
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 Mathematics and Statistics
(619) 594-6191
Teacher Education
(619) 594-6131

Section I. Master's Degree Program

General Information

The Department of Mathematics and Statistics 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.

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 Mathematics and Statistics must have passed a qualifying examination in mathematics education.

Specific Requirements for the Master of Arts Degree for Teaching Service in the Department of Mathematics and Statistics

(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

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 Mathematics
- Kathleen M. Fisher, Ph.D., Professor of Biology, Director, Center for Research in Mathematics and Science Education
- Fred M. Goldberg, Ph.D., Professor of Physics
- G. Brian Greer, Ph.D., Professor of Mathematics
- Sandra P. Marshall, Ph.D., Professor of Psychology
- Cheryl L. Mason, Ph.D., Professor of Teacher Education
- Alan McCormack, Ed.D., Professor of Teacher Education
- Walter C. Oechel, Ph.D., Professor of Biology
- Randolph A. Philipp, Ph.D., Professor of Teacher Education
- Larry K. Sowder, Ph.D., Professor of Mathematics
- Janet S. Bowers, Ph.D., Associate Professor of Mathematics
- Victoria R. Jacobs, Ph.D., Associate Professor of Teacher Education
- Rafaela M. Santa Cruz, Ph.D., Associate Professor of Teacher Education
- Randy K. Yerrick, Ph.D., Associate Professor of Teacher Education
- Rebecca Ambrose, Ph.D., Assistant Professor of Teacher Education
- Jennifer Chauvot, Ph.D., Assistant Professor of Mathematics
- Lisa L. Clement, Ph.D., Assistant Professor of Teacher Education
- Joanne Lobato, Ph.D., Assistant Professor of Mathematics
- Eric M. Riggs, Ph.D., Assistant Professor of Geological Sciences
- Donna L. Ross, Ph.D., Assistant Professor of Teacher Education

Faculty Committee for Mathematics Education

- Nadine S. Bezuk, Ph.D., Professor of Teacher Education
- Nicholas A. Branca, Ed.D., Professor of Mathematics
- G. Brian Greer, Ph.D., Professor of Mathematics
- Randolph A. Philipp, Ph.D., Professor of Teacher Education
- Larry K. Sowder, Ph.D., Professor of Mathematics
- Janet S. Bowers, Ph.D., Associate Professor of Mathematics
- Victoria R. Jacobs, Ph.D., Associate Professor of Teacher Education
- Rafaela Santa Cruz, Ph.D., Associate Professor of Teacher Education, Interim Director of the School of Teacher Education
- Rebecca Ambrose, Ph.D., Assistant Professor of Teacher Education
- Lisa L. Clement, Ph.D., Assistant Professor of Teacher Education
- Joanne Lobato, Ph.D., Assistant Professor of Mathematics

Department of Mathematics and Statistics. 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

General Information

(Major Code: 08997)

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 and 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, geological sciences, mathematics, 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 out-of-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

Graduate Adviser: Joanne Lobato

Doctoral Program Members: Ambrose, Bezuk, Bowers, Branca, Clement, Chizhik, Fisher, Goldberg, Greer, Jacobs, Lobato, Marshall, Mason, Philipp, Reed, Riggs, L. Sowder, Yerrick

University of California, San Diego:

Coordinator: Alfred Manaster

Graduate Adviser: Guershon Harel

Doctoral Program Members: Appelbaum, Batali, Case, Cole, Churchland, Harel, Jones, Magde, Manaster, Mehan, Rabin, Sawrey, 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) either a strong baccalaureate degree in mathematics or science (or a related discipline) and a master's degree, or its equivalent, in biology, chemistry, physics, or mathematics; or a strong baccalaureate degree in biology, chemistry, physics, or mathematics and professional experience in that field as a K-12 teacher; (b) a GPA of at least 3.25 in the last 30 semester (or 45 quarter) units of upper division work and at least a 3.5 in the graduate work attempted; (c) good standing in the last institution attended; (d) suitable scores in both the quantitative and verbal sections of the Graduate Record Examinations.

Students applying for admission to the doctoral program should electronically submit the University application available at www.csu-mentor.edu.

The following materials should be submitted as a complete package directly to the office of Mathematics and Science Education:

- (1) Two sets of official transcripts (in sealed envelopes);
- (2) Application for doctoral program in mathematics and science education (www.sci.sdsu.edu/crmse/crmse_app02.pdf);
- (3) GRE scores (received within the past five years);
- (4) Mathematics and Science Education recommendation form as cover sheet (www.sci.sdsu.edu/crmse/rec_form.pdf);
- (5) At least three letters of recommendation.

Mail or deliver your complete admissions package to:
Mathematics and Science Education Ph.D. Program
CRMSE, San Diego State University
6475 Alvarado Road, Suite 206
San Diego, CA 92120-5013

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 Requirement. There is no formal language requirement for the program.

Course Requirements. All students admitted into the doctoral program will fulfill the following requirements. Any alternative method of fulfilling these requirements must be approved by the graduate advisers.

- A. Two core courses on research orientation:
MSE 801
MSE 802
- B. Core courses in Mathematics or Science Education.
Select:
UCSD: MSED 296A, 296B, 296C and
SDSU: MTHED 603 *or* NSCI 600.
Mathematics Education students must select two of the following additional courses:
SDSU: MTHED 604, 605, 606.
- C. Three courses on statistics and research design.
Select one of the following sequences:
UCSD: PSYC 201A, 201B *or*
SDSU: PSY 670A, 670B *or* 770A, 770B, *and* one of the following courses:
SDSU: MSE 810 *or* UCSD: SOC/A 108A.
- D. Two courses in cognitive psychology:
SDSU: PSY 587 *or* UCSD: PSYCH 218A.
One upper division or graduate UCSD cognitive science course.
- E. Three research courses:
SDSU: MSE 820 *or* UCSD: MSED 298
SDSU: MSE 830
SDSU: MSE 899 *or* UCSD: MSED 299
- F. At least one of the following courses at UCSD:
PHIL 124, 145, 146, 147, 209A; SOC/G 168J, 270
- G. Two of the following practicum courses:
SDSU: MSE 805, 806, 807
UCSD: TEP 129A; Discipline 500

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 may be assessed after completion of no more than 24 semester units of coursework. This evaluation may 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 Advisers. Upon admission to the doctoral program, the program directors will assign each student a faculty adviser at both universities. The faculty advisers will serve as advisers until the student's dissertation committee is appointed.

Dissertation Committee. The dissertation committee will be composed of five members with at least two faculty members from each campus. The student will select members of the dissertation committee in consultation with program faculty and the graduate advisers.

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

San Diego State University and the University of California, San Diego have 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.

Section III. Certificate Program

Mathematics Specialist Certificate

The mathematics specialist certificate program, offered through the College of Extended Studies, prepares credentialed teachers to become mathematics specialists in grades 4-6. These specialists will be prepared to teach mathematics in a department setting in grades 4-6, and/or to act as mathematics peer coaches in elementary schools, as needed within a school district. For application or further information, contact Dr. Judith T. Sowder (594-1587) or Dr. Nadine S. Bezuk (594-1370).

Prerequisites for admission include the following:

1. Applicants must have a teaching credential.
2. Applicants must have two years of classroom teaching experience.
3. Two letters of recommendation.

Requirements for the certificate program (12 units):

1. Six units of mathematics courses to include Mathematics 281A-281B, and two units from Mathematics 383, 384, 385, or 386, or courses with equivalent content.
2. Six units of education courses to include Teacher Education 604 and 605.

Students must pass all courses with Cr/NC grading or receive at least a C (2.0) in all courses taken for a letter grade. With consent of the adviser, six units of education coursework may be applied toward a master's degree in education.

Refer to the Mathematics section in the General Catalog for a listing of courses for the certificate program.

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

UPPER DIVISION COURSE IN MATHEMATICS EDUCATION

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

Prerequisites: Classified graduate standing; consent of instructor for undergraduates.

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. (Formerly numbered Mathematics Education 602.)

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.

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

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. Selected Topics in 7-14 Mathematics Curriculum (3)

Prerequisite: Consent of instructor or graduate adviser.

Curricular change in school mathematics, to include geometry, probability, and statistics, with attention to contemporary curricula, to research on learning and teaching in those areas, and to the influences of technology. Implications for instruction.

GRADUATE COURSES IN MATHEMATICS AND SCIENCE EDUCATION (MSE)

801. Faculty Research (1) Cr/NC

Prerequisite: Admission to doctoral program in Mathematics and Science Education.

Issues of learning with reference to how they are addressed by doctoral faculty. Students will interview and write a one-page statement of research interests for each of eight doctoral faculty members.

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/RP

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/RP

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/RP

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/RP

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 (1-15) Cr/NC/RP

Prerequisite: Mathematics and Science Education 820.

Independent investigation in general field of the dissertation.

898. Doctoral Special Study (1-8) Cr/NC/RP

Prerequisite: An officially constituted doctoral committee and advancement to candidacy.

Individual study in the field of specialization.

899. Doctoral Dissertation (1-15) Cr/NC/RP

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

