

## Research at UCSD

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Organized Research Units (ORUs) are academic units the University of California has established to provide a supportive infrastructure for interdisciplinary research complementary to the academic goals of departments of instruction and research. The functions of ORUs are to facilitate research and research collaborations; disseminate research results through research conferences, meetings, and other activities; strengthen graduate and undergraduate education by providing students with training opportunities and access to facilities; seek extramural research funds; and carry out university and public service programs related to ORUs' research expertise. The senior staff of these units are faculty members in related academic departments. Institutes and centers currently in operation at UCSD are described below.

In addition, the university is formally and informally affiliated with various private research organizations such as the Institute of the Americas, The Salk Institute for Biological Studies, Howard Hughes Medical Institute, Ludwig Institute for Cancer Research, and The Burnham Institute.

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### Universitywide Institutes/ Organized Research Units

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**California Space Institute (Cal Space)** was established in 1979 as a multicampus organized research unit of the University of California (UC). Cal Space maintains centers on several campuses, which support and conduct pure and applied space-related science and technological research and development. Specific areas of investigation include the following:

*Remote Sensing*—acquisition, processing, and application of observations by satellites or other remotely automated instruments to study the Earth and its changing environment. The primarily satellite-based investigations study the greenhouse effect, global warming, hydrological cycle, land surface processes, air-sea interactions, radiation, and cloud dynamics.

*Climate*—interdisciplinary scientific research that applies space observations and numerical modeling techniques to fundamental issues of climate prediction and global change caused by both natural and human forces within the atmosphere, the oceans, and on land surfaces.

*Space science and engineering*—investigations of both the solar system and universe, and the development of automation and robotic systems for space exploration. Current investigations include the study of comets, asteroids, the solar wind, and cosmic background radiation. Space observations are often conducted with instruments and techniques designed by Cal Space researchers.

*Education*—promotion of undergraduate and graduate education in the interdisciplinary fields of climate and global change, and space science and engineering. The Cal Space-led state-wide consortium (California Space Grant Consortium) was designated in 1989 as a Space Grant College by NASA's Office of Education. The program expands leadership in the development and application of space resources through research and hands-on space projects, fellowship funding, and educational outreach activities. The California Space Grant Program works with NASA Centers and the aerospace and high technology industries to strengthen its educational objectives.

**Institute of Geophysics and Planetary Physics (IGPP)** was established in 1960 and named the Cecil H. and Ida M. Green IGPP in 1994. It is a multicampus research unit of the University of California, headquartered at UCSD, with branches at UCI, UCLA, UCR, UCSC, as well as Los Alamos and Lawrence Livermore National Laboratories. The present facility includes the Roger and Ellen Revelle Laboratory and the Judith and Walter Munk Laboratory. Present research concentrates on the study of crustal dynamics by measurements of gravity, tilt, displacement, and strain in both continental and oceanic environments; of regional seismicity and linear and nonlinear earthquake and explosion source mechanisms; of the variability of the earth's geomagnetic field and its generation by the geodynamo; of the spherical and aspherical structure of the earth by measurements of free oscillations, surface waves, and travel times; of seafloor tectonics using marine geophysical methods; of linear and nonlinear theoretical and computational fluid dynamics; of the variable mesoscale structure of the oceans and global ocean warming by acoustic tomography; of the structure of the oceanic crust and lithosphere by seismic and electromagnetic measurements on the ocean bottom and at the ocean's surface through seismic multi-channel methods; of sea-floor and planetary topography and gravity using satellite methods; of nonlinear dynamics applied to geomorphol-

ogy; and of tides, waves, turbulence, and circulation in the oceans; of surface change caused by tectonic activity, or climate change using satellite Interferometric Synthetic Aperture Radar (InSAR), as well as airborne and spaceborne laser altimetry. The institute operates a global network of some forty broadband seismometers, the IDA (International Deployment of Accelerometers) Array, with ten of these stations in the former Soviet Union which are telemetered by satellite to the institute; a crustal strain and seismic observatory at the Cecil and Ida Green Piñon Flat Observatory near Palm Springs; a scientific wireless network in California with SDSC, the High Performance Wireless Research and Education Network (HPWREN); a southern California network of Global Positioning System (GPS) satellite geodetic sites operated by the Scripps Orbit and Permanent Array Center (SOPAC) and the California Spatial Reference Center (CSRC); an acoustic network in the Pacific for measuring ocean temperature variability; a modern 3D data visualization facility; a 5m, X-band satellite receiving antenna for satellite remote sensing; a national Ocean Bottom Seismograph Instrument Pool (OBSIP); and telemetered seismic arrays in Kirghizia, and two locations in California. The institute does not grant degrees, but makes its facilities available to graduate students from various departments who have chosen to write their dissertations on geophysical problems. Undergraduate students are involved in independent research projects and as laboratory assistants. Members of the institute staff now hold joint appointments with the Departments of the Scripps Institution of Oceanography, and Applied Mechanics and Engineering Sciences. Support for visiting scholars and grant matching funds is provided through an endowment to the Cecil and Ida Green Foundation for the Earth Sciences.

The **University of California Institute on Global Conflict and Cooperation (IGCC)** is a multicampus research unit serving all ten UC campuses and the UC-managed Lawrence Berkeley, Lawrence Livermore, and Los Alamos National Laboratories. IGCC is based at the Graduate School of International Relations and Pacific Studies (IR/PS) at UCSD, whose faculty provides IGCC's leadership.

IGCC's mission to educate the next generation of international problem-solvers and peacemakers is carried out through teaching activities and research and public service opportunities. Scholars and researchers from inside and outside the UC system, government officials, and students

from the United States and abroad have participated in IGCC projects.

IGCC's initial research focused on averting nuclear proliferation through arms control and confidence-building measures between the superpowers. Since then, its research program has diversified to encompass several broad areas of inquiry: regional relations, international environmental policy, ethnic conflict, terrorism, and international trade and policy issues. In addition, receipt of a prestigious NSF award in 2002 for a program to train the next generation of nuclear policy experts has led to a rekindling of interest in research on traditional security issues.

IGCC supports research and teaching on the causes of international conflict and opportunities to promote cooperation through its annual fellowship and grant cycle. IGCC's development office provides an additional resource for UC aculty seeking foundation funding for their projects. IGCC also serves as a liaison between the academic and policy communities through its Washington, D.C. office, located in the UC Washington Center (UCDC). The Washington, D.C. office administers a graduate internship program in international affairs and the IGCC Dissertation/Foreign Policy Fellow Program. Interns and fellows are placed with governmental and nongovernmental organizations involved in international policy. The Washington office also sponsors policy seminars to showcase UC faculty research results and to provide opportunities for interaction between professors and policymakers.

IGCC's annual **NEWSWired** provides an overview of the previous year's research, funding, awards, projects, meetings, workshops, colloquia, news, and publications. **POLICYPacks** provide concise summaries of IGCC research programs for the policy community. A new annual journal, **IGCCReview**, will feature articles addressing the policy implications of IGCC research conducted by senior UC faculty.

IGCC receives primary support from the regents of the University of California. Additional funding has been provided by the U.S. Departments of Energy, State, and Defense, the U.S. Institute of Peace, the National Science Foundation, the Japan-U.S. Friendship Commission, and Japan's National Institute for Research Advancement (NIRA). IGCC has also received important support from foundations such as the Japan Foundation Center for Global Partnership (CGP), the Carnegie Corporation of New York, The John D. and Catherine T. MacArthur Foundation, the

William and Flora Hewlett Foundation, the Markle Foundation, the Smith Richardson Foundation, and the Rockefeller Foundation.

For more information about IGCC and its research programs, including full-text publications and downloadable **POLICY**Packs, visit the IGCC Web site at <http://www-igcc.ucsd.edu>. IGCC publications can also be downloaded from the California Digital Library's E-Scholarship Repository at <http://repositories.cdlib.org>.

**The White Mountain Research Station (WMRS)** was established as a UC multicampus research unit in 1950 to support high-altitude research. The station includes four laboratory facilities located over a 3,000m (10,000 vertical ft.) altitude transect, ranging from the floor of the Owens Valley to White Mountain at over 14,000 feet above sea level. Located on the western edge of the Great Basin, WMRS also provides access to three major biogeographic regions (Sierra Nevada and White/Inyo montane, Mojave desert, and Great Basin desert), and geologically rich and diverse field sites. WMRS has evolved into a major multidisciplinary research and teaching institution in eastern California, and hosts programs in archaeology and anthropology, atmospheric and space sciences, biological and medical sciences, ecology, conservation and natural resource management, geological, hydrological, and earth sciences.

WMRS facilities include: (1) Owens Valley Laboratories with classrooms, offices, dormitories, and food services for up to seventy people outside the Sierra resort town of Bishop, (2) a newly renovated lodge, cabins, classrooms, and laboratories for fifty people in the Bristlecone pine forest at Crooked Creek (3,094m altitude) (3) the Nello Pace Laboratory and Mount Barcroft facilities (3,801m altitude), which can house thirty-five peoples, and (4) the 450-square-foot Summit Laboratory on White Mountain peak (4,342m altitude), making it the highest research lab in North America.

All of the laboratories are linked by a high-speed wireless internet connection providing instant access between campus-based laboratories and remote-sensing projects in the field. The Owens Valley Laboratory includes a modern molecular biology and genetics laboratory used to study adaptations to the environment and management of the majestic—but endangered—Bighorn sheep. A geographic information system (GIS) laboratory that houses the USGS-funded "Eastern Sierra Geospatial Data Clearinghouse" is

used by scientists and government agencies for natural resource research and policy decisions. WMRS also hosts a Center for Astrophysics and Cosmology at Barcroft and "The Deepest Valley Interagency Plant Propagation Center."

WMRS hosts more than 3,000 users from over 100 institutions per year for research, teaching, and conferences. Research occurs year-round with access to the high-altitude labs at Barcroft via snowmobile. Summer is the busiest time at WMRS, with undergraduate internships, graduate students supported by WMRS Fellowships in residence, plus students and faculty from other universities around the world. Educational uses include several geology field courses and a NSF-funded Research Experience for Undergraduates program. WMRS sponsors professional and post-graduate training courses, annual professional society meetings, a community lecture series, an annual Open House at Barcroft in August, and offers published proceedings from symposia on the environmental science in the region.

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## Campuswide Institutes

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### The AIDS Research Institute

<http://ari.ucsd.edu/index.html>

Established in 1996 and formally opened in 1997, the AIDS Research Institute (ARI) serves as the conduit for the UCSD Programs in HIV Infection and AIDS, in which AIDS researchers in all university departments and our associated institutions can collaborate on research, with the objective of developing new approaches to the prevention, diagnosis, and the treatment of HIV/AIDS.

UCSD faculty have made major advances in our understanding of how the virus works, how it causes disease, how to treat HIV infection and its complications, and the impact of HIV infection on nationwide health and healthcare costs. In addition to the 104 faculty members from 19 departments, the UCSD Program in HIV Infection and AIDS is internationally recognized for its contributions to science and patient care, bringing in more than \$30 million in HIV and AIDS-related grants annually and is ranked among the top ten AIDS programs in the country.

ARI programs include:

- The Center for AIDS Research (CFAR)
- The Adult AIDS Clinical Trials Group (AACTG)

- The Pediatric AIDS Clinical Trials Group (PACTG)
- The California Collaborative Treatment Group (CCTG)
- The HIV Neurobehavioral Research Center (HNRC)
- The Southern California Primary Infection Program
- The HIV Costs and Services Utilization Study (HCSUS)
- The VA Quality Enhancement Research Initiative for HIV (QUERI-HIV)
- The San Diego AIDS Education and Training Center (AETC)
- The Owen Clinic, providing primary health care services
- The AntiRetroviral Research Center (AVRC)
- The UCSD Mother, Child and Adolescent Program

The institute sponsors seminars and workshops as well as offering developmental grants to new investigators in the area of human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) related research.

Together with research and development the ARI is fully committed to serve as a community resource for information and assistance regarding infection, treatment, and education in HIV and AIDS. We are here to serve as the regional resource for all aspects pertaining to HIV and AIDS and, as a leader in research and education, to cure the infected and prevent the uninfected from becoming infected.

### The California Institute for Telecommunications and Information Technology (Calit2)

(<http://www.calit2.net>) is an organized research unit that seeks to ensure that California maintains its leadership in the telecommunications and information technology marketplace. The institute's mission is simple: Extend the reach of the Internet throughout the physical world. Calit2 is a partnership between UCSD and UC, Irvine, and is one of four institutes established in December 2000 through the California Institutes for Science and Innovation (CallSI). It is funded by a state capital grant, federal research grants, industry, and foundations.

The institute is organized conceptually into five vertically interlocking "layers." The five layers are materials and devices; networked infrastructure; interfaces and software systems; four applications areas; and policy, management, and socioeconomic evolution. The initial

four applications—environment and civil infrastructure, intelligent transportation and telematics, digitally enabled genomic medicine, and new media arts—are target core concerns related to California's quality of life and represent large market segments of California's economy poised to be transformed by the new Internet. Each layer and application has a leader listed on the Calit2 Web site.

More than 220 professors and senior researchers, industrial partners, postdoctoral researchers, and graduate and undergraduate students are collaborating on interdisciplinary projects in living laboratories. These labs include collaborative frameworks that span multiple layers to enable creation of larger-scale activities to address real world problems, such as pollution, traffic congestion, and the pressing needs of medical practice. Early activities have focused around eight living labs; some are "technology-driven," some are "application-driven," and one is "culture-driven." The labs provide a context to deploy and test new technologies in various combinations and experiment with new applications.

**The Institute for International, Comparative, and Area Studies (IICAS)** was created in 2001 to promote research on international, comparative, and cross-regional topics. Building on the substantial existing strengths of UCSD in international studies, IICAS coordinates and supports the research of faculty in departments, area studies programs, and the Graduate School of International Relations and Pacific Studies. It is closely associated with undergraduate and graduate education in international studies, including Eleanor Roosevelt College and the international studies major, whose program offices are housed within the institute.

IICAS has three principal initial roles. First, it serves as a research catalyst, fostering and incubating interdisciplinary and cross-area research groups and projects. Activities have included the launch of a European Studies initiative, a faculty research project on globalization, territoriality, and conflict, and a multiyear, interdisciplinary research workshop examining the empire-to-nation transition. Second, IICAS coordinates and provides services for existing and new international and area studies programs in development and events planning and coordination. It also encourages new programs in international and area studies. In this role, IICAS has co-sponsored campus-wide panels and seminars that address critical international issues. Third, the IICAS direc-

tor and advisory committee advise the senior vice chancellor for academic affairs on campus priorities and appointments in international studies. IICAS also provides campus wide services in support of UCSD's international contacts, including international visitors, requests for affiliation agreements, and collaborative international research projects.

**The UCSD Institute of Molecular Medicine (IMM).** Our mission is: *Integration of Molecules and Medicine*—to create an Olympic village for translational medicine in the San Diego biomedical community, *Innovation at Disease Interfaces*—to lead in the cross-fertilization between diverse human diseases and disciplines, *Interdisciplinary Training*—to mentor many of the highest caliber physician-scientists from the United States and abroad, and *International Programs*—to offer global outreach to Europe and Asia through innovative collaborations and partnerships. IMM is designed to provide a unique research and training atmosphere for graduate students, Ph.D. students, M.D. fellows, and M.D./Ph.D. fellows with a scientific focus on molecular medicine in the post-genome era. The Institute of Molecular Medicine was established in June 2000 as an organized research unit at UCSD, and has been designed as a Center Without Walls to encourage interactive, interdisciplinary, educational, and research opportunities in the growing field of molecular medicine. The faculty members of this institute are committed to creating and maintaining a collaborative environment that will ensure the rapid development of novel, biologically targeted therapies to enhance the lives of the patients of tomorrow. The first phase of programs has been established in the areas of cardiovascular and neurological diseases; however, it is anticipated that studies in other complex human diseases will be included as scientific and clinical opportunities are solidified in the new institute. A current National Institutes of Health Training Program is a joint program with collaborators at The Salk Institute, which affords students an opportunity to work for periods of time at both institutions, depending upon the technology that is being applied to their particular research project. Research and educational programs include stem cell biology, regeneration, chemical biology, neuroscience, computer modeling, and genomics.

The Institute of Molecular Medicine's goals and objectives are: 1) to expand on the growing vertebrate genomic databases and a variety of

genetic based approaches to form a multidisciplinary research program to unravel complex human diseases, including heart and neurological disorders; 2) to provide a high-technology platform that will be based upon collaborative research efforts between prominent scientists in the fields of bioengineering, neuroscience, chemistry, physiology, biology, and genetics; 3) to provide an international, cross-institutional, interdisciplinary training program in the Molecular Basis of Complex Human Physiology and Diseases, for M.D., M.D./Ph.D., and Ph.D. postdoctoral fellows; 4) to develop strategic research collaborations, educational exchange programs, and training alliances with other international institutions; and 5) to promote the development of industrial collaborations for specific targeted areas of both scientific and clinical interest.

Seventy-five faculty members from UCSD, the Salk Institute for Biological Studies, The Scripps Research Institute, The Burnham Institute, and internationally based collaborators are participating in the Institute of Molecular Medicine. These participants represent a cross-section of the investigators and educators who constitute the scientific and clinical community of leading investigators working and teaching in areas related to molecular, cellular, genetic, and bioengineering approaches to identify pathways that control complex human physiological systems and related diseases. Each year the IMM hosts an international symposium, Days of Molecular Medicine, which brings world leaders to La Jolla to present state-of-the-art lectures and provides programs that allow students in the IMM to meet and discuss their projects with the speakers and senior scientists in attendance. This year, the journal *Nature Medicine* and IMM will co-sponsor the 2004 symposium "Integrative Physiology and Human Disease: Neurohormonal and Metabolic Pathways" at the Wellcome Trust Genome Center, Hinxton Campus in Cambridge, England. Further information can be found online at <http://www.imm.ucsd.edu/dmm/foundation.html>. The 2005 DMM conference will once again return to the Salk Institute in La Jolla. In addition to strengthening the ties in academia, the symposium also provides an opportunity for corporate sponsors to discuss potential collaborations and meet with the next generation of physician-scientists in this ever-changing field. The Institute of Molecular Medicine is based on the vision that a new era in human health and drug discovery lies at the borders between

curiosity-driven science and tomorrow's medical therapies.

**The Institute for Neural Computation (INC)** focuses on research into how nervous systems function through experimental investigation and modeling of neural activity, and on applying knowledge of nervous system function to the design of new technologies. The institute supports graduate training programs in cognitive neuroscience and computational neurobiology.

The Swartz Center for Computational Neuroscience develops models of brain dynamics from electromagnetic and hemodynamic data acquired during novel human behavioral experiments.

The Machine Perception Laboratory studies human perception and develops similar capabilities for robots. Additional areas of research include visual coding, motor control systems, and learning algorithms. The goal is to gain insights into how the brain works by investigating the nature of the problems it faces. This includes the development of possible solutions to these problems in the form of robots that interact with humans in real time.

The goal of the Lee Laboratory is to develop new machine learning algorithms for advanced signal and image processing inspired by recent progress in understanding how the brain represents and learns sensory information.

Faculty from the Departments of Biology, Computer Science and Engineering, Cognitive Science, Economics, Philosophy, Neurosciences, and Radiology, and the Salk Institute for Biological Studies are actively involved in the institute's activities. The institute has an active visitors program and an industrial affiliates program with ongoing joint research projects. The institute sponsors a seminar series, the annual Rockwood Memorial Lecture, and several scientific workshops and conferences annually.

**The Institute for Nonlinear Science (INLS)** promotes interdisciplinary research and graduate education in the development and application of contemporary methods in the study of nonlinear dynamical systems. Using a common mathematical language, faculty and students from disciplines as diverse as physics, mathematics, oceanography, biology and neuroscience, mechanical and electrical engineering, and economics pursue the implications of generic characteristics of nonlinear problems for their subjects. Each year the institute sponsors several long- and short-term senior visitors from the University of California and elsewhere and provides, through funds from external

funding agencies, support for approximately ten graduate students to work on Ph.D. dissertations concerned with nonlinear problems. Also associated with INLS are approximately twenty full-time research scientists and postdoctoral researchers.

The core of INLS activities is composed of (1) joint research among faculty and students across disciplinary lines and (2) lecture series and working seminars designed to convey recent research progress and to stimulate new investigations. Through contracts with external agencies the INLS supports experimental, numerical, and theoretical studies of nonlinear dynamics and chaos in neurophysiology, investigations in nonlinear fluid dynamics and pattern formation, studies (jointly with the University of California, Los Angeles and Stanford University) of applications of chaos in communications, as well as in the nonlinear dynamics of granular materials.

INLS has developed joint research programs with universities, research institutes, and commercial companies in areas of common interest. It actively works with colleagues at UCLA, Stanford, Cal Tech, Argonne National Laboratory, ST Microelectronics, Time Domain Inc., and Randle Corporation. These affiliations provide new research horizons and realistic opportunities for technology transfer.

**Institute for Pure and Applied Physical Sciences (IPAPS)** is an interdisciplinary research unit which brings together faculty and researchers in physics, chemistry, engineering, and Scripps Institution of Oceanography. The institute is concerned with fluids and materials. Specific subjects of research include superconductivity, ferromagnetism, semiconductor heterostructures, solid surfaces, plasma physics, hydromagnetics, turbulence, fluid mechanics, laser physics, and numerical analysis.

Within the IPAPS is the Center for Interface and Materials Science (CIMS), which emphasizes interdisciplinary collaborative research on the properties of surfaces, thin-layered composites, and novel materials, as well as their technological applications. With centralized space and equipment, CIMS brings together faculty and research staff from the Departments of Physics, Applied Mechanics and Engineering Sciences, Chemistry and Biochemistry, Electrical and Computer Engineering, and the Scripps Institution of Oceanography.

The **Sam and Rose Stein Institute for Research on Aging (SIRA)** is an ORU committed to fostering healthy aging by supporting advances in

patient care through innovative research, training, and education. Established in 1983, the unit consists of eighty-five researchers representing eleven different departments ranging from bio-engineering to family and preventive medicine and from neurosciences to psychiatry. This wide diversity fosters an interdisciplinary approach to solving the problems posed by diseases that increase with age. SIRA sponsors "Faculty Start-up Grants" to junior-level scientists in order to allow them to lay a foundation of data necessary to compete for national funding and help with career development. To facilitate cooperative research endeavors, SIRA has also instituted the Faculty Collaborative Grant Program that provides funding for researchers from different medical/biological disciplines to work together in developing innovative projects.

In addition, the institute is active in recruiting young students to the field of aging through the "Student Investigator Grant Program." Undergraduate and medical students, who have expressed an interest in age-related research, are teamed with established senior scientists to pursue a research project. *Healthwise*, the monthly newsletter, informs community members of upcoming lectures and events sponsored by SIRA and UCSD, health and wellness information, and advances in medical research. Coupled with the newsletter, a monthly public lecture open to the public is presented by SIRA faculty members. These lectures are videotaped and replayed on UCSD-TV, other local stations, and also by satellite stations. These tapes are available to SIRA members, faculty, and students, and can be purchased at the UCSD Bookstore. In addition to our community outreach and education, SIRA and the Academic Geriatric Resource Center has developed a new series called "Aging in the New Millennium." These health promotion presentations provide information to seniors enabling them to make appropriate and healthy lifestyle choices. These presentations are taped and will be aired on UCSD-TV.

Lastly, SIRA provides health promotion presentations to the public and non-profit community groups through its executive director and research faculty. Contact [steininstitute@ucsd.edu](mailto:steininstitute@ucsd.edu) for information and scheduling.

All of the above information and more can be accessed on the SIRA Web site, <http://SIRA.ucsd.edu>.

**Whitaker Institute of Biomedical Engineering (WIBE)** was established as an organized research unit in 1991 and named as the Whitaker



Institute in 2000. Its purpose is to promote and coordinate interdisciplinary research among faculty and students at the interfaces of engineering, biology, and medicine. The overarching theme is integrative bioengineering, spanning the spectrum from molecular to organismal levels and integrating engineering and biomedical sciences. The major research thrusts are genomic bioengineering, molecular biomechanics, tissue engineering, and systems biology. Engineering principles and techniques are combined with biomedical research across the entire biological hierarchy ranging from genomic and molecular levels, through cells and tissues, to organs-systems. The aim is to have an integrative understanding of the structure-function relationships in normal and pathological conditions and development of bioengineering approaches to restore, maintain, or improve functions. The research pursued in WIBE involves the heart, blood vessels, blood, lung, kidney, liver, pancreas, muscle, bone, cartilage, tendon, ligament, skin, nerve, brain, retina, and cochlea, as well as targeted molecular delivery based on engineering principles. WIBE research and training activities include medical subjects such as cancer, diabetes, myocardial infarction, hypertension, atherosclerosis, peripheral vascular diseases, hemolytic anemias, pulmonary diseases, renal diseases, hepatobiliary diseases, inflammation, AIDS, burns, trauma, shock, retinopathies, tympanic membrane perforation, orthopedic disorders, and sports injuries. Coordinated engineering and biomedical research allows generations of quantitative information and new investigative approaches.

The ultimate goal is improving the methods of prevention, diagnosis, and treatment of diseases. WIBE facilitates university-industry cooperation. It sponsors regular research seminars, workshops, and symposia to promote information exchange and generate new ideas and projects, and fosters interdisciplinary training of graduate students and postdoctoral fellows. WIBE has nearly 100 faculty and research scientists from the Jacobs School of Engineering, School of Medicine, Divisions of Biological Sciences and Physical Sciences, Scripps Institution of Oceanography, and members of neighboring institutions, including The Burnham Institute, the Salk Institute for Biological Studies, and The Scripps Research Institute. The institute has an industrial advisory board, which has twenty company representatives in San Diego and elsewhere, that fosters collaborative research projects, joint grant

applications, co-sponsoring of symposia and workshops, student internship, and other academia-industry cooperative activities. Together with the Department of Bioengineering, WIBE received a Leadership Award from the Whitaker Foundation. Matching gifts from the Charles Lee Powell Foundation and the William J. von Liebig Foundation, as well as other donors, have made possible the construction of the new Powell-Focht Bioengineering Hall in 2002, the first privately funded building on the UCSD campus.

**The Project on Glucose Monitoring and Control** is a unit within WIBE. Its goal is to develop and evaluate new approaches, both natural and engineered, to achieve ideal blood glucose control and metabolic management in diabetes and related diseases. The project brings together researchers and clinicians from bioengineering, electrical engineering, computer science, and medicine, as well as extramural collaborators. The project serves as a nucleus for information exchange, development of new sensor and medication delivery approaches, and development and evaluation of control strategies.

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## Centers

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**The Rebecca and John Moores UCSD Cancer Center (CC)**, active in the fight against cancer since 1979, is a National Cancer Institute-designated Comprehensive Cancer Center. The specific goals of the Cancer Center are to enhance the present level of basic research, increase collaborative research, increase the application of basic science to solve clinical problems through translational research, disseminate new knowledge to oncology professionals and scientists in the San Diego community, enable the biomedical industry to transfer new technology to the clinical setting, develop a strong effort in cancer prevention and control, and educate and train undergraduate and postgraduate physicians, and basic scientists. Under the auspices of a Cancer Center Support Grant from the National Cancer Institute, there are seven active program areas within the Cancer Center. These include Cancer Biology, Cancer Genetics, Cancer Prevention and Control, Cancer Pharmacology, Cancer Symptom Control, Translational Oncology, and Viral Malignancy. Shared resources at the Cancer Center include Biostatistics, Clinical Trials, Data Compilation and Analysis, Digital Imaging, DNA Sequencing, Flow Cytometry, Histology and Immunohistochemistry,

Microarray, Molecular Pathology, Nutrition, Radiation Medicine, and Transgenic Mouse.

Research and educational grants support the training of postdoctoral fellows and medical students. The Clinical Trials Office coordinates clinical research trials involving cancer patients at UCSD and is the focal point for a large Oncology Outreach Network which provides state-of-the-art protocol treatment opportunities for patients in a broad geographic area. Patient care activities of the Cancer Center are located in the Combined Oncology Clinic at the Theodore Gildred Facility and in UCSD Medical Center, both located in Hillcrest, and at the Oncology Clinic of the Perlman Ambulatory Care Center and in UCSD Thornton Hospital, both located in La Jolla. Basic research activities of the Cancer Center are carried out at a variety of other locations on or adjacent to the La Jolla campus. Total membership of the Cancer Center exceeds 260 laboratory investigators and clinical physicians from twenty-two academic departments. The research funding for Cancer Center members exceeds \$180 million. Construction is currently underway on the university's east campus to erect a five-story, 270,000-square-foot building to unite many of the center's essential programs and services; it is scheduled for completion in early 2005.

**The Center for Astrophysics and Space Sciences (CASS)** is an interdisciplinary research unit established in 1979. The center brings together academic and research staff from the Departments of Physics, Chemistry, and Electrical and Computer Engineering. Research is conducted in the scientific areas of theoretical cosmology, computational astrophysics, observational cosmology, interstellar medium, star formation; solar observational and theoretical studies; X-ray and gamma-ray astrophysics; experimental and theoretical magnetospheric and space plasma physics; and cosmochemistry, including the chemistry of interstellar matter.

CASS provides a jointly shared facility which has office, laboratory, and computer space to enhance the interchange of expertise. Researchers in CASS have access to many University of California observing facilities, including the 2 Keck 10m telescopes, Lick Observatories, and Keck Telescopes, and have contributed experiments to many major NASA space missions including the Hubble Space Telescope and the Rossi X-Ray Timing Explorer. Associated with CASS are included seventeen faculty, about twenty-five Ph.D.-level research staff, twelve graduate students,

and thirty technical and administrative support personnel.

The center's facilities, faculty, and research staff are available to graduate students in the Departments of Physics, Electrical and Computer Engineering, and Chemistry who have chosen to write their dissertation on subjects of research encompassed by CASS. Graduate and undergraduate courses in astrophysics, astronomy, and space sciences are developed and taught by the academic staff of CASS. The total yearly budget is about \$5 million, mostly from federal funding sources.

**The Center for Comparative Immigration Studies (CCIS)** is an interdisciplinary, multinational research and training program devoted to comparative work on international migration and refugee movements. Its primary missions are to conduct comparative (especially cross-national) and policy-oriented research, train academic researchers, students, and practitioners, and disseminate research conducted under its auspices to academics, policymakers, and NGOs through research seminars, conferences, publications, the Internet, and the mass media. CCIS seeks to illuminate the U.S. immigration experience through systematic comparison with other countries of immigration, particularly in Europe and the Asia-Pacific region.

The Center promotes research in the following areas: (1) the causes, dynamics, and consequences (economic, political, and sociocultural) of international migration, including low-skilled and high-skilled migrant workers and refugees; (2) the determinants and outcomes of laws and policies to regulate immigration and refugee flows; (3) transnational relationships (economic, political, cultural, ethnic) between immigrant sending and receiving countries; (4) the impact of international migration on citizenship, national identity, and ethnic relations; (5) immigrant rights, advocacy, and social services; (6) immigrant political mobilization and participation; (7) the socioeconomic, political, and cultural interactions of immigrants with native-born residents of receiving countries.

CCIS hosts visiting predoctoral and postdoctoral research fellows, and conducts an annual field research project on Mexican migration to the United States. The Center's Forced Migration Laboratory conducts research in San Diego's refugee communities originating in sub-Saharan Africa, the Middle East, Central America, and Southeast Asia. The laboratory promotes interaction between academic specialists in refugee

studies and practitioners, aimed at identifying and disseminating best practices for refugee resettlement. The center has an active publications program consisting of monographs, anthologies, and working papers. Funding is provided by the University of California, private foundations, and international agencies.

A number of graduate research assistantships are available. Applications for graduate study in any of the disciplines covered by CCIS should be directed to the academic department in which graduate study is to be undertaken.

The overall objective of the **Center for Energy Research (CER)** is to provide an academic research unit for interdisciplinary interactions among UCSD faculty, research staff, and students aimed at promoting and coordinating energy research and education. Approximately sixty-one faculty, staff, and students are affiliated with the CER. The goals of the CER are complementary to academic departments of instruction and research with an emphasis on bridging the various disciplines related to energy research on the campus. Emphasis is currently on combustion and fusion energy research. The CER will also provide a vehicle for developing other dimensions of energy research, including energy policy research. The specific goals of the CER are: (1) to provide an inter-departmental coordinating function for energy research groups and projects at UCSD, (2) to enhance the prospects of extramural research funding involving inter-departmental and multi-disciplinary collaborations in energy research, (3) to promote the visibility of energy topics in undergraduate and graduate programs at UCSD, (4) to provide a mechanism for interacting with other institutions involved in energy research with particular attention to potential industrial partners, and (5) to promote the visibility of energy research at UCSD to potential sponsors and funding agencies.

A number of graduate research assistantships are available. Applications for graduate study in any of the disciplines covered by the CER should be directed to the academic department in which graduate study is to be undertaken.

The **Center for Environmental Research and Training (CERT)** coordinates the broad range of environmental research activities across the university. Departmental participation includes the Departments of Anthropology, Chemistry and Biochemistry, Economics, Division of Biological Sciences, School of Engineering, School of Medicine, Scripps Institution of Oceanography,

the Center for U.S.-Mexican Studies, and the Graduate School of International Relations and Pacific Studies. This extensive group offers an opportunity to address environmental issues across traditional disciplinary boundaries. This opportunity is particularly crucial for understanding the complex interactive nature of global and regional environmental issues. The CERT also provides an interface for interaction with environmental agencies outside the university, including the environmental technology sector and governmental agencies.

The **Center for Human Development (CHD)** is an interdisciplinary, research-centered unit designed to meet the growing needs for interdisciplinary exchange on issues related to human development. The goal of CHD is to provide a forum for interdisciplinary exchange that creates dialogue between members of diverse disciplines. The Center is organized around five structurally distinct components, but with integrated functions. Each function is designed to serve a specific set of needs and to make unique contributions to the larger enterprise. These components are the following: (1) research support and infrastructure, (2) enrichment of human development's instructional counterparts—the undergraduate Human Development Program and a proposed interdisciplinary graduate program, (3) dissemination activities focused on but not limited to local community needs, (4) public policy analysis, and (5) assessment activities. In addition, the Center serves as a focal point for research, evaluation, and assessment activities associated with the campuswide Center for Research in Educational Equity, Assessment, and Teaching Excellence (CREATE).

The **Center for Human Information Processing (CHIP)** is a research facility for the study of the neural and cognitive mechanisms underlying human perception, thought, and emotion.

CHIP has two missions—a practical one and a theoretical one. The practical goal is to help develop new therapeutic approaches for the treatment of neurological and psychiatric patients (e.g., stroke and childhood autism). The theoretical agenda is to understand the neural basis of human behavior—the question of how the activities of millions of tiny wisps of protoplasm in the brain gives rise to all the richness of our conscious experience and the complexity of our cognitive processes.

It is ironic that even though we now have a vast amount of factual information about the

brain, even the most basic questions about the human mind remain unanswered. How does the human brain create and respond to art? Why do we enjoy music? How are metaphors represented in the brain? What is "body image" and why does it get distorted in Anorexia nervosa? How did language evolve? Or even more basic questions such as: How do we see color? Can we pay attention to only one thing at a time? How do we recognize faces so effortlessly?

CHIP has become well known for tackling questions such as these experimentally. CHIP has played a major role in the emergence of such new disciplines as "neuro-ethics," "neurotheology," "neuroeconomics," "neuro-aesthetics," and "neuro-epistemology."

CHIP has four divisions, each operating with the common goal of furthering our understanding of human cognitive processes and the neurological bases of these processes. The subdivisions are: brain and perception division, the cognitive processes division, the division of neuropharmacology and alternative medicine, and the language processing division.

CHIP provides facilities for visiting scholars and supports workshops, conferences, and brown-bag discussion groups centering on the theoretical and empirical issues in each of these areas.

The **Laboratory of Comparative Human Cognition**: Each member of LCHC pursues forms of critical empirical research, which aim to understand the historical construction of human life. We use a range of methodological tools to throw into relief the contingency of culturally inflected collective social practices, change over time, and the implications of social practices for human development. And, in keeping with the critical ethos of our orientation, we often utilize strategies to actively initiate change in the settings we investigate. We take an ecological approach, looking at systems that include meditating tools, people, representations, institutions, and activities. We are especially interested in the collective accomplishment of knowledge practices—cognition, learning, remembering (and forgetting), teaching, research, and engineering. Collectively, our research spans all ages. At the same time, because the institutionalization of social practices holds an important place in our studies, specific projects often take the form of "educational" or "workplace" research. In both "domains," the place of discourses, economics, and technologies in the development of social relations of power, and their implications for

change over time, are scrutinized. We find comparisons across these realms a powerful source of insight and theoretical development.

The LCHC published fifteen volumes of *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition*. It now publishes a journal, *Mind, Culture, and Activity: An International Journal*. The LCHC also coordinates an international electronic discussion (<http://communication.ucsd.edu/MCA/Mail/index.html>) that currently includes more than 400 researchers from sixteen countries. The LCHC conducts a weekly seminar and workshops focused on special topics, including cutting-edge research reports from members of an interdisciplinary, international group of LCHC alumni who visit periodically.

The **Center for Iberian and Latin American Studies (CILAS)** coordinates and promotes Latin American and Iberian research and service activities for faculty and students in all departments at the university and outreach programs for the San Diego community. It sponsors multi-disciplinary colloquia, conferences, projects and publications, collaborations and exchanges with Latin American institutions, as well as library expansion. The center is currently launching new initiatives in the areas of public health; democracy, civil society, and citizenship; and cultural studies. The center also hosts visiting scholars, and it awards grants and fellowships each year to promising graduate students.

The **Center for Magnetic Recording Research (CMRR)** is devoted to multidisciplinary research and education in areas of science and engineering that form the foundation for information storage technologies for computer disk and tape drives. Founded in 1983 in partnership with a consortium of industrial sponsors, the center's continuing mission is to advance the state-of-the-art in magnetic disk and tape storage technologies, while producing highly trained graduate students and postdoctoral professionals. Together, the center's faculty and graduates have made major contributions to the remarkable progress that storage systems have achieved in storage capacity, data transfer rate, and cost efficiency over the past two decades.

CMRR supports four endowed professorial chairs, currently in the areas of magnetic materials, recording physics, tribology and mechanics of the head/medium interface, and signal processing and coding. The chaired professors also hold faculty appointments in the Departments of Physics, Electrical and Computer Engineering,

and Mechanical and Aerospace Engineering. Graduate student researchers, post-graduate researchers, professional scientists, and visiting scholars representing international academic institutions and industrial laboratories contribute to a research and educational environment that is dynamic and varied.

As part of the center's mission to educate future leaders in the vital information storage industry, the faculty teach specialized classes at the undergraduate and graduate levels that train students in the theoretical methods and experimental techniques underlying advanced magnetic recording technology. In addition, the center contributes to the continuing education of professionals in the storage industry through regular seminars, research reviews, and focused workshops.

Virtually all major information storage companies are sponsors of CMRR, and they provide substantial research support through their membership fees, focused research grants, and graduate student fellowships. "Real-world" research opportunities are also available to students through academic-year and summer internships with selected sponsors. Additional support has come from private foundations, state, and federal funding agencies, as well as from active participation in joint university-industry programs, such as those coordinated by the Information Storage Industry Consortium (INSIC).

Through cooperative research projects and the CMRR affiliated faculty program, the center also fosters interactions with researchers in other campus organizations, including the Department of Chemistry and Biochemistry, the Department of Computer Science and Engineering, the San Diego Supercomputer Center, and the Information Storage Industry Center in the Graduate School of International Relations and Pacific Studies. The interests of these affiliates cover a broad spectrum, including novel materials for data recording, disk-drive failure prediction, computational analysis of the recording process, and the globalization of the magnetic recording industry.

CMRR also supports a world-class Library/Information Center for information storage technology that provides a range of services to sponsors, resident researchers, and students. Services include licensed database searching, patent searching, document retrieval, and expedited access to proprietary technical resources.

The **Center for Molecular Agriculture (CMA)** promotes research and education in plant genetics



and plant molecular biology with an eye to the application of that research to the improvement of crops. Crop improvement cannot any longer rely exclusively on traditional plant breeding methods but requires the application of new technologies that include but are not limited to genetics and genomics, informatics, molecular gene isolation, and plant transformation. The CMA brings together researchers from UCSD and the Salk Institute and is a resource for the entire San Diego community. It provides a focal point for interaction with the local and statewide agricultural biotechnology industry. The Center wishes to play an active role in the debate about the safe cultivation and use of genetically modified crops.

The **Center for Molecular Genetics (CMG)** promotes molecular genetic research and the training of graduate students and postdoctoral fellows in the biological, chemical, and biomedical sciences. The center's research incorporates studies in both model systems and humans that share a focus on dissecting the molecular basis of human diseases. The latest techniques of gene isolation and manipulation, as well as the genetic transformation of both cells and organisms, are applied to major problems in biology and medicine. The center serves as a resource for the entire UCSD campus for molecular genetic techniques, materials, and facilities. The CMG also is host to seminar series, conferences, and workshops that encourage cross-disciplinary interactions among biomedical and bioinformatic investigators.

**The Center for Research in Biological Systems (CRBS)** is an organized research unit that exists to provide human resources, high-technology equipment, and administrative services to researchers engaged in fundamental research on cell structure and function relationships, particularly those involved in central nervous system processes, cardiovascular networking, and muscular contraction. CRBS scientists investigate these processes through invention, refinement, deployment of sophisticated technologies, especially

- High-powered electron microscopes that reveal three-dimensional cell structures
- State-of-the-art X-ray crystallography and magnetic resonance analysis that provide detail on protein structures at high resolution
- Laser-scanning and Confocal light microscopes that reveal molecules tagged with fluorescent markers as they traffic within cells and pass transfer signals within and between cells

- High performance computing and grid-based integration of distributed data

CRBS facilitates an interdisciplinary infrastructure in which people from biology, medicine, chemistry, and physics can work with those from computer science and information technologies in collaborative research. CRBS researchers share interests in the study of complex biological systems at many scales, from the structures of enzymes, proteins, and the body's chemical communications network at atomic and molecular levels, to an organism's physiology, strength, and support at cellular and tissue levels.

The CRBS infrastructure integrates resources for high-performance computing, visualization and database technologies, and the grid-integration of large amounts of archival storage data. The California Institute for Telecommunications and Information Technology (Cal-IT<sup>2</sup>) and the San Diego Supercomputer Center (SDSC) are collaborators in simulating the activity of biological systems, analyzing the results, and organizing the growing storehouse of biological information.

The aims of CRBS researchers are met in interdisciplinary research efforts of major federally funded research efforts that are presently the heart of CRBS:

- BIRN, the Biomedical Informatics Research Network <http://www.nbirn.net> tests new modes of large-scale biomedical science. BIRN builds infrastructure and technologies to enable large-scale biomedical data mining and refinement.
- NCMIR, the National Center for Microscopy Imaging Research <http://www.ncmir.ucsd.edu> specializes in the development of technologies for improving the understanding of biological structure and function relationships spanning the dimensional range from 5nm<sup>3</sup> to 50µm<sup>3</sup>.
- NBCR, the National Biomedical Computation Resource <http://nbcrc.ucsd.edu> conducts, catalyzes, and advances biomedical research by harnessing, developing, and deploying forefront computational, information, and grid technologies.
- JCSG, the Joint Center for Structural Genomics <http://www.jcsg.org> creates new technologies to drive high-throughput structure determination. The Bioinformatics Core at UCSD is responsible for target selection, sample tracking, information management, structure validation and deposition, and poststructural analysis. Through these functions, the group

provides the integrated informatics backbone required for the successful operation of JCSG.

CRBS researchers also have significant roles in collaborations with

- PRAGMA, Pacific Rim Applications and Grid Middleware Assembly, <http://www.pragma-grid.net> establishes sustained collaborations and advances the use of grid technologies in applications throughout the Pacific Region to allow data, computing, and other resource sharing.
- Optiputer, <http://www.optiputer.net>, involves the design and development of an infrastructure to integrate computational, storage and visualization resources over parallel optical networks using lambda switching communication mechanisms.

CRBS is an entity evolving as research evolves. It was established in 1996 to involve researchers from disciplines across UCSD, the School of Medicine, the Salk Institute for Biological Studies, Calit2, and SDSC, including bioengineering, biology, chemistry, computer science, mathematics, neurosciences, pharmacology, psychiatry, and physics, and forges interactions with biotechnology and biocomputing companies for technology transfer. Interaction, collaboration, and multiscale research produce new perspectives, reveal fruitful research topics, lead to the development of new technologies and drugs, and train a new generation of researchers in biological systems.

**The Center for Research in Computing and the Arts (CRCA)** is an organized research unit of UCSD whose mission is to facilitate the creation of new forms of art that arise out of the developments of digital technologies. Current focus areas include networked multimedia, virtual reality, computer-spatialized audio, and live performance techniques for computer music and graphics.

As the University of California's oldest arts research center, CRCA pursues innovative approaches to the arts, crossing disciplinary boundaries with the humanities, engineering, and the sciences. Faculty members devise new modes of artistic practice through their liaisons with international cultural institutions, high-tech industries, and interdisciplinary collaborations.

CRCA coordinates the New Media Arts layer of the California Institute for Telecommunications and Information Technologies [Calit2] at UCSD. The center's cultural research activities are considered a model "living laboratory" for Calit2

provocatively, and critically, pursuing new cultural forms and social engagements provided by developments in IT and telecommunications.

CRCA provides the support framework for a broad range of approaches to artistic, scholarly, and technological development that is at the basis of our digitally transformed culture. We actively encourage the investigation of what constitutes the potent cultural acts of our time and the viable mechanisms that should be engaged to create them. More information about the center, its researchers, public events, and the process for engagement, can be found at <http://crca.ucsd.edu>.

**Center for Research in Language (CRL).** The foci of the center are on language processing, language learning, language disorders, and simulations of all these aspects of language in artificial systems. Research in the center is interdisciplinary and draws upon the fields of linguistics, psychology, cognitive science, neurosciences, computer science, and communication.

The center's facilities are designed to accommodate laboratory research projects by the faculty and graduate students; facilities include a number of high-performance work stations, a computer laboratory, extensive equipment for audio recording and analysis, and equipment for psycholinguistic experimentation.

Current research projects include studies of language and cognitive development in children; language impairment in children and adults; word and sentence processing in bilinguals; foreign vocabulary in American Sign Language; development of neurally inspired parallel processing models of speech perception; studies in first language acquisition; cross-linguistic comparisons of the process of language acquisition and aphasia; research on the integration of grammatical analyses and theories; a project to collect large-scale text corpora in electronic form; and a study of expectancy generation in sentence processing. The center administers an NIH pre- and postdoctoral training grant, "Language, Communication and the Brain." CRL has also entered into several institutional agreements with research institutions in Europe, Asia, and the Americas, providing for the exchange of personnel and support for projects of mutual interest. An ongoing speaker series presents a broad range of experimental approaches to the study of language. The center publishes a monthly electronic newsletter.

The Project in Cognitive and Neural Development is an activity of CRL. Its purpose is to provide

a forum for interdisciplinary research on brain and cognition in human children, including research on the neural bases of language and communication. The project brings together faculty and research staff from the UCSD Departments of Cognitive Science, Communication, Linguistics, Neurosciences, Psychology, Psychiatry and Sociology, the San Diego State University Departments of Psychology and Communication Disorders, and the Salk Institute for Biological Studies.

**The Center for U.S.-Mexican Studies (CUSMS),** established in 1979, is the nation's largest program devoted to the study of Mexico and U.S.-Mexican relations. It supports research in the social sciences and history, graduate student training, publications, and public education activities that address the full range of problems affecting economic and political relations between Mexico and the United States.

Through its visiting researchers program, the center each year sponsors the research of predoctoral and postdoctoral scholars, who spend three to nine months in residence. Typically, people from Mexico receive over half of these awards, which are made through an open, international competition. Other visiting fellows come from Europe, Canada, East Asia, and the rest of Latin America. The center's permanent academic staff also conducts long-term studies of Mexico's competitiveness in the global economy, Mexican financial markets, the impact of remittances on development, political change and the administration of justice in Mexico, environmental problems in Mexico and the U.S.-Mexico borderlands, Mexican immigration to the U.S., and new forms of North American economic integration. The center publishes much of the research conducted under its auspices.

Each summer, the center conducts a seminar in studies of the United States for twenty-three to twenty-five Latin American social scientists and nonacademic professionals.

The center's interdisciplinary Research Seminar on Mexico and U.S.-Mexican Relations, which meets throughout the academic year, features presentations of recent research by scholars from throughout the United States, Mexico, and other countries. In addition, several research workshops on specialized subjects are held each year.

The center has an active public education program, which includes frequent briefings for journalists, public officials, and community groups.

**The Glycobiology Research and Training Center (GRTC)** seeks to facilitate and enhance

glycobiology research and training at UCSD. Current faculty membership includes many UCSD faculty from several departments across the School of Medicine, SIO, and the general campus as well as adjunct faculty at nearby institutions. Affiliate members include interested scientists in the La Jolla area as well as faculty from other UC campuses.

Glycobiology is the study of the structure, biosynthesis, and biology of sugar chains (called oligosaccharides or glycans) that are widely distributed in nature. All cells and many proteins in nature carry a dense and complex array of covalently attached glycans. These are often found on cellular and secreted macromolecules, in an optimal position to modulate or mediate events in cell-cell and cell-matrix interactions that are crucial to the development and function of a complex multicellular organisms. They can also mediate interactions between organisms (e.g., between host and parasite). In addition, simple, rapidly turning-over protein-bound glycans are abundant in the nucleus and cytoplasm, where they appear to serve as regulatory switches. The development of a variety of new technologies for exploring the structures of these glycans has recently opened up this new frontier of molecular biology.

The GRTC seeks to foster interactive research in glycobiology by coordinating the availability of state-of-the-art instrumentation and expertise in the structural analysis of glycans through a Glycotechnology Core Resource, increasing intellectual and collaborative interactions by organizing symposia, joint programs and seminars, coordinating joint applications for extramural support, improving access to relevant informatics, and facilitating the transfer of basic glycobiology research to practical applications. The Center also strongly emphasizes graduate, post-graduate, and medical student education in glycobiology, including contributions by the faculty to core curricula, as well as to elective courses and journal clubs.

**The San Diego Supercomputer Center (SDSC)** is an organized research unit of UCSD that provides world leadership in developing and applying technology to advance science. SDSC research activities are undertaken jointly with faculty from UCSD departments, including computer science and engineering, bioengineering, biochemistry and chemistry, pharmacology, physics, and Scripps Institution of Oceanography; local research institutions such as The

Scripps Research Institute and the Salk Institute for Biological Studies; and national and international collaborators.

With a staff of 400 scientists, software developers, and research, operations, and user support staff, SDSC is focused on data management, high-end computing, integrative biosciences, geoscience, grid and cluster computing, and visualizations.

SDSC's data management activities provide data integration for large-scale application efforts within UCSD and beyond in fields such as geosciences, biological and environmental sciences. Two key projects include the Geoscience Network (GEON) and the Science Environment for Ecological Knowledge (SEEK). GEON weaves together separate informational strands into a unified fabric that enables the discovery of data relationships within and across Earth science disciplines.

SEEK uses SDSC's computational science resources to provide the computational and data-management components of UCSD's strong environmental informatics program. Reflecting the dramatic increase in humankind's ability to change the environment, the study of environmental informatics is increasingly critical to California. SDSC and UCSD are building and supporting a program that spans scales from the molecular level to entire populations, accurately modeling the impact of population on the environment.

In addition, SDSC pursues data management activities such as digital library initiatives, data-system standardization, and opportunities to impact large-scale data mining, analysis, and knowledge synthesis with academic, federal, and commercial partners. SDSC's high-end computing unit is leading a national effort to understand and deploy the most capable computational environments and to make those environments easily accessible and usable by scientific communities—locally, nationally, and globally. SDSC maintains leadership in critical strategic capabilities, including chemistry, parallel applications and performance modeling, scientific visualization, and increasing collaborations with the social sciences.

Researchers involved in SDSC's integrative biosciences area are developing projects to understand how cellular behavior emerges from the molecular level, how tissue behavior emerges from the cellular level, and so on up to the level of the organism. SDSC is collaborating in this area with the UCSD School of Medicine, the Center for Research in Biological Structure, The Scripps Research Institute, the Salk Institute for Biological

Studies, and local biotech and pharmaceutical companies. SDSC also is focusing on large-scale collaborative bioscience projects worldwide using an infrastructure based on high-performance computation and analysis of massive amounts of data.

As the leading-edge site of the National Partnership for Advanced Computational Infrastructure, SDSC is collaborating with forty-one partner institutions. The partnership is developing a ubiquitous, continuous, and pervasive computational environment for tomorrow's scientific discovery. Major academic researchers around the country use the powerful computing resources at SDSC to make breakthroughs in diverse areas of science—from astronomy and biology to chemistry and particle physics.

In early 2004, SDSC deployed DataStar, a 10.4 teraflops (trillion floating point operations per second) supercomputer with a total shared memory of 3.2 terabytes. DataStar is among the top supercomputers in the world. DataStar is used by researchers in academia and industry to conduct large-scale scientific research applications that involve extremely large data sets or have stressful input/output requirements.

SDSC and four partners are developing the TeraGrid—the first large-scale and production grid that provides a national computational infrastructure for open scientific research. SDSC's partners are the National Center for Supercomputing Applications at the University of Illinois, Argonne National Laboratory, the Center for Advanced Computing Research at the California Institute of Technology, and the Pittsburgh Supercomputing Center. The TeraGrid integrates more than 20 teraflops of computing power distributed at the five sites through a cross-country network backbone that operates at 40 gigabits per second. The storage facilities at SDSC alone include more than 500 terabytes of high-speed disk and six petabytes of archival storage. The complete TeraGrid project also includes facilities for high-resolution visualization environments, as well as toolkits for grid computing.

SDSC hosts huge digital collections, including astronomical images from the 2-Micron All Sky Survey, images from the Art Museum Image Consortium, Chinese text from the Pacific Rim Digital Library Alliance, and tomographic images of the human brain. The technology is also being used to prototype persistent digital archives for the National Archives and Records Administration and other government agencies with huge data archives.

The Cooperative Association for Internet Data Analysis (CAIDA) at SDSC engages Internet providers, vendors, and users in engineering and technical collaborations to promote a more robust, scalable Internet infrastructure. CAIDA works with the community to develop and transfer tools and technologies that provide engineering and other insights relating to the operation and evolution of the Internet infrastructure. CAIDA works with providers and researchers to refine Internet traffic metrics, foster shared research environments, and encourage the development and testing of advanced networking technologies.

SDSC's Applied Network Research group is currently conducting two Internet research projects. The first involves the National Laboratory for Applied Network Research (NLNAR), an NSF-supported collaboration to provide technical, engineering, and traffic analysis support for NSF's High Performance Connections sites and the nation's high-performance network infrastructure. NLNAR members include SDSC, the National Center for Supercomputing Applications at the University of Illinois, the Pittsburgh Supercomputing Center, and the National Center for Atmospheric Research.

The second activity of the Applied Network Research group is the High Performance Wireless Research and Education Network (HPWREN), a collaboration with SIO that created a noncommercial, prototype, high-performance, wide-area wireless network in San Diego County. The NSF-funded network includes backbone nodes on the UCSD campus and a number of "hard to reach" areas in the county. HPWREN is demonstrating, and evaluating uses of the prototype for network analysis research, for high-speed Internet access for scientists involved in field research projects involving geophysics, astronomy, and ecology, and for educational opportunities for rural Native American learning centers and schools.

The SDSC Fellows Program promotes computational science and engineering activities at UCSD and seeks to strengthen intellectual ties between SDSC staff and other researchers on campus. UCSD faculty members are invited to join this program by contacting Kim Baldrige, [kimb@sdsu.edu](mailto:kimb@sdsu.edu), (858) 534-5149.

Research Experiences for Undergraduates (REU), funded by NSF, provides an opportunity for undergraduates to work on computational science research projects under the guidance

of SDSC mentors and their campus advisers. Students can participate in a full-time summer program or part-time during the academic year. Candidates must apply to and be accepted by the program. Stipends are provided. For more information, contact Rozeanne Steckler, [steckler@sdsc.edu](mailto:steckler@sdsc.edu), (858) 534-5122.

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## Projects

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The goal of the **African and African-American Studies Research Project (AAASRP)** is to facilitate faculty, postgraduate, and graduate research in the areas of Africa and African diaspora studies in the social sciences and the humanities, and to foster the comparative, cross-national, and interdisciplinary dimensions of research, with a core group of scholars drawn from several fields in the social sciences and humanities. These research efforts are linked directly to larger local and international community concerns.

The project sponsors visiting scholars, focused research groups, a seminar, and symposia. Faculty from seven university departments are involved. The project oversees the African Studies Minor. The project is also part of the UC Systemwide Consortium of African Studies Programs and the national Association of African Studies Programs. It provides the basis for the establishment of an organized research unit on African and African-American Studies at a later time. For more information, contact the AAASRP office at (858) 822-0265.

The **Project for Explaining the Origin of Humans** is a broad-based multidisciplinary coalition of individuals in the La Jolla area (from UCSD as well as surrounding institutions) who are interested in defining and explaining the evolutionary origins of humans and in generating testable hypotheses and new agendas for research regarding this matter. Areas of current interest include primate genetics and evolution, paleoanthropology and hominid origins, mammalian and primate neurosciences, primate biology and medicine, the roles of nature and nurture in language and cognition, human and primate society and culture, comparative primate reproductive biology, geographic, environmental and climatic factors in hominid evolution, as well as general theories for explaining humans. The group includes faculty from the Departments of Anthropology, Biology, Chemistry and Biochemistry, Cognitive Science, Linguistics, Medicine, Neurosciences, Oceanography, Pathology, and Psychology. A listing of participants can be found at <http://origins.ucsd.edu>.

The **Project in Display Phosphor Research** provides a forum for research on the synthesis, characterization, and processing of phosphors for high definition display applications. The project brings together faculty and researchers from the UCSD Departments of Chemistry and Biochemistry, Mechanical and Aerospace Engineering (MAE), and Electrical and Computer Engineering (ECE). The project was organized in 1992 in order to expand collaboration with other colleagues at UCSD and to extend research efforts to address both near-term and future research issues concerning phosphor materials and advanced displays.

The **Project In Econometric Analysis (PEA)** is concerned with the analysis of economic and financial data and with techniques for modeling relationships between economic variables and testing economic theories. As economic variables have properties not generally found in other fields, standard procedures from mainstream statistics are often not appropriate. The field of econometrics has been developed to deal with these issues. Its importance is indicated by its effect on the methodologies in other social sciences, such as political science and empirical history, and the fact that several Nobel Prize winners in economics have been econometricians. In fact, the 2003 Nobel Prize in economics was awarded to Clive Granger and Robert Engle, two of the founders of the PEA.

The Project in Econometric Analysis (PEA) supports the work of an active group of researchers and provides opportunities for productive interaction among faculty and students. Areas of active research include financial econometrics, non-linear time series modeling, properties of neural network models, the theory of economic forecasting and various actual applications including evaluations of models and forecasts in finance and economics. The PEA allows links with workers from other universities in this and other countries. In 2000–2001 and 2001–2002 the project had visitors from Europe, Asia, North America, and Australia; some were senior and some were pre- and post-doctoral students. Faculty members and graduate students associated with the project presented their research at workshops and conferences worldwide. In addition, PEA facilitates the submission of grant proposals to outside agencies.

The **Project in Geometry and Physics (PGP)**, established in 1987, provides opportunities for increased collaboration between mathematicians

and physicists. The project hosts several scientific meetings each year and also sponsors a number of research seminars with distinguished scientists from inside and outside the UCSD community.

The **Project on International Affairs (PIA)** is one of the international programs within the Institute on International, Comparative, and Area Studies, focusing on economic and political interactions between states. The project serves to promote interdisciplinary research on international politics and international economics; disseminate current research to UCSD faculty and students; provide a multidisciplinary focal point for research and programming; and enhance campus and community understanding of international political and economic affairs.

The **Project on Responsible Conduct of Research Education (RCR Education Project)** was created in 2003 to promote RCR education both at UCSD and nationally. To achieve this goal, the RCR Education Project is facilitating the formation of an independent Responsible Conduct of Research Education Consortium (RCREC). The RCREC will provide leadership to the research community in promoting education in the responsible conduct of research.

The RCR Education Project and the RCREC are intended to be a broad-based coalition, representing medical, social, and behavioral research, and public and private institutions. Through these collaborations, the RCR Education Project will lay the foundations for the RCREC to advance programs of RCR education, develop RCR education standards, certify or identify programs that meet those standards, facilitate the exchange of RCR education programs among research institutions, and develop outcome measures to evaluate the success of the endeavor. Specific objectives of the RCREC are to: 1) promote RCR education as a central responsibility for any institution involved in research; 2) develop clear definitions for RCR education, including goals, standards, competencies, and methods for evaluating the effectiveness of programs; 3) assist institutions, RCR programs, and investigators in identifying and developing RCR education curricula and resources; 4) facilitate discussion and collaboration among federal agencies, public and private research institutions and organizations, professional societies, and businesses in developing, coordinating, and sharing new and existing RCR educational programs within the research community; and (5) identify and overcome barriers to fulfilling RCR educational needs and requirements.



The **Public Policy Research Project** was established to facilitate interdisciplinary research and educational opportunities in public policy and business-government interaction. Through conferences, focused research groups, and lecture series, the project acts as a catalyst for interaction among economists, political scientists, moral philosophers, historians, cognitive scientists, anthropologists, and sociologists. The project supports programs that: (1) help faculty obtain funding that are engaged in policy-related research, (2) conduct research apprenticeships for doctoral students working on research projects dealing with issues and processes of public policy, and (3) provide technical support and arrange faculty-proposed conferences within the scope of the project's mission statement.

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## Natural Reserve System (NRS)

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The **Natural Reserve System (NRS)** was founded to establish and maintain significant examples of California's diverse ecosystems and terrain. These reserves are used for teaching and research in all disciplines, from geology and environmental sciences to anthropology and art. Faculty and students of the University of California and other institutions are encouraged to use any of the thirty-four reserves in the system for serious academic pursuits. The San Diego campus administers the following four reserves:

**Dawson Los Monos Canyon Reserve:** This 218-acre reserve is located in the cities of Carlsbad and Vista in north coastal San Diego County. Its young, stream-cut valley contains a year-round creek with precipitous north- and south-facing slopes. The major habitat types are Southern Riparian Woodland, Diegan Coastal Sage Scrub, Perennial Coastal Stream, Coast Live Oak Woodland, Mixed Grassland of native bunchgrass and introduced annuals, and South Coastal Mixed Chaparral. This area is also of unique and significant historical and archaeological value. A small field station provides opportunities for small laboratory classes, overnight stays, and on-site research.

**Elliott Chaparral Reserve:** Located ten miles to the east of campus, this 107-acre reserve, adjacent to the large expanse of Marine Corps Air Station Miramar that is undeveloped, features Chamise Chaparral typical of the Southern California coastal plain and a large stand of mature planted eucalyptus. It is readily available during a normal

three-hour lab period or for term paper-length field studies as well as for more lengthy projects.

**Kendall-Frost Mission Bay Marsh Reserve:**

This sixteen-acre reserve, together with the city of San Diego's contiguous Northern Wildlife Preserve, constitute the last remaining forty acres of tidal salt marsh on Mission Bay and one of the few such wetlands remaining in Southern California. It is recognized for the habitat it provides for several rare and endangered birds including the light-footed clapper rail, Belding's savannah sparrow, and the California least tern, as well as many resident and migratory shorebirds and waterfowl, and several fish species. An on-site trailer houses limited residential and laboratory facilities, and extensive facilities exist within ten miles on the UCSD main campus and at the Scripps Institution of Oceanography. There are opportunities for studying restoration ecology of upland and tidal habitats.

**Scripps Coastal Reserve:** This reserve consists of disjunct shoreline and cliff-top (or "knoll") portions. The shoreline part consists of the 67 acre San Diego Marine Life Refuge extending seaward 1,000 feet from the high tide line, and surrounding the Scripps Institution of Oceanography (SIO) Pier. Habitats include sandy beach and submerged plain, to 60 feet below mean lower low water, seasonally exposed cobble beach, rocky reef, pier pilings, and upper submarine canyon ledges. Habitats of the clifftop knoll and canyons include coastal sage scrub, maritime succulent scrub, southern coastal mixed chaparral, and disturbed grassland. The latter is particularly suitable for ecological restoration experiments. This reserve is enhanced by the availability of the laboratories and facilities of adjacent SIO and the main San Diego campus.

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## Campuswide Research Facilities

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### *Academic Computing Services*

See page 88.

### *San Diego Supercomputer Center*

See page 91.

### *The UCSD Libraries*

See page 95.