

# College of Sciences

## Administration

Dean: Stanley Maloy

Associate Dean for Graduate and Research Affairs: Patrick J. Papin

Associate Dean for Academic and Faculty Affairs: Catherine J. Atkins

Assistant Dean for Student Affairs: Estralita Martin

Director of Development:

## General Information

The College of Sciences, composed of eight departments and various subprograms, offers bachelor's, master's, and doctoral degrees, and curricula for preprofessional students in medicine, veterinary medicine, and dentistry. The science curriculum is enhanced by research centers which provide field experience as well as special seminars with guest speakers. The off-campus sites include the Mt. Laguna Observatory, and about 5,000 acres in four biological sciences research stations. The majority of tenured Sciences faculty have active research programs which offer student involvement.

## Curricula Offered

Refer to the Courses and Curricula section of this catalog for a complete listing of program requirements and courses offered by departments within the College of Sciences.

### Doctoral Programs

Biology (Cell and Molecular), Chemistry, Clinical Psychology, Computational Science (Statistics), Ecology, Mathematics and Science Education

### Master's Degrees

Applied Mathematics (M.S.), Astronomy (M.S.), Biology (M.A., M.S.), Biomedical Quality Systems (M.S.), Chemistry (M.A., M.S.), Computational Science (M.S.), Computer Science (M.S.), Geological Sciences (M.S.), Homeland Security (M.S.), Mathematics (M.A.), Microbiology (M.S.), Physics (M.A., M.S.), Psychology (M.A., M.S.), Radiological Health Physics (M.S.), Regulatory Affairs (M.S.), Statistics (M.S.).

### Bachelor's Degrees

Astronomy (B.S.), Biology (B.A., B.S.), Chemical Physics (B.S.), Chemistry (B.A., B.S.), Computer Science (B.S.), Environmental Sciences (B.S.), Geological Sciences (B.S.), International Security and Conflict Resolution (B.A.; jointly with the College of Arts and Letters and the College of Professional Studies and Fine Arts), Mathematics (B.A., B.S.), Microbiology (B.A., B.S.), Physical Science (B.A.), Physics (B.A., B.S.), Psychology (B.A.), Statistics (B.S.).

### Minors

Astronomy, Biology, Chemistry, Computer Science, Energy Studies, Geological Sciences, History of Science and Technology, International Security and Conflict Resolution (jointly with the College of Arts and Letters and the College of Professional Studies and Fine Arts), Mathematics, Oceanography, Physics, Psychology, Statistics.

### Certificate Programs

Biotechnology, Communications Systems, Geographic Information Science, Mathematics Specialist, Professional Computational Science, Regulatory Affairs, Single Subject Mathematics.

### Other Curricula

Allied Health, Prudental, Premedical, Preoptometry, Prepharmacy, Prephysician Assistant, Prepodiatry, Preveterinary.

## Research Centers and Institutes

### Edwin C. Allison Center for Earth System History

Lindsey Leighton and Stephen Schellenberg, Co-Directors

Throughout the history of science, many of the critical breakthroughs in scientific understanding have resulted from cross-disciplinary research. The mission of the Allison Center for Earth System

History is to foster this approach across the fields of paleontology, paleoclimatology, geochemistry, sedimentology, and organismal biology. The center seeks to facilitate research designed to improve and disseminate our understanding of global climate change and biodiversity, arguably the two most important topics facing current and future generations. Research materials of the co-directors and their students form the core of an in-house reference and systematics collection, including Cretaceous to Recent Ostracodes from globally distributed ocean drilling sites and Ordovician, Devonian, and Carboniferous brachiopods and associated communities from the Appalachian Basin, the Great Basin, the Ohio Valley, and the mid-continent. Scholarly examination of these and other materials by SDSU students, faculty, and guests (e.g. visiting students, faculty) are supported through dedicated research space and facilities, including image analysis, carbonate microsampling, and hydrodynamics flume systems. The Web site is

<http://www.geology.sdsu.edu/facilities/allisonctr/>

### Center for Behavioral and Community Health Studies (BACH)

John P. Elder, Director

Terry L. Conway, Linda C. Gallo, Joni A. Mayer, and Gregory A. Talavera, Associate Directors

The Center for Behavioral and Community Health Studies (BACH) is housed at 9245 Skypark Court, Suite 221, San Diego, CA 92113. The center, formerly known as The Center for Behavioral Medicine, was established in 1982 for the purpose of promoting research and academic programs relevant to the applications of behavioral science principles to medicine and health care. The center has ten investigators from three different colleges. The interdisciplinary center encourages participation from all of the university colleges and departments. Currently, active investigators come from the Departments of Exercise and Nutritional Sciences, Psychology, and the Graduate School of Public Health. Current center projects involve collaboration between scientists and clinicians from a variety of specialties as well as a variety of other institutions, including the San Ysidro Health Center, the City of San Diego Parks and Recreation Department, Casa Familiar, the MAAC Project, the University of California, San Diego Medical Center, and the Children's Hospital and Health Center. Funding for the center comes from federal and private foundation grants including several National Institutes of Health agencies. Current sponsors include the National Cancer Institute, National Heart, Lung and Blood Institute, the State of California Department of Health Services, and the University of California Tobacco Related Disease Research Program.

The center provides important research experiences to diverse students who intend to pursue related careers and offers opportunities for project staff and graduate students to participate in community interventions. The Web site is

<http://behavioralhealth.sdsu.edu/frontpage.html>

### Center for Behavioral Teratology (CBT)

Edward P. Riley, Director

Sarah N. Mattson, Associate Director

Teratology is the study of birth defects. The faculty and students at the Center for Behavioral Teratology (CBT) are interested in how prenatal exposure to various drugs influences both brain and behavioral development. Additionally, members of the center engage in research related to the general neurotoxicity of alcohol as well as the study of other birth defects and disorders. The CBT is truly an interdisciplinary research organization, with a broad range of basic and clinical research interests. While the primary purpose of the CBT is to promote research in teratology, personnel in the center also act as a resource to the university and the community. The staff provides in-service talks at local hospitals, schools, and drug treatment facilities, as well as lectures to various classes at the university. The CBT staff has active collaborations with faculty from UCSD, the VA Hospital, Children's Hospital, and the Scripps Research Institute. Faculty in the center have grants from the National Institutes of Health, Tobacco-Related Disease Research Program, and the State of California.

**Coastal and Marine Institute****Richard M. Gersberg, Director**

The Coastal and Marine Institute provides a focus for oceanography and marine studies at SDSU. The institute assists departments within the university in the development of instructional, research, and public service aspects of coastal and ocean-oriented programs and provides special supporting services including advising students, assistance to faculty and students in research, preparation of manuscripts, operation of the SDSU Marine Laboratories and boats, and liaison with other institutions and the community. The institute is operated as a special unit of the College of Sciences and is administered by a director and an advisory council committee consisting of faculty members elected from participating departments. Additional information about marine studies is available from the Coastal and Marine Institute office or from the office of the dean of the College of Sciences. The Web site is <http://www.sci.sdsu.edu/CMI/>.

**Computational Science Research Center (CSRC)****José E. Castillo, Director****Andrew L. Cooksy, Eugene A. Olevsky,  
and Paul J. Paolini, Associate Directors**

The Computational Science Research Center (CSRC) promotes the development and advancement of the interdisciplinary subject of computational science. This is accomplished by fostering research, developing educational programs, and promoting industrial interaction, outreach, and partnership activities.

The center provides an environment for scientific research at San Diego State University. It facilitates the interaction between applied mathematics, computer science, and other disciplines by providing the necessary infrastructure for productive research efforts. Real world applications are the focus of faculty and student projects. These projects provide an educational opportunity for students to hone industrially relevant computational skills.

The goals of the center are to encourage and facilitate research in computation, simulation, visualization, and numerical modeling in all disciplines (business and finance, biology and bioinformatics, engineering, physical sciences, and geography); to interact with other centers, laboratories, universities, and local industry; reduce lag time between algorithm development/analysis and applications; to participate in programs with other countries, including international programs sponsored by the National Science Foundation; to arrange visits by professors, including foreign visitors on sabbaticals and professional staff on industrial sabbaticals; to arrange part time and adjunct appointments for consulting activities by professional staff from local research laboratories; to provide employment, experience, and contacts for students; to sponsor conferences, workshops, and courses; to facilitate collaboration with government laboratories with private sector; to provide bridges to regional industry; and to direct the computational science program at San Diego State University.

Interested students and faculty may obtain more information by calling the CSRC office at 619-594-3430,

<http://www.sci.sdsu.edu/csrc>.

**Center for Energy Studies (CES)****Alan R. Sweedler, Director**

The San Diego State University Center for Energy Studies (CES) facilitates, promotes and supports research and academic programs relating to energy, with particular emphasis on energy matters of concern to the greater San Diego region including the international border with Mexico. The center encourages interdisciplinary research and instructional programs in the broad areas of energy modeling, technology assessment of energy systems, local energy policy planning and data collection relating to energy usage in the San Diego region. SDSU offers through the CES an interdisciplinary minor in energy studies. Completion of the minor will give the student a broad understanding of the technical, economic, social, and political aspects of energy issues. The CES is closely integrated with the environmental sciences program, which offers a Bachelor of Science degree through the College of Sciences. The CES works closely with local and state agencies concerned with energy policy and planning, and serves as a community resource in matters concerning local energy issues, and the impact of energy use of the environment. For more information call the CES at 619-594-1354.

**Field Stations Program****Matthew Rahn, Director**

The Field Stations Program provides opportunities for a broad community of students and faculty to explore the natural ecosystems of southern California. In addition, the field stations serve SDSU by functioning as a liaison to broader public community, highlighting SDSU's expertise regionally, nationally, and internationally. The Field Stations Program manage almost 9,000 acres of San Diego and Riverside county land for university teaching and research.

SDSU currently has four field stations: the Sky Oaks Field Station, 1,640 acres of high elevation redshank chaparral habitat in the Chihuahu Valley east of Temecula Valley; the Santa Margarita Ecological Reserve (SMER), a 4,464 acre reserve located along the upper Santa Margarita River inland from Camp Pendleton in San Diego and Riverside Counties; Fortuna Mountain, 231 acres close to the SDSU campus located within Mission Trails Regional Park; and the Tijuana River National Estuarine Research Reserve, a 2,513-acre reserve which serves as an auxiliary field station for SDSU.

Providing research and education opportunities for the future requires detailed knowledge of how changes in the environment outside the boundaries of a certain area affect ecosystem dynamics within that area. As habitat continues to be lost to development, areas such as the SDSU field stations will increase in importance as sites for studying natural ecosystems.

The proximity of sensitive habitats to a rapidly urbanizing landscape makes this region a recognized biodiversity "hot spot." San Diego State University has an extremely dynamic group of scientists (faculty, researchers, and students) working to understand these unique and threatened ecosystems. Research ranges from the global scale examining global warming and the impacts of increased carbon dioxide on native vegetation to the meso- and micro-scales of chaparral ecosystems dynamics, as well as plant, vertebrate, insect, and fungal diversity. Researchers at SDSU are also increasingly using sophisticated computer modeling and molecular techniques for analyzing environmental change. Natural sciences are the core users of the SDSU field stations. Biology, geography, geological sciences, hydrogeology, and other field sciences are consistent areas of study. There are growing opportunities for interdisciplinary work as well as for nontraditional study in the fields ranging from public health, civil and environmental engineering, recreation, business, and art, to education.

Persons interested in conducting research, instructional use, or access to the SDSU field stations should contact the academic programs of the SDSU Field Stations Program at 619-594-0580. Inquiries can also be made through the SDSU Field Stations Web site at

<http://fs.sdsu.edu/kf/>.

**Heart Institute****Christopher C. Glembotski, Director**

The Heart Institute is sponsored by the College of Sciences and the College of Health and Human Services. The goals of the institute are to enhance basic and clinical research in the cardiovascular sciences, to foster undergraduate and graduate education in cardiovascular physiology and medicine, and to provide a community outreach service focused at heightening the awareness of cardiovascular disease and its prevention in the San Diego region surrounding SDSU. The institute is comprised of faculty members representing four different colleges at SDSU, as well as physicians and scientists from local hospitals and clinical research centers. Importantly, the institute also sponsors SDSU undergraduate and graduate student memberships, which strengthens the involvement of students in all aspects of Heart Institute activities. The unusual blend of talent and expertise that comprise the institute membership results in an interdisciplinary approach to cardiovascular research, education and community outreach that is unique to the Heart Institute. The institute sponsors special seminars, on- and off campus, which cover a wide range of topics in the field, and provides funding for the support of graduate students who are involved in cardiovascular research at SDSU. Areas of focus for the institute include studies of the molecular basis of cardiovascular disease, establishment of unique approaches for the early detection and prevention of cardiovascular disease, and the promotion of cardiovascular health in San Diego area K-12 schools. An important feature of these efforts that distinguishes the Heart Institute is the central role that SDSU students play in each of these areas. Funding for Heart Institute activities comes from a variety of sources, including the National Institutes of Health, the American Heart Association, the Muscular Dystrophy Association, the Rees-Stealy Research Foundation, and several San Diego-based biotechnology companies. For more information contact the Heart Institute office at 619-594-5504.

## Sciences

### Center for Homeland Security Technology Assessment

Robert W. Welty and Eric G. Frost, Co-Directors

The Center for Homeland Security Technology Assessment (CHSTA) provides an opportunity to promote ongoing homeland security efforts at SDSU and to facilitate interactions with other groups working in related areas under the umbrella of the Institute for Public Security and Health. The center is a campus-wide research, education, and outreach effort focused on technologies useful for protection against human-generated and natural disasters in the US and countries around the world. The center assesses various technologies to assist first responders and decision makers by providing an unbiased approach for review, testing, and implementation of technological developments. The center works with the community to solve and coordinate solutions to regional issues, and regularly participates in regional homeland security efforts. The center also considers policy issues specifically linked to technologies to promote public safety within constitutional and legal guidelines.

The center promotes collaborations between faculty, staff, and students at SDSU and other universities and agencies to facilitate the development, assessment, and application of new technologies for use in homeland security. CHSTA is particularly focused on technologies such as telecommunications, visualization, optical and wireless networks, sensor networks, and geospatial mapping to provide inputs into large-scale data analysis and situational awareness functionality, which are required to build larger decision-support and collaboration systems. These applications provide practical solutions to communication, security, surveillance, imaging, database, and data-fusion problems. By integrating technology with language, culture, history, and public policy, the center also helps guide decision makers in the appropriate use of technology and appropriate understanding of vulnerabilities and risks, as well as the complex nature of real-world solutions to security issues. These resources are used to rapidly respond to natural disasters such as earthquakes, tsunamis, hurricanes, fires, and floods on a global basis. They are also useful for building sustainable solutions for avoiding man-made and natural disasters and accelerating business, enhancing the quality of life, and providing international cooperation and educational opportunities.

### Center for Information Technology and Infrastructure

Eric G. Frost and Robert W. Welty, Co-Directors

The Center for Information Technology and Infrastructure (CITI) was established to promote the vision of transforming and empowering SDSU to take advantage of emerging tools in optical networking, wireless communication, and human-computer interactions through visualization. It nurtures new technologies, builds on existing efforts in environmental monitoring, student safety, transportation studies, law enforcement and first responder interaction, homeland security, collaborative education, Internet technologies, GIS systems, and other high interest areas. Activities extend to many sectors of the community (government, business, academia, non-profit organizations, private citizens) and among different jurisdictions within the region.

CITI is a product of the efforts of the SDSU Visualization Center resulting from community exercise development and participation. Its infrastructure exists in the form of hardware, software, facilities, people, and relationships. Many of these resources were informally gathered through the efforts of the SDSU Viz Center, the SDSU Research Foundation, and relationships with corporations. SDSU has actively collaborated and established partnerships with other academic and medical institutions, law enforcement and military agencies, local, state and federal governmental agencies, and high technology corporations. The center's continuing involvement in community exercises and organizations also results in a strong, collaborative relationship with regional law enforcement and first responder agencies. These efforts promote additional research, resulting in increased awareness and understanding, a higher state of preparedness, and greater safety for our residents across the region.

CITI pursues four major themes, which provide framework for the center and a pathway for diverse projects: homeland security; natural disaster mitigation and response; global sharing of information and collaborative visualizations; and remote sensing and environmental monitoring. The Web site is <http://citi.sdsu.edu/>.

### Center for Inland Waters

Stuart H. Hurlbert, Director

The Center for Inland Waters is an interdisciplinary academic unit consisting of faculty members from four SDSU colleges (Arts and Letters, Engineering, Health and Human Services, Sciences). Its purpose is to foster basic and applied collaborative research among SDSU scientists and scholars on inland water resources and ecosystems, the application of their expertise to the solution of water-related problems in southern California and adjoining regions, and the coordination and development of courses, curricula, and physical facilities for water-related instruction and research. Inland water resources include the water supply for domestic, agricultural and industrial uses, the growing system of aqueducts, reservoirs, and aquifers in which this supply is transported and stored, and the rivers, lakes, and wetlands important as habitat for wildlife, as maintainers of environmental health, and as recreation areas. Of special interest to the center are social, economic, hydrological, public health, and ecological issues concerning the Colorado River and its delta, the Salton Sea, and the new Tijuana and Santa Margarita Rivers and their watersheds. The center is operated as a special unit of the College of Sciences and is administered by a director and an elected executive committee. Information on the center and regional water resources is available at <http://www.sci.sdsu.edu/salton/>.

### Center for Research in Mathematics and Science Education (CRMSE)

Ricardo B. Nemirowsky, Director

The Center for Research in Mathematics and Science Education (CRMSE) is an interdisciplinary consortium of faculty interested in research on substantive questions related to the learning and teaching of science and mathematics. The center currently has members from the faculties of biology, mathematics and statistics, physics, policy studies in language and cross-cultural education, psychology, and teacher education. CRMSE is administered by a director and an associate director, who are appointed by the deans of the Colleges of Sciences and Education, in consultation with CRMSE members. Through its activities, CRMSE initiates, encourages, and supports the scholarly pursuit of important theoretical and applied problems in mathematics and science education. CRMSE supports faculty in their current research projects and in the preparation of manuscripts for publication and grant proposals for continued research. The center houses the Doctoral Program in Mathematics and Science Education that is offered jointly by SDSU and the University of California, San Diego. It also houses the Professional Development Collaborative to serve area teachers. The main office of the center is located at 6475 Alvarado Road, Suite 206, San Diego, CA 92120-5013; telephone 619-594-1579; campus mail code 1862. The Web site is <http://www.sci.sdsu.edu/CRMSE/>.

### Center for Microbial Sciences

Anca M. Segall, Director

Stanley R. Maloy, Associate Director

The Center for Microbial Sciences is a research center dedicated to the study of microorganisms. The center's mission is to provide a productive, stimulating, and interactive research environment that will lead to rapid progress in the fields of microbial biology. The center integrates multiple scientific approaches to elucidate basic biological principles that helps in combating human health problems caused by microorganisms and stimulates applications of microorganisms in the biotechnology industry.

The center encourages multidisciplinary scientific research by bringing together a group of creative, cooperative investigators with different scientific backgrounds to attack major questions in microbial biology using a variety of experimental approaches. The center also trains scientists to attack important but neglected problems in microbial biology. The close proximity of the Center for Microbial Sciences to a nucleus of biotechnology companies facilitates interactions with industry. The center also collaborates with neighboring institutions with expertise in other biological areas (UCSD, Scripps Research Institute, Salk Institute, Scripps Institution of Oceanography, and others) providing additional intellectual and physical resources.

The primary goals of the center are: *Research* – To attract a group of imaginative, interactive investigators and provide a stimulating environment for productive, innovative research in microbial biology; *Training* – To train a new generation of scientists to solve important problems in microbial biology using innovative experimental

approaches; *Outreach* – to provide expertise and facilities for visiting scientists from academia and industry to learn new technologies. The Web site is <http://www.sci.sdsu.edu/~smaloy/CMS/>.

#### **Microchemical Core Facility (MCF)**

**Joan Chen, Director**

**Forest L. Rohwer and Robert W. Zeller, Co-Directors**

The Microchemical Core Facility (MCF) is a component of the California State University Program for Education and Research in Biotechnology (CSUPERB). The MCF is a state-of-the-art facility that provides DNA sequencing and purification services for cell and molecular biologists associated with any of the 23 CSU campuses. In addition, the MCF provides for CSU faculty access to the most recent advances in computer-assisted analyses of molecular structure. Located on the third floor of the Chemical Sciences Laboratory building and managed by the Department of Biology, the MCF provides state-of-the-art molecular analyses and characterization to CSU scientists for the lowest possible cost, as well as fostering the training of university faculty at all levels in the most recent techniques available in the molecular life sciences. Funding for the establishment and maintenance of the SDSU MCF is derived from the National Science Foundation with matching funds provided by the State of California. Call 619-594-1669 for more information. The Web site is [http://www.sci.sdsu.edu/dnacore/sdsu\\_dnacore.html](http://www.sci.sdsu.edu/dnacore/sdsu_dnacore.html).

#### **Molecular Biology Institute**

**Greg L. Harris, Director**

The Molecular Biology Institute was established to serve interested departments of the biological and physical sciences in the coordination, support and enhancement of research and instruction in the molecular biological sciences. Interests and activities of the MBI encompass all approaches which aim to explain biology at the molecular level. The MBI sponsors a weekly seminar series that facilitates faculty and student interaction with scientists from other institutions. Currently, full members of the institute are drawn from the Departments of Biology, Chemistry and Biochemistry, and the Graduate School of Public Health, and participate in the respective Ph.D. programs. Associate members are drawn from a variety of disciplines that are cognate with the molecular biological sciences. The

institute is also constituted as the university unit authorized to administer the master's degree program with an emphasis in molecular biology. The research programs of the MBI members are supported by a variety of agencies including the National Institutes of Health, the National Science Foundation, NASA, the American Heart Association, the American Diabetes Association, the Muscular Dystrophy Association, the Department of Energy, the US Department of Agriculture, and the California Metabolic Research Foundation. Additional information is available from the MBI office; 619-594-5655. The Master of Science degree Web site is <http://www.bio.sdsu.edu/cmb/masters.html>.

#### **Visualization Center**

**Eric G. Frost and Robert W. Welty, Co-Directors**

The SDSU Visualization Center (Viz Center) uses computer visualization and communications to bear on societal problems. The Viz Center is focused on processing and providing data sets to the world for humanitarian assistance disaster relief (HADR) events such as earthquakes, tsunamis, volcanoes, wildfires; as well as poverty, sustainable resources, and first responders in their daily efforts to serve the public. The focus is on being a connecting resource between the campus, community, and the world in bringing together solutions to problems that information technology, imaging, data fusion, visualization, and decision support can assist.

The Viz Center develops and deploys tools for homeland security and works closely with many of the homeland security academic and research groups on campus, at the SDSU Research Foundation (SDSURF), and regionally. The Viz Center provides the physical laboratory function for a DHS multi-year, grant-funded project to the SDSURF Regional Technology Center for the assessment of homeland security technologies, governance structures, and data needs on a regional basis. This effort has led to establishment of a national presence as SDSU becomes a leader in addressing homeland security issues. The Viz Center also collaborates with other institutions in Indonesia, China, Mexico, Africa, Australia, Canada, and Central Asia. We interact with companies to help deploy and develop technologies, especially for response to "all hazards" events.

