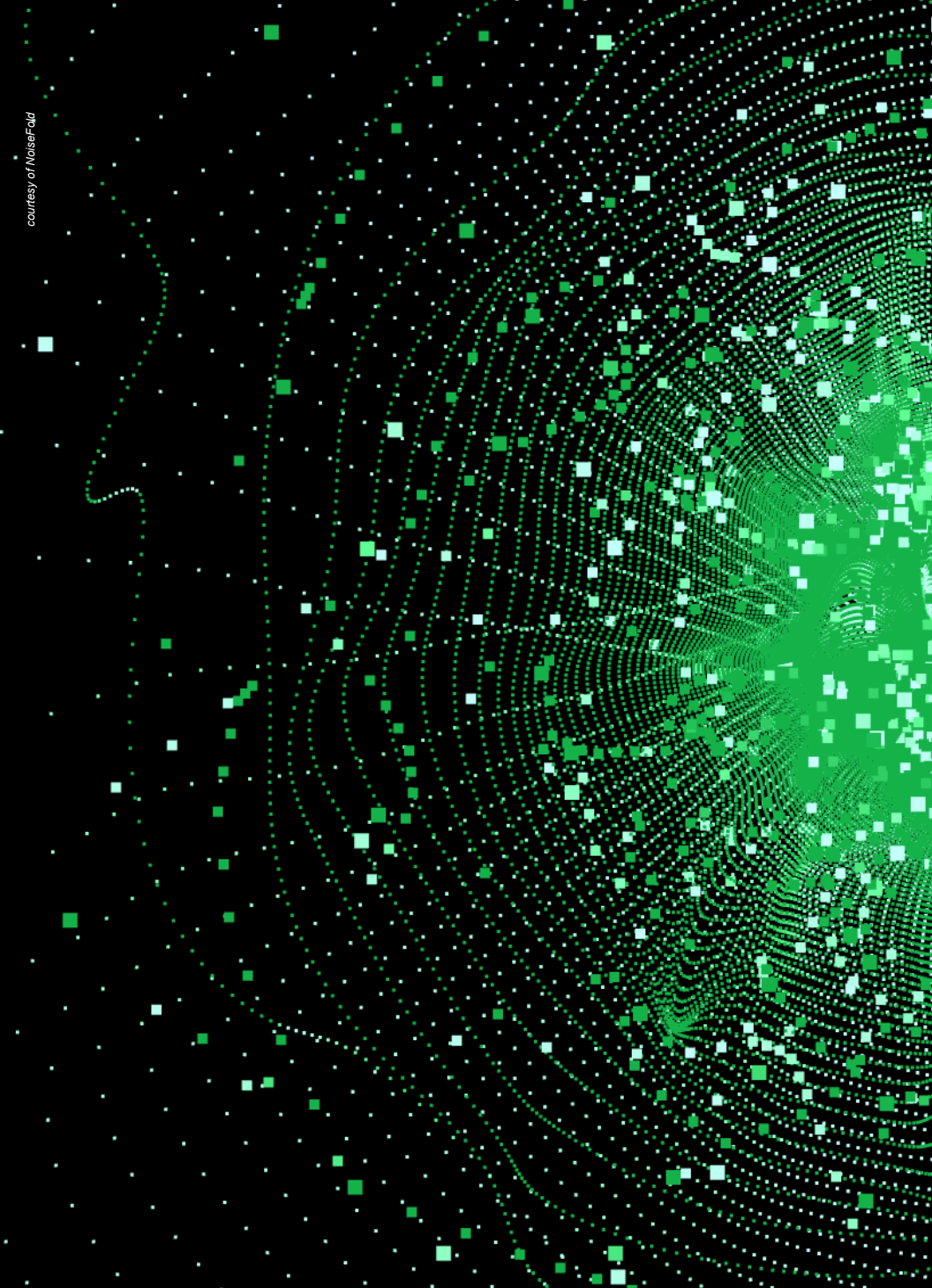
The UNESCO Cape Horn Biosphere Reserve is supported by a network of organizations from both the Northern and Southern hemispheres of the world. It is an international and interdisciplinary cooperative effort that hopes to approach conservation by coupling the social and biological dynamics within policy making.

UNT researchers include:

Christopher Anderson, research assistant professor of biological sciences
ecosystem ecology and invasive species
James Kennedy, professor of biological sciences
aquatic ecology and environmental education
Ricardo Rozzi, associate professor of philosophy and religion studies
biocultural conservation and environmental philosophy

External cluster participants:

Center for Environmental Philosophy, TX
Ecological Society of America, D.C.
Institute of Ecology and Biodiversity, Chile
UNESCO's Man and the Biosphere Program
University of Magallanes, Chile


courtesy of NoiseFold

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