Mathematics and Science Education

In the College of Sciences and
In the College of Education

For further information regarding programs, consult the following:

Ph.D. Program.....CRMSE
6475 Alvarado Rd., #206
(619) 594-5090
email: mathsciphd@sciences.sdsu.edu

M.A. Program..... Mathematical and Computer Sciences
(619) 594-6191
Teacher Education
(619) 594-5777

Mathematics and Science Education Faculty

Stephen K. Reed, Ph.D., Professor of Psychology, Coordinator for Ph.D. Program

Nadine S. Bezuk, Ph.D., Professor of Teacher Education

Nicholas A. Branca, Ed.D., Professor of Mathematical and Computer Sciences

Kathleen M. Fisher, Ph.D., Professor of Biology

Fred M. Goldberg, Ph.D., Professor of Physics

Sandra P. Marshall, Ph.D., Professor of Psychology

Cheryl L. Mason, Ph.D., Professor of Teacher Education

Douglas B. McLeod, Ph.D., Professor of Mathematical and Computer Sciences

Judith T. Sowder, Ph.D., Professor of Mathematical and Computer Sciences, Director, Center for Research in Mathematics and Science Education

Larry K. Sowder, Ph.D., Professor of Mathematical and Computer Sciences

Patrick W. Thompson, Ed.D., Professor of Mathematical and Computer Sciences

Randolph A. Philipp, Ph.D., Associate Professor of Teacher Education

Janet Sue Bowers, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Lisa L. Clement, M.A., Assistant Professor of Teacher Education

Victoria R. Jacobs, Ph.D., Assistant Professor of Teacher Education

Karen D. King, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Joanne Lobato, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Donna L. Ross, Ph.D., Assistant Professor of Teacher Education

Faculty Committee for Mathematics Education

Judith T. Sowder, Ph.D., Professor of Mathematical and Computer Sciences, Committee Co-Chair

Nadine S. Bezuk, Ph.D., Professor of Teacher Education, Associate Director of the School of Teacher Education, Committee Co-Chair

Nicholas A. Branca, Ed.D., Professor of Mathematical and Computer Sciences

Douglas B. McLeod, Ph.D., Professor of Mathematical and Computer Sciences (M.A.T.S. Graduate Adviser)

Larry K. Sowder, Ph.D., Professor of Mathematical and Computer Sciences

Randolph A. Philipp, Ph.D., Associate Professor of Teacher Education

Rafaela Santa Cruz, Ph.D., Associate Professor of Teacher Education

Janet Sue Bowers, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Lisa Clement, M.A., Assistant Professor of Teacher Education

Victoria Jacobs, Ph.D., Assistant Professor of Teacher Education

Karen D. King, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Joanne Lobato, Ph.D., Assistant Professor of Mathematical and Computer Sciences

Section I. Master's Degree Program

General Information

The Department of Mathematical and Computer Sciences offers two specializations in its program of graduate study leading to a Master of Arts degree for teaching service. The specialization for community college teaching offers candidates a program designed to provide them with the mathematical breadth necessary to teach a wide variety of lower-division collegiate mathematics courses, while also providing them with a better understanding of the issues involved in teaching and learning mathematics. The specialization for secondary teaching offers coursework designed to strengthen the mathematical background of secondary teachers, to provide teachers with a deeper understanding of learning and teaching mathematics in grades 7-12, and to allow teachers the opportunity to analyze curriculum and evaluation efforts in a manner that can lead them to make reasoned judgments about curricular, testing, and instructional issues in grades 7-12 mathematics.

Courses described in this section may also be of interest to students seeking the Master of Arts degree in education with concentrations in elementary curriculum and instruction or secondary curriculum and instruction, offered by the School of Teacher Education.

Associateships

Graduate teaching associateships in mathematical sciences are available to qualified students. Support for qualified candidates may also be available through the School of Teacher Education, through the Center for Research in Mathematics and Science Education or through employment on faculty research grants. Applications are available from the appropriate campus offices.

Admission to Graduate Study

All students must satisfy the general requirements for admission to the University with classified graduate standing, as described in Part Two of this bulletin.

Advancement to Candidacy

All students must satisfy the general requirements for advancement to candidacy as described in Part Two of this bulletin. In addition, students seeking the Master of Arts degree for teaching service in the Department of Mathematical and Computer Sciences must have passed a qualifying examination in mathematics education.

Specific Requirements for the Master of Arts Degree for Teaching Service in the Department of Mathematical and Computer Sciences

(Major Code: 17011)

In addition to meeting the requirements for classified graduate standing and the basic requirements for the master's degree as described in Part Two of this bulletin, the students must complete a graduate program of at least 30 units, 24 of which must be from the Department of Mathematical and Computer Sciences. At least 15 of the 24 must be 600- and 700-numbered courses. A student's program must be prepared in conference with and approved by the graduate adviser.

The two specializations leading to the Master of Arts for teaching service require completion of a specific pattern of graduate units described below.

Specialization in Mathematics for Community College Teaching. This specialization is designed to satisfy the requirements for teaching service at the community college level. Students must have completed a bachelor's degree in mathematics (or equivalent) before entering the program and must have completed six units selected from Mathematics 521A, 524, and 534A. The third course can be taken prior to entrance to the program or as part of the 30-unit degree requirements.

Plan A requires Mathematics 600, 601, 602, and Mathematics Education 603; six units selected from Mathematics 509, 720, Mathematics Education 604, 605, 606; nine units of electives selected with the approval of the adviser; and Mathematics 799A, Thesis.

Plan B requires Mathematics 600, 601, 602, and Mathematics Education 603; nine units selected from Mathematics 509, 720, Mathematics Education 604, 605, 606; and nine units of electives selected with the approval of the adviser. In addition, students must pass a comprehensive examination in mathematics education.

Specialization in Mathematics for Secondary Teaching. This specialization is designed to strengthen the mathematical background of secondary teachers, while providing coursework to better understand the learning and teaching of mathematics in grades 7-12. Students should have the equivalent of a bachelor's degree in mathematics before entering the program.

Plan A requires Mathematics 524; Mathematics Education 603; three units selected from Mathematics 510, 511, 512, or 600; three units selected from Mathematics 521A or 601; three units selected from Mathematics 534A or 602; six units selected from Mathematics 509, 720, Mathematics Education 604, 605, 606; six units of electives selected with the approval of the adviser; and Mathematics 799A, Thesis.

Plan B requires Mathematics 524; Mathematics Education 603; three units selected from Mathematics 510, 511, 512, or 600; three units selected from Mathematics 521A or 601; three units selected from Mathematics 534A or 602; nine units selected from Mathematics 509, 720, Mathematics Education 604, 605, 606; and six units of electives selected with the approval of the adviser. In addition, students must pass a comprehensive examination in mathematics education.

Section II. Doctoral Program

(Major Code: 08997)

General Information

San Diego State University and the University of California, San Diego, offer jointly a doctoral program in mathematics and science education. The program faculty at SDSU are members of the College of Sciences or the College of Education and are affiliated with the Center for Research in Mathematics and Science Education (CRMSE). They represent a number of different disciplines, including biology, mathematics, natural science, physics, psychology, and teacher education. The program faculty at UCSD, also an interdisciplinary group, are members of the Division of Natural Sciences (biology, chemistry, mathematics, and physics) or the Division of Social Sciences (cognitive science, philosophy, and sociology). The program is administered under the College of Sciences at SDSU and under the Division of Natural Sciences at UCSD.

The research interests of the participating faculty members cover a wide range of issues in the learning and teaching of mathematics and the sciences. Graduates of the program will be qualified to take a variety of professional positions, including faculty appointments in universities, colleges, and community colleges; specialist positions in public school districts; and extra-school employment in settings that require expertise in mathematics and science education.

Doctoral Faculty

The following faculty members of the cooperating institutions participate in the joint doctoral program, being available for direction of research and as departmental members of joint doctoral committees.

San Diego State University:
Coordinator: Stephen K. Reed
Committee Members: Bezuk, Bowers, Branca, Fisher, Goldberg, Lobato, Marshall, Mason, McLeod, Philipp, J. Sowder, L. Sowder, Thompson,

University of California, San Diego:
Coordinator: Barbara Sawrey
Committee Members: Batali, Case, Cole, Churchland, Green, Jones, Magde, Manaster, Mehan, Shenk, Smith, Wienhausen

Admission to Doctoral Study

Applicants for admission to the doctoral program in mathematics and science education must meet the general requirements for admission to both universities with classified graduate standing as outlined in the respective current catalogs. Applicants must also meet the special requirements of this program. These include: (a) an acceptable baccalaureate degree from an accredited institution; (b) a master's degree, or its equivalent, in biology, chemistry, physics, or mathematics; a GPA of at least 3.25 in the last 30 semester (or 45 quarter) units of upper division work and at least a 3.50 in the graduate work attempted; (d) good standing in the last institution attended; (e) suitable scores in both the quantitative and verbal sections of the Graduate Record Examinations. Applications from outstanding candidates who have not earned a master's degree may be accepted, under the condition that they spend the first year earning a master's degree in one of the disciplines listed above.

Application. Students seeking admission to the doctoral program should write directly to the Doctoral Program in Mathematics and Science Education, CRMSE, San Diego State University. A complete application requires that the following information be provided:

The appropriate application form, including a statement of purpose.

Transcripts of academic work already completed.

Results of the Graduate Record Examinations.

Three letters of recommendation (sent directly to the Doctoral Program Coordinator, Center for Research in Mathematics and Science Education (CRMSE), San Diego State University).

Specific Requirements for the Doctor of Philosophy Degree

Residency Requirements. After formal admission to the doctoral program, the student must spend at least one academic year in full-time residence on each of the two campuses. The definition of residence must be in accord with the regulations of San Diego State University and the University of California, San Diego.

Language Requirements. There is no formal language requirement for the program. If a student intends to pursue a course of study in which knowledge of another language is necessary, the Advisory Committees will impose the appropriate language requirement.

Course Requirements. All students admitted into the doctoral program will fulfill the following requirements:

A. Three core courses at SDSU:
   MSE 801
   MSE 802
   MSE 810 or PSY 778

B. Four core courses at UCSD:
   UCSD 296A
   UCSD 296B
   UCSD 296C
   UCSD 500-level course in student's discipline

C. One of the following statistics courses at SDSU:
   PSY 670A
   PSY 770A

D. Two courses in cognitive psychology, taken either at SDSU or UCSD:
   SDSU: PSY 587
   UCSD: PSYCH 218A and 218B

E. One of the following seminars in mathematics or science education at SDSU:
   MTHED 603
   N SCI 600

F. At least one of the following courses at UCSD:
   PHIL 113
   PHIL 180
   PHIL 181
   PHIL 182
   HISC 160
   HISC 163
   HISC 164
   SOC 168J

G. One of the following practicum courses:
   SDSU MSE 805
   SDSU MSE 806
   SDSU MSE 807
   UCSD TEP 290

Beyond these requirements, no specified number of courses is required for the doctoral degree. It is expected, however, that all the doctoral students will supplement the requirements with electives that contribute to individual career objectives.

Examinations. Students in the doctoral program will be evaluated at the following levels:

(1) **First Year Evaluation.** The student's ability to master graduate level course material will be assessed after completion of no more than 24 semester units of coursework. This evaluation will take place not later than the third semester of the student's enrollment in the program. The evaluation will be based on the student's performance in coursework and on indicated research competence, and it will be undertaken by the student's advisory committee together with instructors from the student's first year courses.

(2) **Comprehensive Examinations.** At the end of the second year, the student will take a written comprehensive examination in general cognition and an oral examination on issues of learning pertinent to the student's area of specialization.

(3) **Oral Examination.** During the third year in the program, the student will make an oral presentation to the dissertation committee to accompany a written proposal for the doctoral thesis. The student will be questioned on both the topic of the investigation and on the proposed research methodology. Upon successful completion of this presentation, the student will be recommended for advancement to candidacy for the doctoral degree.

(4) **Dissertation Defense.** After completion of the dissertation, the candidate will present a public defense of the doctoral dissertation. A copy of the dissertation must be made available to the doctoral faculty at both institutions four weeks prior to the defense. Copies of the abstract of the dissertation, along with the announcement of the defense, must be publicly available at least one week before the defense. The student's dissertation committee will make a recommendation to the graduate deans to pass or fail the student.

Faculty Adviser. Upon admission to the doctoral program, the program directors will assign each student a faculty adviser. The faculty adviser will serve as adviser until the student has completed the first year of coursework and has been favorably evaluated as described above in (1).

Advisory Committee. Following the first-year evaluation, a doctoral adviser will be selected who will serve as primary adviser for the student's program of study and for the dissertation study. The student and the doctoral adviser, in consultation with the program directors, will select one additional member from the cooperating faculty at each campus to serve on the advisory committee. In consultation with the student, the advisory committee will develop a course of study for the student. The advisory committee will be the official advising group for the student until a dissertation committee has been chosen and recommended to the Graduate Divisions of the two institutions by the advisory committee.

Dissertation Committee. The dissertation committee will be composed of five members with at least two faculty members from each campus. The student and the advisory committee will select members of the dissertation committee in consultation with program faculty and the program directors. Members of the student's advisory committee may serve on the dissertation committee or new members may be selected by the student or the program directors.

Dissertation. Following the successful completion of all prescribed coursework and qualifying examinations, the major remaining requirement for the Ph.D. degree will be the satisfactory completion of a dissertation consisting of original research carried out under the guidance of the major professor. Approval of the completed dissertation attests that an organized investigation that expands the frontiers of knowledge and understanding in mathematics and science education has been carried out.

Award of the Degree. The Doctor of Philosophy degree in Mathematics and Science Education will be awarded jointly by the Regents of the University of California and the Trustees of The California State University in the names of both cooperating institutions.

Financial Support

The Center for Research in Mathematics and Science Education at SDSU has a number of research and teaching associateships available to support students admitted to the Joint Doctoral Program. All students applying to the program will be considered for financial support.

Courses Acceptable on the Master's Degree Program in Mathematics Education

GRADUATE COURSES IN MATHEMATICS EDUCATION

600. Teaching and Learning Mathematics in the Early Grades (Pre-K to 4) (3)

Prerequisites: Mathematics Education 603 or 604 or Teacher Education 610A and K-12 teaching experience.

Research in teaching and learning mathematics in preschool through grade four. Innovative early childhood mathematics curricula, promising instructional practices. Assessment techniques to guide instruction.

601. Teaching and Learning Mathematics in the Middle Grades (3)

Prerequisites: Mathematics Education 604 or Teacher Education 610A and K-12 teaching experience.

Research on teaching and learning mathematics in grades five through eight. Innovative middle grades mathematics curricula, promising instructional practices. Assessment techniques to guide instructions.

602. Technology in Teaching and Learning Mathematics: Grades K-8 (3)

Prerequisites: Teacher Education 610A, Educational Technology 470, and K-12 teaching experience.

Research in use of technology in learning and teaching mathematics in grades K-8. Major focus devoted to use of applications. Other uses for technology addressed include simulations, communication, and calculational speed.

Courses Acceptable on the Master's and Doctoral Degree Programs in Mathematics and Science Education

603. Seminar on Research in Mathematics Learning and Instruction (3)

Prerequisite: Consent of instructor or graduate adviser.

The learning and teaching of mathematics, with emphasis on applications of current psychological theories to mathematics learning, and research on mathematics teaching.

604. Seminar on Curriculum and Evaluation Issues in Mathematics (3)

Prerequisite: Consent of instructor or graduate adviser.

Curriculum projects in mathematics, and evaluation as it pertains to mathematics curricula, to programs, and to mathematics students and teachers.

605. Algebra in the 7-14 Curriculum (3)

Prerequisite: Consent of instructor or graduate adviser.

Curricular change in algebra, with attention to experimental curricula, to research on learning of algebra, and to influences of technology. Implications for instruction.

606. Geometry in 7-14 Curriculum (3)

Prerequisite: Consent of instructor or graduate adviser.

Curricular change in geometry, with attention to experimental curricula, to research on learning and teaching of geometry, and to influences of technology. Implications for instruction.

GRADUATE COURSES IN MATHEMATICS AND SCIENCE EDUCATION

801. Research in Learning (1) Cr/NC
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
Issues of learning with reference to how they are addressed by ongoing projects at CRMSE. Faculty from both institutions will make presentations.

802. Orientation Practicum (1-3) Cr/NC
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
Experience with research programs will introduce students to a variety of research questions and approaches. One research program per unit; minimum three units required in program.

805. Supervised Teaching of Teacher Preparation Courses (3) Cr/NC/SP
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
Students will plan and teach, under supervision, a course that prepares prospective teachers to teach mathematics or science at either the elementary or secondary level.

806. Supervised School Practicum (3) Cr/NC/SP
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
School-based project focusing on inservice of teachers or on curriculum development, or work with a school district administrator or mathematics or science.

807. Specially Designed Practicum (3) Cr/NC/SP
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
Practical experience to assist students in gaining experience in career they have selected.

810. Seminar in Research Design (3)
Prerequisite: Admission to doctoral program in Mathematics and Science Education; Psychology 670A, and consent of instructor.
Issues such as analysis of protocols, problems of measurement in evaluation of learning, development, and assessment of cognitive models in learning in mathematics and science.

820. Research Project (3-6) Cr/NC/SP
Prerequisite: Admission to doctoral program in Mathematics and Science Education.
Participation in an ongoing research project and development of a related study.

830. Research Seminar (3)
Prerequisite: Successful completion of qualifying examination.
Students and faculty present ongoing research for discussion and critique.

897. Doctoral Research (1-8) Cr/NC/SP
Prerequisite: An officially constituted doctoral committee and advancement to candidacy.
Independent investigation in general field of the dissertation.

898. Doctoral Special Study (1-8) Cr/NC/SP
Prerequisite: An officially constituted doctoral committee and advancement to candidacy.
Individual study in the field of specialization.

899. Doctoral Dissertation (3-6) Cr/NC/SP
Prerequisite: An officially constituted dissertation committee and advancement to candidacy.
Preparation of the dissertation for the doctoral degree. Enrollment is required during the term in which the dissertation is approved.

For additional courses applicable to the Master of Arts degree for Teaching Service see:

Mathematics 600: Geometrical Systems
Mathematics 601: Topics in Algebra
Mathematics 602: Topics in Analysis

For additional courses related to mathematics education see:

Teacher Education 511: Diagnosis and Remediation of Difficulties in Mathematics

Teacher Education 610A: Seminar in Mathematics Education–Elementary School