

# Academic Catalog 2019-2020

## Biobehavioral Sciences

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# Biobehavioral Sciences

## Contact Information

**Department Chair:** Dr. Carol Ewing Garber

**Contact:** Yvonne Wallace

**Email:** ceg2140@tc.columbia.edu

**Phone:** 212-678-3891

**Address:** 1058 Thorndike Hall

**Box:** 5

## Mission

The Department of Biobehavioral Sciences offers programs that focus on the application of the biological, physiological, behavioral, and sociocultural sciences underlying human communication, movement, and their disorders to clinical, educational, and community settings. An understanding of the normal and abnormal biobehavioral processes is applied to clinical practice. The scientific knowledge obtained from studying each of these specialized fields is used to enhance the educational, adaptive, and communicative capabilities of individuals with normal and impaired abilities across the lifespan.

Graduates of our master's programs assume professional roles in educational, health-related, and community agency settings as speech-language pathologists, exercise physiologists, occupational therapists, physical therapists, and research coordinators. As these professionals often work in interdisciplinary teams, the department facilitates opportunities for students to interact across professional boundaries.

Our doctoral graduates are prepared for university faculty positions and administrative positions in clinical, educational, and organizational field-based settings. They may also pursue careers in research.

The department maintains clinics and laboratories to support the teaching and research components of the programs. These facilities include the Edward D. Mysak Speech and Hearing Center, as well as laboratories in applied physiology, motor learning, kinematics, language and cognition, and adaptive communication technologies.

The master's degree program in Communication Sciences and Disorders is accredited by the Council on Academic Accreditation of the American Speech-Language-Hearing Association (ASHA).

# Communication Sciences and Disorders

## Department of - Biobehavioral Science

### Contact Information

**Phone:** 212 678-3895

**Fax:** 212 678-8233

**Email:** csd@tc.columbia.edu

**Director:** Professor Cate Crowley

## Program Description

The master's program in Communication Sciences and Disorders is accredited by the Council on Academic Accreditation of the American Speech-Language-Hearing Association.

The program in Communication Sciences and Disorders offers advanced education and training in the processes of individual human communication (speech, hearing, language disorders of human communication and swallowing). Coursework and clinical training of assessment and treatment for such disorders is a major component of the program.

Emphases and interests of the program are reflected in the work of the faculty. Dr. Cate Crowley's work concentrates on culturally and linguistically appropriate disability evaluations; cleft palate speech and feeding assessment and treatment; appropriate and effective international practice. Dr. Lisa Edmonds' research involves the development and evaluation of novel treatments to improve communication in persons with acquired communication disorders, with a focus on aphasia, including bilingual aphasia; the development of outcome measures for aphasia, particularly in discourse; the investigation of underlying factors related to language disorders, including the use of eye tracking methodology. Dr Carol Hammer's research focuses on investigating cultural and environmental influences on young children's development; developing assessment instruments that target dual language learners' language and literacy skills; and developing and evaluating home-and classroom-based interventions. Dr. Erika

Levy's research interests include treatment efficacy for intelligibility in children with dysarthria due to cerebral palsy and in adults with Parkinson's Disease. Dysarthria speech characteristics and treatment outcomes are examined in English, French, Spanish, and Mandarin. In addition, her lab examines cross-language speech perception. Dr. Michelle Troche's research is aimed at improving health outcomes and quality of life associated with disorders of airway protection (i.e. swallowing and cough); better understanding of the mechanisms underlying airway protection and its disorders; development of novel and robust evaluation and treatment techniques for dystussia (deficits of cough function) and dysphagia (deficits of swallowing function).

Programs leading to the M.S. degree in Communications Sciences and Disorders prepare graduates for positions in a variety of professional settings: school systems, community speech and hearing centers, rehabilitation centers, hospital clinics, private practice, state departments of education, health departments, federal agencies, and colleges and universities.

Because of the program's central concern with the processes of individual human communication, swallowing and their disorders and management, it has special interests in, and relations with, the fields of psychology, linguistics, bilingualism, anatomy and physiology, special education, and various health related professions including medicine, dentistry, physical therapy, occupational therapy, dental hygiene, nursing, and hospital administration.

## Degree Summary

COMMUNICATION SCIENCES AND DISORDERS (CSDR)

Master of Science (M.S.), Doctor of Philosophy (Ph.D.)

COMMUNICATION SCIENCES AND DISORDERS-INITIAL CERTIFICATION (CSDR-INIT)

Master of Science (M.S.)

COMMUNICATION SCIENCES AND DISORDERS BILINGUAL OPTION-DUAL CERTIFICATION (CSDB-DUAL)

Master of Science (M.S.)

COMMUNICATION SCIENCES AND DISORDERS-PROFESSIONAL CERTIFICATION (CSDR-PROF)

Master of Science (M.S.)

## BILINGUAL EXTENSION INSTITUTE (SPTB) CERTIFICATION

For a complete listing of degree requirements, please continue on to this program's "Degrees" section in this document

# Degree Requirements

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## Master of Science

### Master of Science

This degree program incorporates academic and clinical practicum requirements for the American Speech-Language-Hearing Association's Certification of Clinical Competence (ASHA CCC-SLP) as well as departmental and college requirements. Students who complete the degree program are also eligible for New York State licensing in speech and language pathology. Students may also elect to apply for the New York State Education Department (NYSED) Teacher of Students with Speech and Language Disabilities Certificate (TSSL) and the NYSED bilingual certificate to the TSSL. New York State Education Department (NYSED) has teacher certification requirements that are needed for program completion and graduation which are listed in the Office of Teacher Education section of the catalog.

The minimum number of points for completion of the program in communication sciences and disorders is approximately 62, including practicum courses.

Students are admitted to the program with undergraduate majors in speech and language pathology or with all required pre-requisite courses completed. Completion of the program is typically accomplished within two calendar years (four semesters and one summer session) of full time study.

### Bilingual-Multicultural Program Focus

The Bilingual-Bicultural Program Focus is for students who wish to develop expertise in working with culturally and linguistically diverse children and adolescents with communication disorders. Following the Bilingual -Multicultural Program Focus will satisfy the coursework and field placement requirements for the bilingual extension to the New York State TSSL. Under New York State Education Department regulations, the bilingual extension certificate is required to provide speech and language intervention for bilingual children and adolescents.

ages 3 through 21. This includes working in a school system in New York State as well as providing bilingual therapy in a private practice where funding comes from the New York City Department of Education.

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## **Doctor of Philosophy (Ph.D., 75 points)**

This program is designed for individuals primarily interested in research and teaching careers in speech and language pathology. A minimum of 75 points must be completed, though 30 points may potentially be transferred from a Master's program. There is no language requirement. All doctoral candidates must complete a dissertation. For general details concerning the doctoral programs, please consult the Office of Doctoral Studies website. For more information about our doctoral program, please go to our program web site.

# Application Information

Students who have a degree in communication sciences and disorders/speech-language pathology are encouraged to apply to our Masters program. In addition, students from diverse academic and experience backgrounds are encouraged to apply, as we routinely accept many students into the program who do not have formal degrees in communication sciences and disorders. For more information on our Application Process, please see our FAQ page. In addition, see information from the Admissions office about our program: <http://www.tc.columbia.edu/admissions/areas-of-study/health-sciences-and-health-promotion/> and click on "View and Print Program Details" to see further information.

## **Doctor of Philosophy (Ph.D)**

Doctoral candidates in our program typically have a masters' degree in communication sciences and disorders. However, students with a master's degree in a related field will be considered for admission. In addition to the regular admission requirements, doctoral applicants must also submit:

### **All Doctoral Applicants**

Doctoral applicants are strongly urged to discuss their plans with one of the department's faculty before completing the application process, since acceptance is attached to joining a particular research lab. See our doctoral website for application details.

## **Faculty List**

### **Faculty**

**CATHERINE J CROWLEY**

Professor of Practice

Professor of Communication Sciences and Disorders

**LISA A EDMONDS**

Associate Professor in Communication Sciences and Disorders

**ERIKA SHIELD LEVY**

Associate Professor in Communication Sciences and Disorders

**CAROL J HAMMER**

**MICHELLE SHEVON TROCHE**

Associate Professor of Speech and  
Language Pathology

**Lecturers**

JO ANN NICHOLAS  
Lecturer

**Instructors**

BERNADINE RAE GAGNON  
Chief Clinical Supervisor  
  
LAUREN ELIZABETH LIRIA  
Clinical Supervisor - Speech Language  
Pathology

FELIX ANTONIO MATIAS  
Director of Edward D. Mysak Clinic for  
Communication Disorders

LINDSAY RACHEL MILGRAM  
Clinical Supervisor - Speech Language  
Pathology  
  
ELISE M WAGNER  
Assistant Director of Clinic

## **Course List**

### **BBS 6042 Grant Writing: From a Fundable Idea Through Review**

This course targets grant fundamentals from the beginning of the writing process through the review process. Focus is placed on funding mechanisms available through the National Institutes of Health, Institute of Education Sciences and National Science Foundation as well as private foundations. The course covers writing key areas of research proposals; developing biosketches, budgets and supplemental materials; and the review and resubmission process.

### **BBSQ 4030 Speech science**

Pre-requisites: No prerequisites, but knowledge of speech articulation and the International Phonetic Alphabet is helpful. This course examines the production, transmission, and perception of speech and discusses applications to communication disorders and to second-language speech communication.

### **BBSQ 4031 Anatomy and physiology for speech, language, and hearing**

This course teaches the basic structures and functions of the articulatory, vocal, respiratory, and nervous systems and applies this information to the field of speech-language pathology and audiology.

### **BBSQ 4042 Audiology**

This course covers acoustics, anatomy, and physiology of the auditory system, pure tone and speech audiometry, types and communication effects of hearing loss, amplification, and immittance.

### **BBSQ 4046 Introduction to augmentative and alternative communication**

This introductory course will provide a comprehensive overview of Augmentative and Alternative Communication (AAC). A thorough examination of the assessment and therapeutic processes will be presented. Emphasis will be placed upon individuals exhibiting severe communication disorders secondary to congenital/acquired cognitive and motor impairments. Low- and high-tech AAC systems will be discussed and demonstrated.

## **BBSQ 4047 Early motor behaviors in children: Normal and abnormal**

Study of normal and abnormal development of sensory-motor speech processes and related oral motor behaviors; etiology, diagnosis, and management of pre-speech and eating pathologies in infants and severely handicapped individuals from an early intervention perspective.

## **BBSQ 5003 Literacy Development and Disorders: Assessment and Intervention**

The course prepares students who are studying to become speech-language pathologists to support the literacy abilities of children who are at risk for or have reading disorders. The course covers key areas in the development, assessment, and intervention of children's reading abilities. Topics covered include emergent literacy, book reading, vocabulary, phonological sensitivity, reading comprehension, fluency, and decoding in monolingual and bilingual children.

## **BBSQ 5041 School speech-language-hearing programs**

Analyzes the impact of federal and state laws on service delivery in school setting. Develops skills to meet the needs of students with communication-disorders with the full range of disabilities, including working with other professionals to assist children in accessing the general curriculum.

## **BBSQ 5044 Speech and language perception and processing**

*CSD Majors take course for 2 points only.* Examination of the models proposed to explain speech perception and discussion of the research that assigns a special role to speech and language.

## **BBSQ 5111 Assessment and evaluation**

*Prerequisites: A course in normal language development and a course in Language Disorders in Children.* Examines how to provide evidence-based and culturally and linguistically appropriate disability evaluations with a focus on birth through 21 disability evaluations under the federal law. Students acquire knowledge and skills in standardized tests, alternative assessment approaches, and dynamic assessment, covering the full range of disabilities.

## **BBSQ 5112 Articulation disorders**

*Prerequisite: Phonetics course.*

Study of phonological rule disorders and disorders associated with functional and various structural problems in children. Critical analysis of research in assessment and treatment.

## **BBSQ 5113 Voice disorders**

*Prerequisite: BBSQ 4031 or equivalent.* Study of voice disorders associated with functional, structural, endocrinological, and neurological problems. Analysis of recent research and evidence-based approaches to voice therapy.

## **BBSQ 5114 Stuttering and other fluency disorders**

This course examines the nature of stuttering and other fluency disorders across the lifespan. Emphasis is placed on assessment, intervention, and prevention.

## **BBSQ 5115 Language disorders in children**

*Prerequisite: A course in normal language development.* Language disorders in children, including native English speakers and children from culturally and linguistically diverse homes, covering the full range of disabilities. Course covers birth through late adolescence and includes impact of language disorders on language acquisition, literacy development, and uses of technology.

## **BBSQ 5116 Language disorders in adults**

*Prerequisite: BBS 4032 Neuroscience or equivalent.* Theoretical and practical approaches to understanding the etiology, assessment, classification, and treatment of aphasia and other communication disorders in adulthood.

## **BBSQ 5118 Cleft palate and speech habilitation**

Explores the role of the speech-language pathologist on the cleft palate team and in international practice. Develops knowledge and skills needed by the SLP to address communication and feeding issues associated with cleft palate and other craniofacial disorders.

## **BBSQ 5119 Alaryngeal speech**

Survey of medical and surgical treatments for laryngeal carcinoma. Analysis of physiologic, acoustic, and psychosocial aspects of alaryngeal speech. Study of therapeutic methods.

## **BBSQ 5120 Communication disorders in bilingual/bicultural children**

Studies effect of bilingualism, bilingual education, sociolinguistics, psycholinguistics and multicultural perspectives in education on children and adolescents. Considers appropriate assessment and treatment to ensure

optimal academic success for dual language learners and multidialectal students by providing culturally and linguistically appropriate services, covering the full range of disabilities.

### **BBSQ 5125 Clinical approaches to aural habilitation of children**

*Prerequisite: BBSQ 4042 Audiology or equivalent.* This class examines clinical procedures available to audiologists, speech pathologists, and deaf educators for implementing speech-reading, auditory training, and speech-language therapy for the hard-of-hearing child. Use of amplification and counseling approaches.

### **BBSQ 5129 Audiological concepts and principles**

*Prerequisite: BBSQ 4042 Audiology or equivalent.* This course covers auditory pathologies, electrophysiological (ABR), and electraacoustical (OAE) tests. Tests of central auditory function, controversial issues in audition.

### **BBSQ 5130 Assessment and intervention in dysphagia**

Prerequisite: BBSQ 4031 or equivalent, previous course addressing neurological bases of communication/upper airway dysfunction. This class examines clinical practice in swallowing and feeding disorders in children and adults. Normal and abnormal development and mature function assessment and treatment.

### **BBSQ 5210 Practicum in school speech-language pathology**

Assessment and Intervention planning and implementation for school age clients across the full range of disabilities. Practice in speech and language pathology at related field facilities. Majors enroll until practicum requirements for the M.S. degree are completed.

### **BBSQ 5212 Practicum in school speech-language pathology (Summer)**

Participation and student teaching in a school remedial speech and hearing program: survey, organization, remedial procedures. Special fee: \$150.

### **BBSQ 5312 Diagnostic methods and practice in speech-language pathology**

*Prerequisite: BBSQ 5111 Assessment and evaluation.* Assessment planning and implementation for clients across the full range of disabilities and across the lifespan. Methods of assessing native English speakers and culturally and linguistically diverse clients.

## **BBSQ 5331 Therapy Practicum**

Assessment and intervention planning and implementation for clients across the full range of disabilities and across the lifespan. Practice in speech and language pathology at the Edward D. Mysak Clinic for Communication Disorders and/or related field facilities. Majors enroll until practicum requirements for the M.S. degree are completed

## **BBSQ 5332 Therapy Practicum: Regular clinic**

Assessment and intervention planning and implementation for clients across the full range of disabilities and across the lifespan. Observation and practice in speech and language pathology at the Edward D. Mysak Clinic for Communication Disorders and at related field facilities. Majors enroll until practicum requirements for the M.S. degree are completed.

## **BBSQ 5333 Therapy Practicum: Laboratory methods and instrumentation in clinical practice**

Instruction and practice in acoustic and physiologic measures related to voice, articulation, and fluency disorders. Majors must enroll for one term. Special fee: \$150.

## **BBSQ 5335 Therapy Practicum: Infant evaluation clinic**

Observation and participation in the evaluation of pre-speech and feeding behaviors in at-risk infants and in the development of individualized management programs.

## **BBSQ 5336 Therapy Practicum: Stuttering clinic**

*Prerequisite: BBSQ 5114 Stuttering or equivalent.* Observation and discussion of assessment, remediation, and prevention of fluency disorders. Special fee \$150.

## **BBSQ 5343 Hearing measurement**

Practice in hearing screening, audiological evaluation, and aural rehabilitation issues across the lifespan.

## **BBSQ 5815 Pediatric dysphagia, birth to 21**

The course will cover dysphagia across pediatric ages, birth to 21, and as it is evaluated and treated in four pediatric settings--the neonatal intensive care unit, early intervention, pre-schools, and schools. This course cannot be used as a replacement for the program requirement, BBSQ 5130, Dysphagia Assessment and Management. It is a good elective for students interested in pediatrics, those who will be working in school settings, and those interested particularly in dysphagia.

## **BBSQ 5820 Bilingual SLP Extension Institute**

The Bilingual SLP Extension Institute is for non-matriculated students who are speech-language-pathologists or holders of the NYSED Teachers of Speech and Language Disabilities (TSSL) or the Teachers of Speech and Hearing Handicapped (TSHH). It is comprised of two 3-credit courses that meet the academic and clinical requirements of the NYSED bilingual extension certificate. All students receive an "Advanced Certificate in Bilingual Speech-Language Pathology." Students acquire the knowledge and skills to provide culturally and linguistically appropriate services for all students with a focus on dual language learners. The institute is available both online and in-person.

### **BBSQ 5940 Evaluating research in speech-language pathology and audiology**

Evaluation of research methods and the interpretation of research leading to evidence-based practice approaches.

### **BBSQ 5941 Research needs and methods in speech-language pathology and audiology**

Rotation in lab conducting complementary research, to result in a product (manuscript, measure,

presentation). Taught by core doctoral faculty.

### **BBSQ 6351 Advanced practice: Clinical**

Doctoral students are required to register in four sections during their period of candidacy. Observation of faculty during therapy, diagnosis, supervisory, teaching, or research activities and participation in such activities.

### **BBSQ 6352 Advanced practice: Supervision**

Doctoral students are required to register in four sections during their period of candidacy. Observation of faculty during therapy, diagnosis, supervisory, teaching, or research activities and participation in such activities.

### **BBSQ 6353 Advanced practice: Teaching**

This course covers the teaching requirement for doctoral students. For this requirement, doctoral students take full or partial responsibility for teaching a course at Teachers College or elsewhere. They design or redesign the class syllabus and assignments and develop and teach at least half of the class sessions under the guidance of a faculty member.

### **BBSQ 6354 Advanced practice: Laboratory**

Doctoral students are required to register in four sections during their period of candidacy. Observation of faculty during therapy, diagnosis, supervisory, teaching, or research activities and participation in such activities.

### **BBSQ 6355 Advanced practice: Administration**

Doctoral students are required to register in four sections during their period of candidacy. Observation of faculty during therapy, diagnosis, supervisory, teaching, or research activities and participation in such activities.

### **BBSQ 6514 Language: Brain, biology and language acquisition**

For doctoral candidates and advanced master's degree students in speech-language pathology. Doctoral candidates are required to enroll in at least three sections of seminars in the BBSQ 6513-6517 series. Seminars involve intensive study and analysis of current research and issues in the particular topics.

### **BBSQ 6516 Seminar on Fluency and its disorders**

For doctoral candidates and advanced master's degree students in speech-language pathology. Doctoral candidates are required to enroll in at least three sections of seminars in the BBSQ 6513-6517 series. Seminars involve intensive study and analysis of current research and issues in the particular topics.

### **BBSQ 6517 Neuropathology of speech**

*Prerequisite:* BBSQ 4031 or equivalent, BBSQ 4030 or equivalent, and previous course addressing neurological bases of speech. The purpose of this course is to provide a detailed study of acquired and progressive disorders of the motor speech system. We will explore motor speech disorders from neurological, theoretical and clinical perspectives. For doctoral students, the course will also address the development of their dissertation study (literature review, research questions, design). Doctoral students must ask for permission from instructor to be in the course.

### **BBSQ 6940 Supervised research in speech-language pathology and audiology**

*Prerequisite:* BBSQ 5941 *Research methods.* Doctoral candidates are required to enroll in their advisor's section for both semesters. Opportunity to design and conduct pilot studies and projects.

### **BBSQ 6941 Supervised research in speech-language pathology and audiology**

*Prerequisite: BBSQ 5941 Research methods.* Doctoral candidates are required to enroll in their advisor's section for both semesters. Opportunity to design and conduct pilot studies and projects.

### **BBSQ 7500 Dissertation seminar in speech-language pathology and audiology**

*Prerequisite BBSQ 6941 Supervised research.* Development of doctoral dissertations and projects and presentation of plans for approval. Doctoral candidates are required to enroll for one year and must begin the sequence in the fall term immediately following completion of BBSQ 6941.

### **BBSQ 8900 Dissertation-advisement in speech-language pathology and audiology**

Prerequisite: BBSQ 7500 Dissertation seminar. Individual advisement on doctoral dissertations. Fee to equal 3 points at current tuition rate for each term. For requirements, see section in catalog on Continuous Registration for Ed.D./Ph.D. degrees.

# Curriculum and Teaching in Physical Education

**Department of - Biobehavioral Sciences**

## Contact Information

**Phone:** (212) 678-3325

**Fax:** (212) 678-3322

**Email:** [msnsprogram@tc.edu](mailto:msnsprogram@tc.edu)

**Director:** Professors Lori Quinn, Carol Ewing Garber, Laura Azzarito

## Program Description

**Curriculum and Teaching in Physical Education (PECT)**

Master of Arts (M.A.)

Master of Education (Ed.M.)

Doctor of Education (Ed.D.)

## Degree Summary

For a complete listing of degree requirements, please continue on to this program's "Degrees" section in this document

# Degree Requirements

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## **Master of Arts (M.A., 32-point)**

The specific career goals of the student are used in planning the graduate program. Programs include one or more of the following features:

### *Field-Based Experiences*

The theoretical study of curriculum and teaching concepts is integrated with field-based applications of those concepts. Part of the student's graduate study experience takes place in elementary, secondary, or college physical education settings. Students who are concurrently employed as physical education teachers use their own schools as field sites; other students are assigned to selected field sites.

### *Program Design and Development*

Students critically examine an array of traditional and innovative physical education program designs, and then formulate their own conception of curriculum. Program evaluation techniques are studied and then used to conduct field evaluations of ongoing programs. Students learn systematic techniques for program development and use them to plan programs for field settings.

### *Teaching: Performance and Analysis*

Students critically evaluate existing theories and models of teaching, and devise their own concepts of teaching. A spectrum of analytic techniques is used to analyze videotaped and live samples of interactive teaching.

### *Study and Application of Concepts of Human Movement and Health*

Students study theory and research in the applied sciences of anatomy, movement analysis, exercise physiology, health, nutrition, motor learning, and their applications to program designs and teaching strategies.

### *Culminating Experience*

Students in the M.A. and Ed.M. programs are required to complete a culminating experience that integrates material from their course-work. This experience can be field-based, theoretical, or a research project related to physical education. The student and his or her advisor will discuss and design an individual experience that helps meet the goals of the student's program.

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## **Master of Education (Ed.M., 60-point)**

The specific career goals of the student are used in planning the graduate program. Programs include one or more of the following features:

### *Field-Based Experiences*

The theoretical study of curriculum and teaching concepts is integrated with field-based applications of those concepts. Part of the student's graduate study experience takes place in elementary, secondary, or college physical education settings. Students who are concurrently employed as physical education teachers use their own schools as field sites; other students are assigned to selected field sites.

### *Program Design and Development*

Students critically examine an array of traditional and innovative physical education program designs, and then formulate their own conception of curriculum. Program evaluation techniques are studied and then used to conduct field evaluations of ongoing programs. Students learn systematic techniques for program development and use them to plan programs for field settings.

### *Teaching: Performance and Analysis*

Students critically evaluate existing theories and models of teaching, and devise their own concepts of teaching. A spectrum of analytic techniques is used to analyze videotaped and live samples of interactive teaching.

### *Study and Application of Concepts of Human Movement and Health*

Students study theory and research in the applied sciences of anatomy, movement analysis, exercise physiology, health, nutrition, motor learning, and their applications to program designs and teaching strategies.

## *Culminating Experience*

Students in the M.A. and Ed.M. programs are required to complete a culminating experience that integrates material from their coursework. This experience can be field-based, theoretical, or a research project related to physical education. The student and his or her advisor will discuss and design an individual experience that helps meet the goals of the student's program.

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## **Doctor of Education (Ed.D., 90-point)**

The specific career goals of the student are used in planning the graduate program. Programs include one or more of the following features:

### *Field-Based Experiences*

The theoretical study of curriculum and teaching concepts is integrated with field-based applications of those concepts. Part of the student's graduate study experience takes place in elementary, secondary, or college physical education settings. Students who are concurrently employed as physical education teachers use their own schools as field sites; other students are assigned to selected field sites.

### *Program Design and Development*

Students critically examine an array of traditional and innovative physical education program designs, and then formulate their own conception of curriculum. Program evaluation techniques are studied and then used to conduct field evaluations of ongoing programs. Students learn systematic techniques for program development and use them to plan programs for field settings.

### *Teaching: Performance and Analysis*

Students critically evaluate existing theories and models of teaching, and devise their own concepts of teaching. A spectrum of analytic techniques is used to analyze videotaped and live samples of interactive teaching.

### *Study and Application of Concepts of Human Movement and Health*

Students study theory and research in the applied sciences of anatomy, movement analysis, exercise physiology, health, nutrition, motor learning, and their applications to program designs and teaching strategies.

*Research Competence (for Ed.D. students)*

All doctoral students develop proficiency in research and complete a dissertation under the advisement of a faculty sponsor. With their career goals in mind, students design their programs to include coursework that focuses on research methods and the results of research in physical education, and participate in research experiences to demonstrate competence and successfully complete the dissertation.

All doctoral students participate in an intensive seminar that reviews research in physical education and also attend a continuous research semester during most semesters of their enrollment in the program. Students must satisfactorily complete all parts of the program certification exam and a literature review to be certified and officially begin the dissertation process.

During the dissertation process, students work closely with an advisor and complete pilot studies to enhance their research skills. Students who are planning on academic careers that will include conducting research may participate in faculty research projects throughout their program to further enhance their research preparation.

## **Faculty List**

### **Faculty**

LAURA AZZARITO

Associate Professor of Physical Education

JOSEPH T CICCOLO

Assistant Professor of Applied Physiology

CAROL EWING GARBER

Professor of Movement Sciences

ANDREW MICHAEL GORDON

Professor of Movement Sciences

LORI QUINN

Associate Professor of Movement Science  
& Kinesiology

### **Visiting Faculty**

JEFFREY SCOTT MELENDEZ

Adj/PTVisiting Prof/PTLecturer Physical  
Education 111717-6139

### **Adjunct**

PAUL MICHAEL GALLO

Adjunct in Applied Physiology

TERRY R KAMINSKI

Adjunct Assistant Professor of Movement  
Sciences

RICHARD MAGILL

Adjunct Full Professor of Motor Learning  
and Control

JENNIFER F. RASMUSSEN

Adjunct Assistant Professor in Physical  
Education

### **Instructors**

STEPHEN SILVERMAN

Professor of Education

MICHAEL ANTHONY SOPIO

Instructor

## Course List

### **BBS 5060 Neuromuscular responses and adaptation to exercise**

A review of the physiology of muscle contraction in addition to in-depth discussion of topics related to the field which include: the relationship between muscle activation and respiration during exercise, muscle fatigue, eccentric versus concentric contractions and adaptation to strength training.

### **BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences**

The course provides students with techniques and strategies for collecting, analyzing, and reporting data from a qualitative perspective. Students will be able to consider various research issues when working with different populations in various contexts, such as schools, clinical settings, health contexts, families, communities, or other organizations.

### **BBSR 4002 Visual Methods and Education**

This seminar-style course has been designed to help students develop a critical understanding and appreciation of the theory, methodology, and foundation of qualitative visual research methods in an applied context.

### **BBSR 4005 Applied anatomy and biomechanics**

Topics include: gross anatomy and function of human skeletal and muscular systems, mechanics of human movement, and analysis of skills in dance and physical education. Designed primarily for students without a prior course in anatomy or biomechanics. Students will be expected to participate in a laboratory offered immediately preceding the scheduled class time. Lab fee: \$50.

### **BBSR 4050 Biomechanical analysis of human movement**

Permission required. Covers the principles and techniques required to analyze human movement, which can be used to develop practical research questions. Quantitative and qualitative techniques for analysis of movement are discussed in relation to the study of learning, motor control, motor development, and motor impairments. Lab fee: \$100.

### **BBSR 4060 Motor learning**

Study of factors relating to the acquisition and performance of motor skills.

Includes review and analysis of appropriate research findings.

### **BBSR 4070 Introduction to the psychosocial aspects of sport and exercise**

The purpose of this course is to provide the student with an in-depth and comprehensive understanding of the psychological and social processes in exercise, sport, and physical activity. The focus is on the key theoretical psychosocial principles that are well known to govern exercise and sport behavior, including the physical, affective, and cognitive aspects. The course explores theoretical, methodological, and applied approaches to a variety of topics including stress, cognition, mood, emotion, perceptions of the self, mental illness, exercise adherence, drug use and addiction, self-regulation and self-control, motivation, goal setting, arousal and performance, group dynamics, coaching, and burnout.

### **BBSR 4080 Teaching in Physical Education**

Constructivist pedagogies in Physical Education

### **BBSR 4090 Physical fitness, weight control, and relaxation**

Contributions of exercise to human well-being throughout life. Classroom, gymnasium, and laboratory experiences included. Designed for teachers, counselors, and others who desire an introduction to basic concepts of physical fitness.

### **BBSR 4095 Applied physiology I**

Prerequisite: a course in human physiology. Physiological bases of exercise.

Lectures concerning the effects of exercise on the major physiological systems (cellular, cardiovascular, thermoregulatory, pulmonary, renal, body fluids, hormonal).

### **BBSR 4151 Laboratory methods in biomechanics**

Permission required. Enrollment limited. Prerequisite: BBSR 4050. Students develop technical skills in the application of biomechanics to the study of movement behavior including video-based data collection and computer-based kinematic analysis. Students design and conduct a pilot research study using biomechanical analysis of a functional movement. Special fee: \$100.

### **BBSR 4161 Motor learning laboratory**

An introduction to qualitative and quantitative analysis of movement and action during acquisition of functional skills. Course fee \$100. Corequisite: BBSR 4060.

### **BBSR 4700 Student teaching in physical education**

Student teaching in both elementary and secondary schools for a full semester.

Includes a required seminar.

### **BBSR 4861 Workshop in motor learning and control**

Students carry out a case study of skill acquisition in a functional movement task and integrate qualitative and quantitative findings in a final essay, characterizing the learning process.

### **BBSR 5028 Motor development across the lifespan**

Review and analysis of theoretical models and experimental research related to development and performance of motor skills throughout the lifespan.

### **BBSR 5040 Curriculum designs in physical education**

Review of existing curriculum designs, traditional and new. Systematic development of curriculum plans.

### **BBSR 5041 Analysis of teaching in physical education**

An analysis of the decisions and actions of teachers in relation to their role as director of learning. Includes experiences in executing and analyzing teaching skills.

### **BBSR 5050 Neurophysiology of motor control and electromyography**

Review and analysis of theoretical models and experimental research related to development and performance of motor skills throughout the lifespan.

Advanced topics dealing with the experimental and clinical use of electromyography. Topics will be integrated with the kinematics of movements being observed. A laboratory project using EMG will be required. Lab fee: \$50.

### **BBSR 5055 Bases of motor control systems**

Study of control processes subserving the coordination of movement.

### **BBSR 5095 Exercise and health**

The role of exercise in diagnosis, prevention, and rehabilitation of health problems such as cardiovascular disease, pulmonary disease, diabetes, obesity, and stress. Scientific evidence from both epidemiological and applied practice perspectives are emphasized.

### **BBSR 5120 Critical Issues in Physical Culture**

This course broadly looks at socio-historical and educational issues of social justice in sports, exercise, fitness, and physical education. It offers a sociological, pedagogical, and critical inquiry into the study of human movement.

### **BBSR 5151 Introduction to the analysis of biomechanical signals**

Introduction to MATLAB programming with a focus on variables, conditional statements, loops, data visualization, basic algorithm development, and Graphical User Interfaces (GUIs). Concepts and techniques used in the analysis

of biomechanical/biological signals will be applied to kinematic/physiological data (e.g., electromyographic, kinetic, accelerometer, heart rate data, etc.) using MATLAB. Applications of MATLAB extend to the analysis of all types of quantitative data. Thus, students with data from other sources are welcome to use their own data for course assignments. Interactive lectures and weekly labs are intended for students across disciplines to develop the skills required to use MATLAB in their own research.

### **BBSR 5194 Applied physiology laboratory II**

The discussion and practice of techniques for collection and analysis of physiologic data (strength testing, electromyography, computerized data acquisition). Lab fee: \$100.

### **BBSR 5195 Advanced applied physiology laboratory**

Prerequisite: BBSR 5194. Introduction of advanced physiologic measurement techniques and concepts. Included are indirect calorimetry, spectrophotometry, vascular volume dynamics, autonomic reflexes, thermoregulation, noninvasive cardiac output, computer data plethysmography, tonometry, acquisition, and post-acquisition analyses. Lab fee: \$100.

### **BBSR 5200 Fieldwork in movement science and education**

Permission required. For advanced students prepared to investigate problems.

### **BBSR 5251 Fieldwork seminar in motor learning and motor control**

Applications of theory/research to therapeutic or educational practice for students in field-based settings.

### **BBSR 5504 Research training in motor learning**

Permission required. A competency-based approach to the preparation of researchers in the areas of neuromotor control and perceptual-motor processes. Several learning experiences are offered each semester, involving lectures, laboratory practica, seminars and individual research advisement. Course fee \$175

### **BBSR 5543 Seminar in Physical Education**

Examination of current issues in curriculum and teaching in physical education relative to diverse student populations and associations with other disciplines.

### **BBSR 5582 Research design in movement science and education**

Basic concepts of research design and statistical analysis. Students learn to interpret articles and design projects.

**BBSR 6201 Supervision of educational or clinical practice in the movement sciences**

Permission required. Corequisite: Actual supervisory experience during that semester. For doctoral students in the movement sciences. Field-based experiences in the guidance of therapists or educators engaged in applying the movement sciences to clinical practice.

**BBSR 6900 Supervised independent research in movement science and education**

Permission required. For advanced students who wish to conduct research under faculty guidance.

**BBSR 7500 Dissertation seminar in movement science and education**

Permission required. Candidate develops proposal for doctoral dissertation in consultation with advisor. Seminar convenes only on days when candidates present proposals for approval.

**BBSR 8900 Dissertation advisement in movement science and education**

Individual advisement on doctoral dissertations. Fee to equal 3 points at current tuition rate for each term. For requirements, see section in catalog on Continuous Registration for Ed.D./Ph.D. degrees.

# Movement Science and Education

## Department of - Biobehavioral Sciences

### Contact Information

**Phone:** (212) 678-3325

**Fax:** (212) 678-3322

**Email:** [msnsprogram@tc.edu](mailto:msnsprogram@tc.edu)

**Director:** Professors Lori Quinn, Carol Ewing Garber, Laura Azzarito

## Program Description

The Program of Movement Sciences and Education at Teachers College, Columbia University excels in graduate education and research in the sub-disciplines of **Kinesiology**, including **Applied (Exercise) Physiology**, **Motor Learning and Control**, and **Physical Education**. The program has a long tradition of excellence.

The **Applied (Exercise) Physiology** concentration focuses on the physiological effects of exercise and disease and on the promotion of physical activity. The effects of exercise training on physiological processes, behavioral health, and physical and mental well being are emphasized. Through a joint program with nutrition education, students can study Nutrition and Exercise Physiology through the Department of Health and Behavior Studies (Program in Nutrition). Students in Applied Physiology can supplement their work in applied exercise physiology with nutrition classes. Students can apply their academic work to improve health and physical fitness across both healthy and disabled populations. Doctoral students conduct related research in laboratory and health care facilities, and in field settings designed to promote physical activity and health.

Students in the Applied (Exercise) Physiology specialization have access to a variety of rich resources at Columbia University. Active collaborations exist between our faculty and faculty in the Columbia University School of Medicine, Mailman School of Public Health, and the New York Center for Obesity Research. Students are welcome to participate in these ongoing projects and attend any of the frequent seminars at the Columbia University Medical Center and the New York Center for Obesity Research.

**Motor Learning and Control** study focuses on the behavioral, biomechanical, and neural bases of development, acquisition, and performance of functional movement skills. Acquisition of skill is examined over the lifespan in typically developing and impaired individuals. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors, sport, and dance. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

**Health and physical education** has a long and distinguished history at Teachers College. Teachers College offered one of the first graduate degrees in health and physical education and continues to offer a wide array of opportunities for graduate study. In addition to courses in curriculum and teaching in physical education, there are a variety of other courses in the movement science, health studies, curriculum and teaching, physical culture, and other areas that provide students with many opportunities for course options. All programs are designed to allow flexibility in program planning.

**Each of these specialties has five components:**

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical or educational skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research and to carry out educational, clinical, or laboratory research.
4. Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
5. Elective courses to meet specific student needs which may be taken throughout the College and University in such areas as Anatomy, Biology, Business, Chemistry, Computer Science, Health Education, Higher and Adult Education, Neurosciences, Nutrition, Physiology, Psychology, Public Health, and Science Education. A list of recommended elective and related courses is available to students in the Movement Science office. At least two courses (for a total of at least 6 points) outside of the program area are required.

## **Degree Summary**

### **Master of Arts: Motor Learning**

The Master of Arts (M.A.) program in Motor Learning & Control (Major Code: MTLG) is designed to provide students with a broad background in movement sciences and related areas. This program is designed for students seeking broad study of motor learning and control. Students with any undergraduate major will be considered. The program provides content relevant to students from a range of applied areas, including dance, Pilates, yoga, movement practitioners (e.g. Feldenkrais Method, Alexander technique), physical and occupational therapists, coaches, and trainers. Students can use this degree as a stepping stone for subsequent application to medical, physical therapy or occupational therapy schools, or doctoral study in kinesiology or rehabilitation sciences.

Study focuses on the behavioral, biomechanical and neural bases of development, acquisition and performance of functional movement skills. Acquisition of skill is examined over the life span in typically developing children and adults and individuals with movement disorders. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

The M.A. program emphasizes bridging between the movement sciences and clinical or educational practice. The objective is to develop a comprehensive and coherent view of theory and research that can be applied to practice within the student's professional field.

The program requires 32 points of graduate study and includes:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical or educational skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research and to carry out educational, clinical or laboratory research.
4. Seminars to discuss theory and research, identification of research problems, and clinical / educational applications.
5. Elective courses to meet specific student needs which may be taken throughout Teachers College in such areas as anatomy, biology, business, chemistry, computer science, health education, higher and adult education, neurosciences, nutrition, physiology, psychology and science education.

A final project is required for the M.A. and may involve one of three options:

1. A scholarly review of research and theory within a topical area drawing application to educational or clinical practice.

2. An educational project including the development of an assessment instrument/ method for clinical or educational practice or a presentation for a continuing education program.
3. A basic or applied research study under the advisement of a faculty member or advanced doctoral student (note this option is required if considering doctoral study).

For the M.A. degree, students may also, in consultation with their faculty advisor, create a flexibly-designed program of study cutting across specialization areas (Motor learning & control, Applied exercise physiology, Physical education) which will meet their professional needs and academic interests. The M.A. program can be completed in 12-18 months of full-time study or two to three years of part-time study (depending on the student's other responsibilities).

### **Special Admission Requirements/Academic Prerequisites**

While students have come from a variety of fields, the following backgrounds are most appropriate: movement sciences, exercise science, physical therapy, occupational therapy, physical education, dance, athletic training, biology, nutrition, nursing, and psychology. Students with strong academic records, who have deficiencies in their science backgrounds, may be admitted with the understanding that these deficiencies will be remedied with appropriate courses.

Students are required to complete all of the following courses with a grade of B or better. Students who earn grades B- or below will need to retake those courses and will be charged tuition again. It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the college for at least half a day to meet with faculty and current students, to audit a course or seminar, and to become acquainted with research areas and resources. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

## **Course Work Requirements**

### **Core Coursework (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5504** Research Training Seminar (Section 02) (2 points)

(\*) BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points

## **Substantive Study (minimum 3 credits)**

**BBSR 4005** Applied anatomy and biomechanics (3)

**BBSR 4055** Neuromotor processes (3)

**BBSR 4090** Physical fitness, weight control and relaxation (3)

**BBSR 4095** Applied physiology I (3)

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5095** Exercise and health (3)

**BBSR 4070** Psychosocial Aspects of Sports and Exercise (3)

**BBSR 6563** Seminar (3)

## **Laboratory Courses (minimum 3 credits)**

**BBSR 4151** Laboratory methods in biomechanics (3)

**BBSR 4195** Applied physiology laboratory I (3)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5194** Applied physiology laboratory II (3)

**BBSR 5195** Advanced applied physiology laboratory (3)

# **Elective Courses (3 credits)**

Students should take 2-3 credits outside the Movement Sciences area (along with required courses BBS 5060 and BBS 5068) to meet the Teachers College breadth requirement. Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Movement Sciences have included courses in Health and Behavioral Studies (HBSE), Human Development (HUDM), Neuroscience and Education (BBSN), Dance (A&HG), and Measurement and Statistics (HUDM). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals. Courses outside of Movement Sciences (BBSR) that you use to fulfill core degree requirements and/or research methods requirements can also count toward the breadth requirement.

## **Additional Information**

**BBSR 5504 (sect 002)** Research training in motor learning (2). Students will enroll in this competency-based course during their last year of study to immerse themselves in current research in motor learning and control, as well as receive advisement on their final project. Note that if all coursework is complete but the student has not completed the final project, students must continue to enroll for 1 point (above and beyond the 32 points) each semester until the project is complete.

**Individualized program.** Students with diverse interests may exchange courses for other department offerings in consult with an advisor.

# **Master of Education: Motor Learning & Control**

The Master of Education (Ed.M.) program in Movement Science and Education with a specialization in Motor Learning and Control (Major Code: MTLG) is designed to provide students with a broad background in movement sciences and related areas. Study focuses on the behavioral, biomechanical and neural bases of development, acquisition and performance of functional movement skills. Acquisition of skill is examined over the life span in typically developing children and adults and individuals

with movement disorders. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

The Ed.M program provides for advanced study in the movement sciences and for individually designed study to meet the student's professional needs and interests. Students can focus on: (a) preparation as a "scholar of practice" able to translate research and theory into appropriate clinical or educational strategies; (b) preparation as a clinical instructor, clinical or educational supervisor or applied investigator; or (c) preparation for study towards the doctoral degree.

The program requires 60 points of graduate study and includes:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical or educational skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research and to carry out educational, clinical or laboratory research.
4. Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
5. Elective courses to meet specific student needs which may be taken throughout the College and University in such areas as anatomy, biology, business, chemistry, computer science, health education, higher and adult education, neurosciences, nutrition, physiology, psychology and science education.

A final project is required for the Ed.M. and may involve one of two options:

1. An applied research study which can focus on clinical or educational issues.
2. A laboratory research study.

For the Ed.M. degree, students may also arrange with their faculty advisor a flexibly-designed program of study cutting across specialization areas (Motor learning & control, Applied exercise physiology, Physical education) which will meet their professional needs and academic interests. Students intending to continue study towards the doctoral degree should arrange their Ed.M. program to include core courses required for doctoral specialization. The Ed.M. program can be completed in 12-18 months of full-time study or two to three years of part-time study (depending on the student's other responsibilities).

## **Course Work Requirements**

For the Ed.M. program, specific requirements for courses, or equivalents transferred from prior graduate study, are:

### **Core Coursework (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5504** Research Training Seminar (Section 02) (2 points)

(\*) BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points

## **Substantive Study (minimum 9 credits)**

**BBSR 4005** Applied anatomy and biomechanics (3)

**BBSR 4055** Neuromotor processes (3)

**BBSR 4090** Physical fitness, weight control and relaxation (3)

**BBSR 4095** Applied physiology I (3)

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5095** Exercise and health (3)

**BBSR 4070** Psychosocial Aspects of Sports and Exercise (3)

## **Laboratory Courses (minimum 6 credits)**

**BBSR 4151** Laboratory methods in biomechanics (3)

**BBSR 4195** Applied physiology laboratory I (3)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5194** Applied physiology laboratory II (3)

**BBSR 5195** Advanced applied physiology laboratory (3)

**Seminars, tutorials or conferences:** minimally 6 credits in movement sciences (BBSR courses).

## **Elective Courses (2-3 credits)**

Students should take 2-3 credits outside the Movement Sciences area (along with required courses BBS 5060 and BBS 5068) to meet the Teachers College breadth requirement. Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Movement Sciences have included courses in Health and Behavioral Studies (HBSE), Human Development (HUDM), Neuroscience and Education (BBSN), Dance (A&HG), and Measurement and Statistics (HUDM). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals. Courses outside of Movement Sciences (BBSR) that you use to fulfill core degree requirements and / or research methods requirements can also count toward the breadth requirement.

**BBSR 5504 Research training in motor learning** (Minimum 2 points). Students will enroll in this competency based course during their last year of study to immerse themselves in current research in motor learning and control, as well as receive advisement on their final project. Note that if all coursework is complete but the student has not completed the final project, students must continue to enroll for 1 point (above and beyond the 60 points) each semester until the project is complete.

**Individual program:** Minimally 12 points in movement sciences (additional BBSR courses in substantive, laboratory, fieldwork or seminar study) and / or related areas outside of the program in Movement Sciences and Education (non-BBSR courses, including graduate courses at Columbia University).

### **Special Admission Requirements/Academic Prerequisites**

While students have come from a variety of fields, the following backgrounds are most appropriate: movement sciences, kinesiology, physical therapy, occupational therapy, physical education, dance, athletic training, biology, nutrition, nursing, and psychology.

Students with strong academic records, who have deficiencies in their science backgrounds, may be admitted with the understanding that these deficiencies will be remedied with appropriate courses.

It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the college for at least half a day to meet with faculty and current students, to audit a course or seminar, and to become acquainted with research areas and resources. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

## **Doctor of Education: Motor Learning & Control**

Motor Learning & Control focuses on the behavioral, biomechanical, and neural bases of development, acquisition, and performance of functional movement skills.

Acquisition of skill is examined over the life span in typically developing children and adults and individuals with movement disorders. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

This specialty has five components:

- Substantive study of theory and research as embodied in lecture and laboratory courses.
- Development of clinical or educational skills in laboratory and fieldwork courses.
- Research training to enable students to read and interpret original research and to carry out educational, clinical, or laboratory research.
- Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
- Elective courses to meet specific student needs which may be taken throughout the College and University in such areas as Anatomy, Biology, Business, Chemistry, Computer Science, Health Education, Higher and Adult Education, Neurosciences, Nutrition, Physiology, Psychology, and Science Education. A list of recommended elective and related courses is available to students in the Movement Science office.

In the preparation of doctoral students, the goal is to develop those competencies necessary to pursue scholarly and scientific work and to formulate strategies to enhance professional practice. The focus of the Ed.D. program is to prepare leaders of applied research for clinical and educational practice. Graduates often assume positions in clinical academic departments or teaching universities.

Research training uses an apprenticeship model. Students work closely with faculty throughout their preparation: initially as apprentices with access to considerable Advisement, subsequently as collaborators, then progressing to a position as independent researchers.

Typically, the dissertation research is an extension of one or two prior studies. Often, research leading up to the dissertation is presented at national meetings or is published in professional journals.

In addition to substantive study and research preparation, students are expected to design an individual program representing their research area and professional concerns. Such preparation requires a significant commitment to graduate study. Doctoral students are required to be engaged in research at least three weekdays per week (on- or off-site) and be available for advisement at least two mornings or afternoons.

For the doctoral program with specialization in Motor Learning, specific course requirements (or equivalents transferred from prior graduate study) are:

### **Substantive Study (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

**BBSR 4151** Laboratory methods in biomechanics (3)

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5504** Research Training Seminar (Section 02) (2-3 points each semester, continuous enrollment required until completion of degree requirements, typically 18 points)

**Four courses (12 points) selected from:**

**BBSR 4055** Neuromotor processes (3)

**BBSR 4070** Introduction to Psychosocial Aspects of Sport/Exercise

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5251** Fieldwork seminar in motor learning and motor control (1-2)

**Three topical seminars (9)**

**BBSR 5596** Topics in applied physiology (3)

**BBSR 6563** Seminar in neuromotor processes (3)

**BBSR 6564** Advanced topics in neuromotor processes (3)

**BBSR 6565** Seminar in motor learning and motor control (3)

**BBSR 6571** Research seminar in the psychosocial aspects of human movement (3)

**Statistics sequence minimum (9)**

**HUDM 4122** Probability and statistical inference

**HUDM 5122** Applied regression analysis

**HUDM 5123** Linear models and experimental design

**Two courses in educationally-relevant areas must also be selected from the list below or substituted with advisor permission (6)**

**C&T 4004** Basic course in school improvement (3)

**C&T 4052** Designing curriculum and instruction (3)

**C&T 4078** Curriculum and teaching in urban areas (3)

**C&T 4114** Multicultural approaches to teaching young children (3)

**C&T 4159** Teacher education programs (3)

## C&T 5020 The environments of school (3)

### Individual program and electives (17)

#### **Service Requirements:**

- **Teaching Assistantships** Program faculty believe strongly in the value of assistant teaching (TA'ing). TA'ing can provide students with valuable opportunities to learn new material, review material previously acquired and obtain teaching skills and materials. The objective of the required teaching assistantship is to provide Ed.D. students with a quality learning experience that will benefit them regardless of whether they pursue academic or nonacademic careers. Doctoral students are *required* to serve as a teaching assistant for one Masters level course before graduating (whether in a paid or non-paid capacity). Every effort will be made to match student preferences with available opportunities, but students should expect that they may not always receive their first preference. Beyond this, additional teaching assistantship opportunities may be available for more advanced courses.
- **Graduate Study/Clinical Practice Traineeships** are available for *occupational and physical therapists* enrolled in or admitted to degree programs in Movement Science. They are offered in collaboration with several clinical agencies located in the metropolitan New York area that provide services to diverse groups including pediatric, adult, and geriatric clients. These traineeships involve up to 20 hours per week in a clinical setting and provide stipend and tuition benefits. International students may qualify, contingent on obtaining appropriate New York State clinical licensure. The latter may take up to 12 months so interested prospective students should contact the coordinator as soon as possible during the application process. The instructional staff in Movement Science provides clinical supervision. A case study approach is used to directly bridge between substantive study and clinical practice. For more detailed information, contact the Coordinator of Clinical Traineeships at (212) 678-3325.
- Part-time **paid research or laboratory assistantships** may be available for students in their middle to advanced stage of study.

#### **Doctor of Philosophy: Kinesiology**

We offer a full-time PhD in Kinesiology with students specializing either in motor learning and control, applied physiology or physical education. The Ph.D. program requires a full-time commitment to graduate studies and students should not expect to hold outside employment during their studies. This commitment will ensure that

advisement, research activities, and course work can be completed to the degree of competence that is expected in a research-intensive degree program. The degree of Doctor of Philosophy emphasizes research and intensive specialization in a field of scholarship.

The minimum requirements for the Ph.D. degree in Kinesiology are: satisfactory completion of a planned program of 75 graduate points beyond the Baccalaureate; submission of a statement of total program indicating periods of intensive study subsequent to the first year of graduate study which accompanies the program plan of study; satisfactory performance on a departmental Certification Examination; and preparation and defense of a research dissertation. In addition, doctoral students in Kinesiology are expected to complete a sequence of three research studies, or the equivalent, to meet degree requirements. Relevant courses completed in other recognized graduate schools to a maximum of 30 points, or 45 points if completed in another Faculty of Columbia University, may be accepted toward the minimum point requirement for the degree. Each degree candidate must satisfy departmental requirements for the award of the M.Phil. degree prior to continuance in the Ph.D. program. These degree requirements are specified in the Requirements for the Degree of Doctor of Philosophy Bulletin, obtainable from the Office of Doctoral Studies. Each student and his or her advisor develop a program that will help the student meet his or her goals and successfully complete the series of studies that meets the research requirements of the program.

For more information about special application requirements, program description and degree program requirements for the Ph.D. program in Kinesiology, contact Professor Gordon at [msnsprogram@tc.edu](mailto:msnsprogram@tc.edu).

For a complete listing of degree requirements, please continue on to this program's "Degrees" section in this document

# Degree Requirements

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## About the Master's Degree Programs

For the M.A. and Ed.M. programs with specialization in Movement Science and Education, students have two options. They may specialize in one of the three areas offered within Movement Science (Applied Physiology, Motor Learning and Control, Physical Education) or in consultation with an advisor, they may arrange a flexibly-designed program of study cutting across specialization in the movement sciences that will meet their professional needs and academic interests.

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## Master of Arts

The Master of Arts (M.A.) program in Motor Learning & Control (Major Code: MTLG) is designed to provide students with a broad background in movement sciences and related areas. This program is designed for students seeking broad study of motor learning and control. Students with any undergraduate major will be considered. The program provides content relevant to students from a range of applied areas, including dance, Pilates, yoga, movement practitioners (e.g. Feldenkrais Method, Alexander technique), physical and occupational therapists, coaches, and trainers. Students can use this degree as a stepping stone for subsequent application to medical, physical therapy or occupational therapy schools, or doctoral study in kinesiology or rehabilitation sciences.

Study focuses on the behavioral, biomechanical and neural bases of development, acquisition and performance of functional movement skills. Acquisition of skill is examined over the life span in typically developing children and adults and individuals with movement disorders. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

The M.A. program emphasizes bridging between the movement sciences and clinical or educational practice. The objective is to develop a comprehensive and coherent view of theory and research that can be applied to practice within the student's professional field.

The program requires 32 points of graduate study and includes:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical or educational skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research and to carry out educational, clinical or laboratory research.
4. Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
5. Elective courses to meet specific student needs which may be taken throughout Teachers College in such areas as anatomy, biology, business, chemistry, computer science, health education, higher and adult education, neurosciences, nutrition, physiology, psychology and science education.

A final project is required for the M.A. and may involve one of three options:

1. A scholarly review of research and theory within a topical area drawing application to educational or clinical practice.
2. An educational project including the development of an assessment instrument/method for clinical or educational practice or a presentation for a continuing education program.
3. A basic or applied research study under the advisement of a faculty member or advanced doctoral student (note this option is required if considering doctoral study).

For the M.A. degree, students may also, in consultation with their faculty advisor, create a flexibly-designed program of study cutting across specialization areas (Motor learning & control, Applied exercise physiology, Physical education) which will meet their professional needs and academic interests. The M.A. program can be completed in 12-18 months of full-time study or two to three years of part-time study (depending on the student's other responsibilities).

## **Special Admission Requirements/Academic Prerequisites**

While students have come from a variety of fields, the following backgrounds are most appropriate: movement sciences, exercise science, physical therapy, occupational therapy, physical education, dance, athletic training, biology, nutrition, nursing, and psychology. Students with strong academic records, who have deficiencies in their science backgrounds, may be admitted with the understanding that these deficiencies will be remedied with appropriate courses.

Students are required to complete all of the following courses with a grade of B or better. Students who earn grades B- or below will need to retake those courses and will be charged tuition again. It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the college for at least half a day to meet with faculty and current students, to audit a course or seminar, and to become acquainted with research areas and resources. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

## **Course Work Requirements**

### **Core Coursework (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5504** Research Training Seminar (Section 02) (2 points)

(\*) BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points

### **Substantive Study (minimum 3 credits)**

**BBSR 4005** Applied anatomy and biomechanics (3)

**BBSR 4055** Neuromotor processes (3)

**BBSR 4090** Physical fitness, weight control and relaxation (3)

**BBSR 4095** Applied physiology I (3)

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5095** Exercise and health (3)

**BBSR 4070** Psychosocial Aspects of Sports and Exercise (3)

**BBSR 5199** Conference Seminar (3)

#### **Laboratory Courses (minimum 3 credits)**

**BBSR 4151** Laboratory methods in biomechanics (3)

**BBSR 4195** Applied physiology laboratory I (3)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5194** Applied physiology laboratory II (3)

**BBSR 5195** Advanced applied physiology laboratory (3)

#### **Elective Courses (3 credits)**

Students should take 2-3 credits outside the Movement Sciences area (along with required courses BBS 5060 and BBS 5068) to meet the Teachers College breadth requirement. Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Movement Sciences have included courses in Health and Behavioral Studies (HBSE), Human Development (HUDM), Neuroscience and Education (BBSN), Dance (A&HD), and Measurement and Statistics (HUDM). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals. Courses outside of Movement Sciences (BBSR) that you use to fulfill core degree requirements and/or research methods requirements can also count toward the breadth requirement.

#### **Additional Information**

**BBSR 5504 (sect 002)** Research training in motor learning (2). Students will enroll in this competency-based course during their last year of study to immerse themselves in current research in motor learning and control, as well as receive advisement on their final project. Note that if all coursework is complete but the student has not completed the final project, students must continue to enroll for 1 point (above and beyond the 32 points) each semester until the project is complete.

**Individualized program.** Students with diverse interests may exchange courses for other department offerings in consult with an advisor.

### **Additional Courses offered in Movement Sciences and Education:**

#### **General Department Courses**

**BBS 4032** Neuroscience of human speech and language (2)

**BBS 4050** Applied biomedical instrumentation (3)

**BBS 5069** Brain and behavior II: Perception, emotion, memory and cognition (1-2)

**BBSQ 4043** The human nervous system (3)

#### **Seminars, Tutorials and Conferences**

**BBSR 4865** Tutorials in motor learning (0-3)

**BBSR 5596** Topics in applied physiology (3)

**BBSR 6564** Advanced topics in neuromotor processes (3)

**BBSR 6565** Seminar in motor learning and motor control (3)

#### **Fieldwork**

**BBSR 5200** Fieldwork in movement sciences (1-4)

**BBSR 5251** Fieldwork seminar in motor learning and motor control (1-2)

**BBSR 6201** Supervision of educational or clinical practice in the movement sciences (0-2)

#### **Research Preparation**

**BBSR 4900** Research and independent study in movement sciences and education (1 or more)

**BBSR 5595** Research seminar in applied physiology (3)

**BBSR 5582** Research design in the movement science and education(3)

**BBSR 6900** Supervised independent research in movement sciences (1-9)

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## Masters of Arts: Applied Physiology

### PROGRAM DESCRIPTION

The Applied Physiology concentration focuses on the study of physical activity behavior, physiological and psychological effects of acute and chronic exercise, how exercise influences physical and mental health, and on the promotion of physical activity in community, clinical, and public health settings. The effects of exercise training on psychological and physiological processes, neuromuscular and biomechanical function, health, and physical and mental wellbeing are emphasized. Students can apply their academic work to jobs that involve exercise testing and training, including programs designed to improve health and physical fitness in healthy individuals, in people with or at risk for chronic illness or disability, and in community, clinical, research, and public health settings. The program also may serve as a stepping-stone to medical, professional schools, and doctoral studies.

The Master of Arts (M.A.) program emphasizes bridging science and practice. The overarching objective of the program is to develop competence in practical skills and critical thinking skills that facilitate applying scientific knowledge to practice within the student's professional field. The program can be individualized to span the movement sciences and includes at least two Teachers College courses (for a total of 6 points) in programs outside of the movement sciences (i.e., non "BBSR" courses), such as neuroscience, nutrition education, health education, and other programs.

The Masters of Arts program in Applied Physiology requires a minimum of 32 points of graduate study, and it typically takes twelve months of full-time, or two years of part-time study. Full time students who wish to graduate in May-- or who have no previous formal study in Kinesiology/Movement Science-related field-- are strongly advised to start the program in the Summer semester.

The Program has five components:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical practice skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research.
4. Elective courses to meet specific needs, which may be taken throughout the Teachers College in an area of your choice.
5. A culminating examination or project integrating material from Applied Physiology coursework.

## **PROGRAM REQUIREMENTS**

The Masters of Arts program in Applied Physiology requires a minimum of 32 points. These courses come from the required core courses, electives in movement sciences, and breadth elective courses taken outside of the program. In addition, students who enter the program without prior formal study in Kinesiology, Movement, or Exercise Sciences or a closely-related field may be required to take coursework in addition to these program requirements, and it is strongly recommended they start in the summer semester if at all possible. All students must complete a final comprehensive examination or integrative project. No transfer credit from other graduate schools is awarded for Master of Arts students. Students are expected to consult with the Registrar's Office or website for additional information about degree requirements, policies and procedures (<http://www.tc.columbia.edu/registrar/pages/degree-information/degreerequirements/>).

The specific requirements for the M.A. program in Applied Physiology are described below:

### **Required Core Courses (minimum of 15 points)**

Students are required to complete all of the following courses with a grade of B or better. Students who earn grades B- or below will need to retake those courses and will be charged tuition again.

- BBSR 4095 Applied physiology I (3)
- BBSR 5594 Applied Physiology 2 (3)
- BBSR 4195 Applied physiology laboratory I (3)
- BBSR 5194 Applied physiology laboratory II (3)

- BBSR 5582 Research Design in the Movement Sciences (3) OR
- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences

**Electives in Movement Sciences and Education (BBSR) (minimum of 6 points).**

Students are required to take at least two additional BBSR courses (for a minimum of 6 points) in addition to the core required courses. These electives may include, but are not limited to, the following BBSR courses:

- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences and Education (3)
- BBSR 4054 Anatomy and Physiology (3)
- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4050 Biomechanical Analysis of human movement (3)
- BBSR 4055 Neuromotor processes (3)
- BBSR 4060 Motor learning (2-3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBSR 4090 Physical Fitness, Weight Control and Relaxation (2-3)
- BBSR 4900 Research and Independent Study in Movement Science and Education (1-3)
- BBSR 5028 Motor Development (2-3)
- BBSR 5050 Neurophysiology of motor control and electromyography (3)
- BBSR 5055 Basis of Motor Control (3)
- BBSR 5057 Movement disorders (3)
- BBSR 5095 Exercise and health (3)
- BBSR 5096 Advanced Exercise and Physical Activity Prescription (3)
- BBSR 5101 Scientific Basis of Exercise and Weight Management (3)
- BBSR 5120 Critical issues in Physical Culture and Education (3 credits)
- BBSR 5151 Introduction to Programming for Signal Analysis of Biobehavioral Signals (2-3)

- BBSR 5200 Fieldwork in Movement Sciences and Education (1-3)
- BBSR 5195 Advanced Applied Physiology Laboratory (3)
- BBSR 5595 Research seminar in applied physiology (1-3)

### **Elective Courses for Those Planning for Exercise Professional Certifications**

Any student considering taking a professional certification should discuss course selection with program faculty and also check the certification requirements posted by the certifying organization. Please note it is possible that you may need to take extra courses above the 32 point requirement to meet the requirements to sit for some professional certifications. Students in MA and Ed.M. programs in AP can meet the curricular requirements for the American College of Sports Medicine (ACSM) Certified Exercise Physiologist (EP-C) and Certified Clinical Exercise Physiologist (CEP) certifications, as long as certain elective courses are taken in addition to the required core courses. The courses you elect will depend on the certification you select and your previous undergraduate study. For those interested in the Certified Strength and Conditioning Specialist (CSCS), there are no specific course requirements to take the examination, however, there are elective courses that are recommended to help you prepare for the exam.

Further information about the CSCS certification can be found here: <https://www.nsca.com/cscsexam-prerequisites/#bd>

American College of Sports Medicine (ACSM) certifications requirements can be found here: <http://certification.acsm.org>

### **Breadth Courses outside of Movement Sciences and Education (a total of 6 points).**

Breadth elective courses must be taken in any program or department at Teachers College, except Movement Sciences (BBSR). Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Applied Physiology have included courses in Biobehavioral Sciences (BBS) Health Education (HBSS), Nutrition (HBSV), Diabetes Education (HBSD), Neuroscience and Education (BBSN), and Statistics (HUDM). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement, but they may count toward your degree if

approved by your advisor, as long as other degree requirements are met. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals.

Here is a partial list of popular breadth courses in the Department of Biobehavioral Sciences to consider:

- BBS 5060 Neuromuscular responses and adaptation to exercise (2)
- BBS 5068 Brain and Behavior I Communication in the nervous system (1-2)
- BBS 5069 Brain and Behavior II (1-2)
- BBSN 4003 Foundations of Neuroscience (3)
- BBSN 4000 Cognitive Neuroscience (3)
- BBSN 5122 Psychoneuroimmunology and Education

**Research Seminar (minimum of 4 points required for those choosing the Final Integrative Project Option)**

Registration and attendance at research seminar is required for all who choose the Integrative Final Project option. Students should expect to register in seminar during all semesters when working on Integrative project, with at least two semesters required (for a minimum of 4 points). This course can count toward your Movement Sciences elective.

- BBSR 5595 Research seminar in applied physiology (1-3)

**Recommended Background Courses for Students Entering without Prior Study in Kinesiology, Movement or Exercise Sciences.**

It is recommended that students who come in without prior formal study in Kinesiology, Movement or Exercise Sciences take one or more of the following courses in addition to the program requirements outlined above. Some of these courses can be taken in the summer so a summer semester start may be advisable. Students should consult with their program advisor about taking additional courses. The courses that may be recommended can include one or more of the following:

- BBSR 4054 Anatomy and Physiology (3)
- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4060 Motor learning (3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBSR 4090 Physical Fitness, Weight Control and Relaxation (2-3)

### **Comprehensive Examination or Integrative Final Project**

A comprehensive examination or integrative final project is required for the M.A. degree in Applied Physiology. The comprehensive examination option is strongly recommended for most M.A. students. The decision to complete the integrative project should be made early in the program in consultation with your advisor or program faculty, as this takes at least two semesters to complete and requires registration in BBSR 5595 Research Seminar in Applied Physiology for at least two semesters (during the proposal development and writing phase on the project). The comprehensive examination is given during Fall, Spring, and Summer A semesters. The examination covers the content of the required core courses and can be completed as soon as these required core courses are completed. Arrangements to sit for the examination can be made with the Applied Physiology Program Director the semester before you plan to take the examination.

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## **Master of Education**

The Master of Education (Ed.M.) program in Motor Learning (Code: MTLG) is designed to provide students with a broad background in movement sciences and related areas. Study focuses on the behavioral, biomechanical and neural bases of development, acquisition and performance of functional movement skills. Acquisition of skill is examined over the life span in typically developing and impaired individuals. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors, sport and dance. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

The Ed.M program provides for advanced study in the movement sciences and for individually designed study to meet the student's professional needs and interests. Students can focus on: (a) preparation as a "scholar of practice" able to translate research and theory into appropriate clinical or educational strategies; (b) preparation as a clinical instructor, clinical or educational supervisor or applied investigator; or (c) preparation for study towards the doctoral degree.

The program requires 60 points of graduate study and includes:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical or educational skills in laboratory and fieldwork courses.
3. Research training to enable students to read and interpret original research and to carry out educational, clinical or laboratory research.
4. Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
5. Elective courses to meet specific student needs which may be taken throughout the College and University in such areas as anatomy, biology, business, chemistry, computer science, health education, higher and adult education, neurosciences, nutrition, physiology, psychology and science education.

A final project is required for the Ed.M. and may involve one of two options:

1. An applied research report which can focus on clinical or educational issues.
2. A laboratory research paper.

For the Ed.M. degree, students may specialize in one of the three areas (Applied Physiology [Code: APHY], Motor Learning [Code: MTLG], Physical Education [Codes: PECT]) offered within Movement Sciences and Education or, in consultation with an advisor, they may arrange a flexibly-designed program of study cutting across specialization areas which will meet their professional needs and academic interests. Students intending to continue study towards the doctoral degree should arrange their Ed.M. program to include core courses required for doctoral specialization.

## **Course Work Requirements**

For the Ed.M. program, specific requirements for courses, or equivalents transferred from prior graduate study, are:

### **Core Coursework (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5504** Research Training Seminar (Section 02) (2 points)

(\*) BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points

### **Substantive Study (minimum 9 credits)**

**BBSR 4005** Applied anatomy and biomechanics (3)

**BBSR 4055** Neuromotor processes (3)

**BBSR 4090** Physical fitness, weight control and relaxation (3)

**BBSR 4095** Applied physiology I (3)

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5095** Exercise and health (3)

**BBSR 4070** Psychosocial Aspects of Sports and Exercise (3)

**BBSR 5199** Conference Seminar (3)

### **Laboratory Courses (minimum 6 credits)**

**BBSR 4151** Laboratory methods in biomechanics (3)

**BBSR 4195** Applied physiology laboratory I (3)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5194** Applied physiology laboratory II (3)

**BBSR 5195** Advanced applied physiology laboratory (3)

**Seminars, tutorials or conferences:** minimally 6 credits in movement sciences (BBSR courses).

### **Elective Courses (2-3 credits)**

Students should take 2-3 credits outside the Movement Sciences area (along with required courses BBS 5060 and BBS 5068) to meet the Teachers College breadth requirement. Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Movement Sciences have included courses in Health and Behavioral Studies (HBSE), Human Development (HUDM), Neuroscience and Education (BBSN), Dance (A&HD), and Measurement and Statistics (HUDM). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals. Courses outside of Movement Sciences (BBSR) that you use to fulfill core degree requirements and/or research methods requirements can also count toward the breadth requirement.

**BBSR 5504 Research training in motor learning** (Minimum 2 points). Students will enroll in this competency based course during their last year of study to immerse themselves in current research in motor learning and control, as well as receive advisement on their final project. Note that if all coursework is complete but the student has not completed the final project, students must continue to enroll for 1 point (above and beyond the 60 points) each semester until the project is complete.

**Individual program:** Minimally 12 points in movement sciences (additional BBSR courses in substantive, laboratory, fieldwork or seminar study) and/or related areas outside of the program in Movement Sciences and Education (non-BBSR courses, including graduate courses at Columbia University).

### **Special Admission Requirements/Academic Prerequisites**

While students have come from a variety of fields, the following backgrounds are most appropriate: movement sciences, kinesiology, physical therapy, occupational therapy, physical education, dance, athletic training, biology, nutrition, nursing, and psychology. Students with strong academic records, who have deficiencies in their science backgrounds, may be admitted with the understanding that these deficiencies will be remedied with appropriate courses.

It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the college for at least half a day to meet with faculty and current students, to audit a course or seminar, and to become acquainted with research areas and resources. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

### **Additional Courses offered in Movement Sciences and Education:**

#### **General Department Courses**

**BBS 4032** Neuroscience of human speech and language (2)

**BBS 4050** Applied biomedical instrumentation (3)

**BBS 5069** Brain and behavior II: Perception, emotion, memory and cognition (1-2)

**BBSQ 4043** The human nervous system (3)

#### **Seminars, Tutorials and Conferences**

**BBSR 4865** Tutorials in motor learning (0-3)

**BBSR 5596** Topics in applied physiology (3)

**BBSR 6564** Advanced topics in neuromotor processes (3)

**BBSR 6565** Seminar in motor learning and motor control (3)

#### **Fieldwork**

**BBSR 5200** Fieldwork in movement sciences (1-4)

**BBSR 5251** Fieldwork seminar in motor learning and motor control (1-2)

**BBSR 6201** Supervision of educational or clinical practice in the movement sciences (0-2)

## Research Preparation

**BBSR 4900 Research and independent study in movement sciences and education (1 or more)**

**BBSR 5595** Research seminar in applied physiology (3)

**BBSR 5582** Research design in the movement science and education (3)

**BBSR 6900** Supervised independent research in movement sciences (1-9)

Doctor of Education: Motor learning

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## Master of Education: Applied Physiology

### PROGRAM DESCRIPTION

The Applied Physiology concentration focuses on the study of physical activity behavior, physiological and psychological effects of acute and chronic exercise, how exercise influences physical and mental health, and on the promotion of physical activity in community, clinical and public health settings. The effects of exercise training on psychological and physiological processes, neuromuscular and biomechanical function, health, and physical and mental wellbeing are emphasized. Students can apply their academic work to jobs that involve exercise testing and training, including programs designed to improve health and physical fitness in healthy individuals and in people with or at risk for chronic illness or disability and in community, clinical, research, and public health settings. The program also may serve as a stepping-stone to medical, professional schools and doctoral studies.

The Master of Education program provides for advanced study in the movement sciences and for individually designed study to meet the student's professional needs and interests. This program is particularly recommended for students planning on future doctoral study and research careers and those planning to teach at the community college level. The Master of Education (Ed.M.) program emphasizes bridging science and practice and training in the conduct of research. The overarching objective of the program is to develop competence in practical

skills and critical thinking skills that facilitate applying scientific knowledge to practice within the student's professional field. The program can be individualized to cross the Movement Sciences.

In the Ed.M. program, students can focus on:

- Preparation as a "scholar of practice," able to translate research and theory into appropriate clinical or educational strategies;
- Preparation as a clinical instructor, clinical or educational supervisor, or research assistant/associate
- Preparation for study towards the doctoral degree (e.g., Ph.D., Ed.D., D.Ph., or M.D.)

The program requires a minimum of 60 points of graduate study and takes about two years of full-time study or three to four years of part-time study to complete.

The Program has five components:

1. Substantive study of theory and research as embodied in lecture and laboratory courses.
2. Development of clinical practice skills in laboratory and fieldwork courses.
3. Research training to enable students to read, interpret, and conduct original research.
4. Elective courses to meet specific needs, which may be taken throughout the Teachers College in an area of your choice.
5. A culminating project integrating material from your coursework.

## **PROGRAM REQUIREMENTS**

The Master of Education program in Applied Physiology requires a minimum of 60 points. These courses come from the required core courses, electives in movement sciences, research methods and statistics, and breadth elective courses taken outside of the program. In addition, students who enter the program without prior formal study in Kinesiology or in Movement or Exercise Sciences or closely-related field may be required to take coursework in addition to these program

requirements. All students must complete a final comprehensive integrative project. Students intending to continue study towards the doctoral degree or other professional program should arrange their Ed.M. program to include courses that may be required for doctoral or professional specialization. Some transfer credits from other graduate schools may be awarded for Master of Education students. Students are expected to consult the Registrar's Office website for additional information about degree requirements, policies and procedures(<http://www.tc.columbia.edu/registrar/pages/degree-information/degree-requirements/>).

The specific requirements for the Ed.M. program in Applied Physiology are described below:

### **Required Core Courses (minimum of 15 points)**

Students are required to complete all of the following courses with a grade of B or better. Students who earn grades B- or below will need to retake those courses and will be charged tuition again.

- BBSR 4095 Applied physiology I (3)
- BBSR 5094 Applied Physiology II (3)
- BBSR 4195 Applied physiology laboratory I (3)
- BBSR 5194 Applied physiology laboratory II (3)
- BBSR 5582 Research Design in the Movement Sciences (3) OR
- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences

### **Electives in Movement Sciences and Education (BBSR courses) (minimum of 12 points)**

Students are required to take at least four additional BBSR courses (for a minimum of 12 points) in addition to the core required courses. These electives may include, but are not limited to, the following BBSR courses:

- BBSR 4054 Anatomy and Physiology (3)
- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4050 Biomechanical Analysis of human movement (3)
- BBSR 4060 Motor learning (3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)

- BBSR 4090 Physical Fitness, Weight Control and Relaxation (2-3)
- BBSR 4900 Research and Independent Study in Movement Science and Education (1-3)
- BBSR 5057 Movement Disorders (3)
- BBSR 5200 Fieldwork in Movement Sciences and Education (1-3)
- BBSR 5028 Motor Development (2-3)
- BBSR 5050 Neurophysiology of motor control and electromyography (3)
- BBSR 5055 Basis of Motor Control (3)
- BBSR 5057 Movement disorders (3)
- BBSR 5095 Exercise and health (3)
- BBSR 5096 Advanced Exercise and Physical Activity Prescription (3)
- BBSR 5101 Scientific Basis of Exercise and Weight Management (3)
- BBSR 5151 Introduction to Programming for Signal Analysis of Biobehavioral Signals (3)
- BBSR 5195 Advanced applied physiology laboratory (3)
- BBSR 5595 Research seminar in applied physiology (1-3)

### **Elective Courses for Those Planning for Exercise Professional Certifications**

Any student considering taking a professional certification should discuss with AP faculty and also check the certification requirements posted by the certifying organization. Students in MA and Ed.M. programs in AP can meet the curricular requirements for the American College of Sports Medicine (ACSM) Certified Exercise Physiologist (EP-C) and Certified Clinical Exercise Physiologist (CEP) certifications, as long as they take certain elective courses in addition to the required core courses. The courses you elect will depend on the certification you select and your previous undergraduate study. For the Certified Strength and Conditioning Specialist (CSCS), there are no specific course requirements other than graduating or being enrolled in an accredited program (the AP program is accredited), however, there are elective courses that are recommended to help you prepare for the exam.

Further information about the CSCS certification can be found here: <https://www.nsca.com/cscsexam-prerequisites/#bd>

American College of Sports Medicine (ACSM) certifications requirements can be found here: <http://certification.acsm.org>

### **Research Methods and Statistics (minimum of 9 points)**

These courses may include, but are not limited to the following:

- BBSR 5582 Research Design in the Movement Sciences (3)
- HUDM4120 Basic concepts in statistics (if no undergraduate statistics) (3)
- HUD 4120 Methods of Empirical Research
- HUDM 4122 Probability and statistical inference (3)
- HUDM 4050 Introduction to Measurement
- HUDM 5122 Applied Regression Analysis (3)
- HUDM 5123 Linear Models and Experimental Design (3)
- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences and Education (3)
- MSTC 5001 Qualitative Research Methods in Science Education
- Other TC/CU graduate research methods/ statistics courses with approval of advisor

### **Research Seminar (minimum 4 points)**

Registration and attendance at research seminar is required for all Ed.M. students. Students should expect to register in seminar during all semesters when working on Integrative Final project, with at least two semesters required for a minimum of 4 points).

- BBSR 5595 Research seminar in applied physiology (1-3)

### **Breadth Courses outside of Movement Sciences and Education (a total 6 points).**

Breadth Elective Courses must be taken in any program or department at Teachers College, except Movement Sciences (BBSR). Please see the academic schedule and academic catalog for a full list of available courses. Popular breadth elective courses for students in Applied Physiology have included courses Health Education (HBSS), Nutrition (HBSV), Diabetes Education (HBSD), and Neuroscience and Education (BBSN). Please note that courses taken at Columbia Schools outside of Teachers College cannot count toward the breadth elective requirement, but they may count toward your degree if approved by your advisor, as long as other degree requirements are met. It is recommended that you discuss your electives with your advisor or program faculty for assistance in selecting courses that may contribute toward your educational and career goals. Courses outside of Movement Sciences (BBSR) that you use to fulfill core degree requirements and/or research methods requirements can also count toward the breadth requirement.

Here is a partial list of popular breadth courses in the Department of Biobehavioral Sciences to consider:

- BBS 5060 Neuromuscular responses and adaptation to exercise (2)
- BBS 5068 Brain and Behavior I: Communication in the nervous system (1-2)
- BBS 5069 Brain and Behavior II (1-2)
- BBSN 4001-4002 Foundations of Neuroscience I and II (3)
- BBSN 4000 Cognitive Neuroscience (3)
- BBSN 5122 Psychoneuroimmunology and Education

### **Recommended Background Courses for Students Entering without Prior Study in Kinesiology, Movement, or Exercise Sciences.**

It is recommended that students who come in without prior formal study in Kinesiology, Movement, or Exercise Sciences take one or more of the following courses in addition to the program requirements outlined above. Some of these courses can be taken in the summer so a Summer start in the program is strongly suggested. Students should consult with their program advisor about the advisability of taking these additional courses.

- BBSR 4054 Anatomy and Physiology (3)

- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4060 Motor learning (3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (3)
- BBSR 4090 Physical Fitness, Weight Control and Relaxation (2-3)

## **Integrative Final Project**

A year-long comprehensive integrative final project is required for the Ed.M. degree in Applied Physiology. The planning to complete the integrative project should be made early in the program in consultation with your advisor or program faculty, as this takes at least two semesters to complete and requires registration in BBSR 5595 Research seminar in applied physiology for at least 2 semesters (during the proposal development and writing phase on the project).

The Integrative Final Project may consist of one of the following:

- A scholarly systematic review of research in applied physiology and movement sciences
  - An educational project including the development of an assessment instrument/ method for clinical or educational practice or a presentation for a continuing education, health promotion or physical activity program
  - An applied research project under the mentorship of a doctoral student or program faculty member
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## **About the Doctoral Programs**

In the preparation of doctoral students, the goal is to develop those competencies necessary to pursue scholarly and scientific work and to formulate strategies to enhance professional practice. Formal admission to the doctoral program is based upon level of achievement in coursework and seminars; demonstration of research competence; a research direction compatible with faculty and laboratory resources; and signs of professional promise. A list of current research projects in Applied Physiology can be obtained from the program coordinator.

Applicants for the Ed.D. degree are reviewed on an ongoing basis throughout the academic year. However, consideration for general and diversity awards is given to those applicants who meet the early application deadline. See the Admissions section of this bulletin for details. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted. Applicants for the Ph.D. in Kinesiology are reviewed once a year subsequent to the December 15th application deadline.

Specialization in Applied Physiology, Motor Learning and Control, or Physical Education is required for the doctoral program in these areas. Within each area of specialization, students prepare course and laboratory projects, research papers, and other materials appropriate for their projected professional activities. The program requires a minimum of 90 points of graduate study.

The doctoral program prepares individuals for leadership roles in the movement sciences and in the fields of physical education, nutrition, dance education, and rehabilitation (occupational, physical and respiratory therapy). Graduates have assumed positions as faculty members and program directors in universities and colleges; as researchers in educational, clinical, or biomedical settings; and as administrators, supervisors, or consultants in clinical or educational facilities. Preparation focuses advanced study and research training within the specialization.

#### **Special Application Requirements, Applied Physiology Programs:**

While students have come from a variety of fields, the following backgrounds are most appropriate: kinesiology, movement sciences, exercise science, physical therapy, occupational therapy, physical education, athletic training, biology, nutrition, nursing, and psychology. Students with strong academic records who have deficiencies in their science backgrounds may be admitted on a provisional basis with the understanding that these deficiencies will be remedied with appropriate courses taken in addition to those required for the M.A. degree. It is strongly recommended that students without undergraduate coursework in anatomy and physiology (usually a two-semester sequence with laboratory) take these courses prior to entering the program. It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the College to meet with faculty. If desired, it is possible to audit a class or seminar session during

your visit. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

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## **Doctor of Education: Applied Physiology**

The goal of the Doctor of Education with specialization in Applied Physiology is to prepare doctoral students to pursue scholarly and scientific work. Students are expected to contribute significantly to the completion of at least one comprehensive research project prior to initiation of their dissertation proposal. The skills developed during completion of this project will enable students to carry out their dissertation projects independently. Students are encouraged to present the work leading up to the dissertation proposal at national meetings and to contribute to the publication of results in peer-reviewed journals. Research may be completed in the applied physiology laboratories at Teachers College or in another clinical/research setting. If the work is completed outside of Teachers College, students are expected to work closely with their advisor and demonstrate that they have contributed significantly to the completion of the required projects. All work (either at Teachers College or outside of the College) must be developed and completed in close conjunction with advisement of Applied Physiology Program faculty. The preliminary work may be published prior to graduation, but the final study may only be published upon completion of the degree. All Ed.D. students are encouraged to write a grant to obtain pre-doctoral fellowship funding to support their research and to provide some training in grantsmanship.

### **Admission**

*Applicants are expected to satisfy the following requirements for admission:*

1. Prior completion of both a bachelor's and master's degree program (with a major in movement sciences or closely related field at either or both levels). Students who have deficiencies but who are otherwise qualified are encouraged to apply to the Masters of Education Program to complete deficiencies.
2. A record of superior academic achievement as evidenced by the grades received in undergraduate and graduate course work.

3. Letters of recommendation from persons familiar with the candidate's academic and professional achievements should attest to the applicant's capability for successful doctoral study.
4. The applicant's written personal statement (accompanying the application) should provide evidence of the ability to communicate effectively in writing and should provide an initial indication that the program is compatible with his or her professional goals. A key part of the admissions process is a research interest compatible with a faculty member in the Movement Sciences.
5. Each applicant should submit one additional writing sample, such as a term paper, thesis, or published article, so that academic writing skills can be assessed. In cases where a thesis is in progress, a research proposal may be acceptable at the discretion of the faculty.
6. In most cases, an interview will be required to clarify any unresolved issues related to the applicant's qualifications and interests and to make certain that the area of study is compatible with the applicant's professional goals and that the area of research interest can be supported by a faculty member in Movement Sciences. In instances where applicants are a long distance from campus, telephone interviews, videoconferences, or interviews at professional meetings may be scheduled.

### **Advisement and Program Planning**

Prior to registration, newly admitted doctoral candidates meet individually with their faculty advisor to plan the initial phases of their programs. A tentative plan for the first year or two of study is developed—subject to change as the need arises. Part-time and full-time programs are arranged depending on the student's circumstances. At an early stage in the planning process, students develop a written plan for meeting program objectives that allows adequate time for graduate study during each semester of enrollment and provides for meeting all program requirements within a reasonable period of time. This plan, together with an official program plan, is filed with the Office of Doctoral Studies. Individual advisement meetings are scheduled frequently throughout the student's tenure in the program and may be initiated by either the student or faculty member. These meetings may be used to plan programs, provide feedback, review past work, deal with school related problems, discuss research, career planning, or discuss other issues.

For the doctoral program in Applied Physiology, specific course requirements (or equivalents transferred from previous graduate study) include

- 1) All coursework required for the Ed.M. degree, plus:
- 2) Registration in BBSR 5595 every semester in attendance (1 point)
- 3) Minimum of 15 points in Research Methods and Statistics
- 4) Minimum of 9 points in substantive study in movement sciences
- 5) Additional courses required to achieve research and career goals

### **Certification**

When students have completed approximately 60-65 of the total points required for the Ed.D. degree, they are evaluated for "certification," a stage of doctoral study which represents full candidacy for the degree. To achieve certification, the student must complete the certification examination, which is a written comprehensive examination covering the scientific literature on three areas related to the student's selected research specialization area, a literature review, and submit a plan for meeting total program objectives. A review committee assesses the student's entire record. The decision of the committee is then forwarded to the Teachers College Ed.D. Committee for final action on the candidate's certification.

### **Dissertation**

Each student completes a dissertation that focuses on a research question in applied physiology. Through course work, the research seminar, working as an apprentice in the research of faculty and more advanced students, and pilot studies, students develop the skills to complete the dissertation. Many types of questions and methodologies, appropriate to applied physiology research, may be employed in completing the dissertation. The dissertation research is expected to address a complex research problem and to be of sufficient quality to result in at least three publications to be published in a top journal.

Throughout the process, the student works closely with his or her advisor on the design and conduct of the doctoral dissertation. Thereafter the student works under the supervision of a dissertation committee until the dissertation is completed. Once the dissertation is successfully defended, it is expected that students will share what they have learned by presenting at professional meetings

and publishing one or more articles.

## Degree Policies

**Statement of satisfactory progress:** Students are expected to make satisfactory progress toward the completion of degree requirements. Program faculty will annually review each student's progress. Please note that satisfactory performance in the applied physiology program is defined as no Incomplete grades and no BBSR or BBS courses in which the grade earned is lower than B. Doctoral students generally are expected to have grades of B or better in coursework in research methods, statistics, and cognate areas.

Where there are concerns about satisfactory progress, students will be informed by the program faculty. If a student is performing below expectations, he / she may be required to complete additional course work. The program will provide a plan and timeline for remediation so students know the expectation for them to continue in the program. If satisfactory progress is not maintained, a student may be dismissed from the program.

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## Doctor of Education: Motor Learning and Control

### Doctor of Education: Motor Learning and Control

Motor Learning & Control focuses on the behavioral, biomechanical, and neural bases of development, acquisition, and performance of functional movement skills. Acquisition of skill is examined over the life span in typically developing children and adults and individuals with movement disorders. Movement analysis is used to elucidate the neuromotor control processes underlying skilled performance in everyday functional behaviors. The teacher or therapist's role in facilitating skill learning and performance is emphasized.

This specialty has five components:

- Substantive study of theory and research as embodied in lecture and laboratory courses.
- Development of clinical or educational skills in laboratory and fieldwork courses.

- Research training to enable students to read and interpret original research and to carry out educational, clinical, or laboratory research.
- Seminars to discuss theory and research, identification of research problems, and clinical/educational applications.
- Elective courses to meet specific student needs which may be taken throughout the College and University in such areas as Anatomy, Biology, Business, Chemistry, Computer Science, Health Education, Higher and Adult Education, Neurosciences, Nutrition, Physiology, Psychology, and Science Education. A list of recommended elective and related courses is available to students in the Movement Science office.

In the preparation of doctoral students, the goal is to develop those competencies necessary to pursue scholarly and scientific work and to formulate strategies to enhance professional practice. The focus of the Ed.D. program is to prepare leaders of applied research for clinical and educational practice. Graduates often assume positions in clinical academic departments or teaching universities.

Research training uses an apprenticeship model. Students work closely with faculty throughout their preparation: initially as apprentices with access to considerable Advisement, subsequently as collaborators, then progressing to a position as independent researchers.

Typically, the dissertation research is an extension of one or two prior studies. Often, research leading up to the dissertation is presented at national meetings or is published in professional journals.

In addition to substantive study and research preparation, students are expected to design an individual program representing their research area and professional concerns. Such preparation requires a significant commitment to graduate study. Doctoral students are required to be engaged in research at least three weekdays per week (on- or off-site) and be available for advisement at least two mornings or afternoons.

For the doctoral program with specialization in Motor Learning, specific course requirements (or equivalents transferred from prior graduate study) are:

## **Substantive Study (23 Credits)**

**BBS 5060** Neuromuscular response and adaptation to exercise (2 points)

**BBS 5068** Brain and Behavior I: Communication in the nervous system (2 points)

**BBSR 5055** Bases of motor control systems (3)

**BBSR 5582** Research design in the movement sciences (3 points).

**BBSR 4060** Motor learning (3) \*

**BBSR 4161** Motor learning laboratory (2 with *co-requisite BBSR 4060*) \*

### **BBSR 4151 Laboratory methods in biomechanics (3)**

**BBSR 5028** Motor development across the lifespan (3 points)

**BBSR 4050** Biomechanical analysis of human movement (3 points)

**BBSR 5151** Introduction to the analysis of biomechanical signals (3)

**BBSR 5504** Research Training Seminar (Section 02) (2-3 points each semester, continuous enrollment required until completion of degree requirements, typically 18 points)

### **Four courses (12 points) selected from:**

**BBSQ 4047** Early motor behaviors in children: normal and abnormal

**BBSR 4055** Neuromotor processes (3)

**BBSR 4070** Introduction to Psychosocial Aspects of Sport/Exercise

**MSTC 5000** Neurocognitive models of information processing (1-3)

**BBSR 5050** Neurophysiology of motor control and electromyography (3)

**BBSR 5057** Movement disorders (3)

**BBSR 5251** Fieldwork seminar in motor learning and motor control (1-2)

### **Three topical seminars (9)**

**BBSR 5596** Topics in applied physiology (3)

**BBSR 6563** Seminar in neuromotor processes (3)

- BBSR 6564** Advanced topics in neuromotor processes (3)
- BBSR 6565** Seminar in motor learning and motor control (3)
- BBSR 6571** Research seminar in the psychosocial aspects of human movement (3)

**Statistics sequence minimum (9)**

- HUDM 4122** Probability and statistical inference
- HUDM 5122** Applied regression analysis
- HUDM 5123** Linear models and experimental design

**Two courses in educationally-relevant areas must also be selected from the list below or substituted with advisor permission (6)**

- C&T 4004** Basic course in school improvement (3)
- C&T 4052** Designing curriculum and instruction (3)
- C&T 4078** Curriculum and teaching in urban areas (3)
- C&T 4114** Multicultural approaches to teaching young children (3)
- C&T 4159** Teacher education programs (3)
- C&T 5020** The environments of school (3)
- ORLD 4010** Purposes and policies of higher education (3)
- ORLD 4011** Curriculum and instruction in higher education (3)
- ORLD 4040** The American college student (3)
- ORLD 4820** Cultural diversity training in higher education settings: Issues and concerns (3)
- ORLD 4830** Transforming the curriculum: Theory and practice (3)

**Individual program and electives (17)**

## Service Requirements:

- **Teaching Assistantships** Program faculty believe strongly in the value of assistant teaching (TA'ing). TA'ing can provide students with valuable opportunities to learn new material, review material previously acquired and obtain teaching skills and materials. The objective of the required teaching assistantship is to provide Ed.D. students with a quality learning experience that will benefit them regardless of whether they pursue academic or nonacademic careers. Doctoral students are *required* to serve as a teaching assistant for one Masters level course before graduating (whether in a paid or non-paid capacity). Every effort will be made to match student preferences with available opportunities, but students should expect that they may not always receive their first preference. Beyond this, additional teaching assistantship opportunities may be available for more advanced courses.
  - **Graduate Study/Clinical Practice Traineeships** are available for *occupational and physical therapists* enrolled in or admitted to degree programs in Movement Science. They are offered in collaboration with several clinical agencies located in the metropolitan New York area that provide services to diverse groups including pediatric, adult, and geriatric clients. These traineeships involve up to 20 hours per week in a clinical setting and provide stipend and tuition benefits. International students may qualify, contingent on obtaining appropriate New York State clinical licensure. The latter may take up to 12 months so interested prospective students should contact the coordinator as soon as possible during the application process. The instructional staff in Movement Science provides clinical supervision. A case study approach is used to directly bridge between substantive study and clinical practice. For more detailed information, contact the Coordinator of Clinical Traineeships at (212) 678-3325.
  - **Part-time paid research or laboratory assistantships** may be available for students in their middle to advanced stage of study.
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## Doctor of Philosophy: Kinesiology

### Doctor of Philosophy: Kinesiology

We offer a full-time PhD in Kinesiology with students specializing either in motor learning and control, applied physiology or physical education. The Ph.D. program requires a full-time commitment to graduate studies and students should not expect to hold outside employment during their studies. This commitment will ensure that advisement, research activities, and course work can be completed to the degree of competence that is expected in a research-intensive degree program. The degree of Doctor of Philosophy emphasizes research and intensive specialization in a field of scholarship.

The minimum requirements for the Ph.D. degree in Kinesiology are: satisfactory completion of a planned program of 75 graduate points beyond the Baccalaureate; submission of a statement of total program indicating periods of intensive study subsequent to the first year of graduate study which accompanies the program plan of study; satisfactory performance on a departmental Certification Examination; and preparation and defense of a research dissertation. In addition, doctoral students in Kinesiology are expected to complete a sequence of three research studies, or the equivalent, to meet degree requirements. Relevant courses completed in other recognized graduate schools to a maximum of 30 points, or 45 points if completed in another Faculty of Columbia University, may be accepted toward the minimum point requirement for the degree. Each degree candidate must satisfy departmental requirements for the award of the M.Phil. degree prior to continuance in the Ph.D. program. These degree requirements are specified in the Requirements for the Degree of Doctor of Philosophy Bulletin, obtainable from the Office of Doctoral Studies. Each student and his or her advisor develop a program that will help the student meet his or her goals and successfully complete the series of studies that meets the research requirements of the program.

For more information about special application requirements, program description and degree program requirements for the Ph.D. program in Kinesiology, contact Professor Gordon at [msnsprogram@tc.edu](mailto:msnsprogram@tc.edu)

# Application Information

While students come from a variety of fields, the following backgrounds are most appropriate: kinesiology, movement sciences, exercise science, physical therapy, occupational therapy, physical education, athletic training, biology, nutrition, nursing, health education, public health, and psychology. Students with strong academic records who have deficiencies in their science backgrounds, may be admitted on a provisional basis with the understanding that these deficiencies will be remedied with appropriate courses taken *in addition to* those required for the MA degree. It is strongly recommended that students without undergraduate coursework in anatomy and physiology (usually a two-semester sequence with laboratory) or exercise physiology take these courses or their equivalent prior to entering the program.

It is recommended that prospective students communicate with an academic advisor to discuss program plans prior to admission. Students are encouraged to make an appointment to visit the College to meet with faculty. If desired, it may be possible to audit a class or seminar session during your visit. Applicants are reviewed on an ongoing basis throughout the academic year. Prior to formal admission, enrollment in up to 8 points of study as a non-matriculated student is permitted.

## Faculty List

### Faculty

LAURA AZZARITO

Associate Professor of Physical Education

ANDREW MICHAEL GORDON

Professor of Movement Sciences

JOSEPH T CICCOLO

Assistant Professor of Applied Physiology

LORI QUINN

Associate Professor of Movement Science  
& Kinesiology

CAROL EWING GARBER

Professor of Movement Sciences

### Visiting Faculty

JEFFREY SCOTT MELENDEZ

Adj/PTVisiting Prof/PTLecturer Physical  
Education 111717-6139

**Adjunct**

PAUL MICHAEL GALLO

Adjunct in Applied Physiology

TERRY R KAMINSKI

Adjunct Assistant Professor of Movement  
Sciences

RICHARD MAGILL

Adjunct Full Professor of Motor Learning  
and Control

JENNIFER F. RASMUSSEN

Adjunct Assistant Professor in Physical  
Education

**Instructors**

STEPHEN SILVERMAN

Professor of Education

MICHAEL ANTHONY SOUPIOS

Instructor

## Course List

### **BBS 5060 Neuromuscular responses and adaptation to exercise**

A review of the physiology of muscle contraction in addition to in-depth discussion of topics related to the field which include: the relationship between muscle activation and respiration during exercise, muscle fatigue, eccentric versus concentric contractions and adaptation to strength training.

### **BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences**

The course provides students with techniques and strategies for collecting, analyzing, and reporting data from a qualitative perspective. Students will be able to consider various research issues when working with different populations in various contexts, such as schools, clinical settings, health contexts, families, communities, or other organizations.

### **BBSR 4002 Visual Methods and Education**

This seminar-style course has been designed to help students develop a critical understanding and appreciation of the theory, methodology, and foundation of qualitative visual research methods in an applied context.

### **BBSR 4005 Applied anatomy and biomechanics**

Topics include: gross anatomy and function of human skeletal and muscular systems, mechanics of human movement, and analysis of skills in dance and physical education. Designed primarily for students without a prior course in anatomy or biomechanics. Students will be expected to participate in a laboratory offered immediately preceding the scheduled class time. Lab fee: \$50.

### **BBSR 4050 Biomechanical analysis of human movement**

Permission required. Covers the principles and techniques required to analyze human movement, which can be used to develop practical research questions. Quantitative and qualitative techniques for analysis of movement are discussed in relation to the study of learning, motor control, motor development, and motor impairments. Lab fee: \$100.

### **BBSR 4060 Motor learning**

Study of factors relating to the acquisition and performance of motor skills.

Includes review and analysis of appropriate research findings.

### **BBSR 4070 Introduction to the psychosocial aspects of sport and exercise**

The purpose of this course is to provide the student with an in-depth and comprehensive understanding of the psychological and social processes in exercise, sport, and physical activity. The focus is on the key theoretical psychosocial principles that are well known to govern exercise and sport behavior, including the physical, affective, and cognitive aspects. The course explores theoretical, methodological, and applied approaches to a variety of topics including stress, cognition, mood, emotion, perceptions of the self, mental illness, exercise adherence, drug use and addiction, self-regulation and self-control, motivation, goal setting, arousal and performance, group dynamics, coaching, and burnout.

### **BBSR 4080 Teaching in Physical Education**

Constructivist pedagogies in Physical Education

### **BBSR 4090 Physical fitness, weight control, and relaxation**

Contributions of exercise to human well-being throughout life. Classroom, gymnasium, and laboratory experiences included. Designed for teachers, counselors, and others who desire an introduction to basic concepts of physical fitness.

### **BBSR 4095 Applied physiology I**

Prerequisite: a course in human physiology. Physiological bases of exercise.

Lectures concerning the effects of exercise on the major physiological systems (cellular, cardiovascular, thermoregulatory, pulmonary, renal, body fluids, hormonal).

### **BBSR 4151 Laboratory methods in biomechanics**

Permission required. Enrollment limited. Prerequisite: BBSR 4050. Students develop technical skills in the application of biomechanics to the study of movement behavior including video-based data collection and computer-based kinematic analysis. Students design and conduct a pilot research study using biomechanical analysis of a functional movement. Special fee: \$100.

### **BBSR 4161 Motor learning laboratory**

An introduction to qualitative and quantitative analysis of movement and action during acquisition of functional skills. Course fee \$100. Corequisite: BBSR 4060.

### **BBSR 4700 Student teaching in physical education**

Student teaching in both elementary and secondary schools for a full semester.

Includes a required seminar.

### **BBSR 4861 Workshop in motor learning and control**

Students carry out a case study of skill acquisition in a functional movement task and integrate qualitative and quantitative findings in a final essay, characterizing the learning process.

### **BBSR 5028 Motor development across the lifespan**

Review and analysis of theoretical models and experimental research related to development and performance of motor skills throughout the lifespan.

### **BBSR 5040 Curriculum designs in physical education**

Review of existing curriculum designs, traditional and new. Systematic development of curriculum plans.

### **BBSR 5041 Analysis of teaching in physical education**

An analysis of the decisions and actions of teachers in relation to their role as director of learning. Includes experiences in executing and analyzing teaching skills.

### **BBSR 5050 Neurophysiology of motor control and electromyography**

Review and analysis of theoretical models and experimental research related to development and performance of motor skills throughout the lifespan.

Advanced topics dealing with the experimental and clinical use of electromyography. Topics will be integrated with the kinematics of movements being observed. A laboratory project using EMG will be required. Lab fee: \$50.

### **BBSR 5055 Bases of motor control systems**

Study of control processes subserving the coordination of movement.

### **BBSR 5095 Exercise and health**

The role of exercise in diagnosis, prevention, and rehabilitation of health problems such as cardiovascular disease, pulmonary disease, diabetes, obesity, and stress. Scientific evidence from both epidemiological and applied practice perspectives are emphasized.

### **BBSR 5120 Critical Issues in Physical Culture**

This course broadly looks at socio-historical and educational issues of social justice in sports, exercise, fitness, and physical education. It offers a sociological, pedagogical, and critical inquiry into the study of human movement.

### **BBSR 5151 Introduction to the analysis of biomechanical signals**

Introduction to MATLAB programming with a focus on variables, conditional statements, loops, data visualization, basic algorithm development, and Graphical User Interfaces (GUIs). Concepts and techniques used in the analysis

of biomechanical/biological signals will be applied to kinematic/physiological data (e.g., electromyographic, kinetic, accelerometer, heart rate data, etc.) using MATLAB. Applications of MATLAB extend to the analysis of all types of quantitative data. Thus, students with data from other sources are welcome to use their own data for course assignments. Interactive lectures and weekly labs are intended for students across disciplines to develop the skills required to use MATLAB in their own research.

### **BBSR 5194 Applied physiology laboratory II**

The discussion and practice of techniques for collection and analysis of physiologic data (strength testing, electromyography, computerized data acquisition). Lab fee: \$100.

### **BBSR 5195 Advanced applied physiology laboratory**

Prerequisite: BBSR 5194. Introduction of advanced physiologic measurement techniques and concepts. Included are indirect calorimetry, spectrophotometry, vascular volume dynamics, autonomic reflexes, thermoregulation, noninvasive cardiac output, computer data plethysmography, tonometry, acquisition, and post-acquisition analyses. Lab fee: \$100.

### **BBSR 5200 Fieldwork in movement science and education**

Permission required. For advanced students prepared to investigate problems.

### **BBSR 5251 Fieldwork seminar in motor learning and motor control**

Applications of theory/research to therapeutic or educational practice for students in field-based settings.

### **BBSR 5504 Research training in motor learning**

Permission required. A competency-based approach to the preparation of researchers in the areas of neuromotor control and perceptual-motor processes. Several learning experiences are offered each semester, involving lectures, laboratory practica, seminars and individual research advisement. Course fee \$175

### **BBSR 5543 Seminar in Physical Education**

Examination of current issues in curriculum and teaching in physical education relative to diverse student populations and associations with other disciplines.

### **BBSR 5582 Research design in movement science and education**

Basic concepts of research design and statistical analysis. Students learn to interpret articles and design projects.

**BBSR 6201 Supervision of educational or clinical practice in the movement sciences**

Permission required. Corequisite: Actual supervisory experience during that semester. For doctoral students in the movement sciences. Field-based experiences in the guidance of therapists or educators engaged in applying the movement sciences to clinical practice.

**BBSR 6900 Supervised independent research in movement science and education**

Permission required. For advanced students who wish to conduct research under faculty guidance.

**BBSR 7500 Dissertation seminar in movement science and education**

Permission required. Candidate develops proposal for doctoral dissertation in consultation with advisor. Seminar convenes only on days when candidates present proposals for approval.

**BBSR 8900 Dissertation advisement in movement science and education**

Individual advisement on doctoral dissertations. Fee to equal 3 points at current tuition rate for each term. For requirements, see section in catalog on Continuous Registration for Ed.D./Ph.D. degrees.

# Neuroscience and Education

## Department of - Biobehavioral Sciences

### Contact Information

**Phone:** (212) 678-3325

**Fax:** (212) 678-3322

**Email:** [msnsprogram@tc.columbia.edu](mailto:msnsprogram@tc.columbia.edu)

**Director:** Professor Peter Gordon

## Program Description

Neuroscience and Education was the first graduate program in the country to focus on the educational and clinical implications of recent advances in understanding brain-behavior relationships. One objective of the multi-disciplinary program is to prepare a new kind of specialist: a professional with dual preparation able to bridge the gap between research underlying brain, cognition, and behavior, and the problems encountered in schools and other applied settings. A second objective is to provide rigorous training and relevant experiences that would allow students to further their knowledge and make links between neuroscience, cognition, education, and clinical practice. The M.S. program is intended for professionals and non-professionals alike who would like to acquire knowledge in fields related to neuroscience and to participate in ongoing research, educational, or clinical practice. Graduates from the program may continue in their respective areas of professional specialization, while others develop careers in research settings or apply to doctoral programs for further study.

## Degree Summary

Neuroscience and Education (NEUR)

- Master of Science (M.S.)

For a complete listing of degree requirements, please continue on to this program's "Degrees" section in this document

# Degree Requirements

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## **Master of Science (M.S.)**

The program of study for the M.S. in Neuroscience and Education offers a systematic sequence of courses within the neurosciences.

- Basic courses provide a thorough introduction to the neural bases of behavior.
- Courses in research methods in behavioral and brain-based research, and data analysis
- Advanced courses and breadth courses explore implications of brain-behavior research for educational and clinical practice.
- Supervised practica enable students to engage in ongoing research projects in neuroscience-related fields or to be involved in neuropsychological assessments and interventions
- Students finish their studies by developing an integrative project as a formal thesis

### **Basic things to know about registration and course requirements:**

1. The MS degree requires that you take 32 graduate degree credits at Columbia University, a minimum of 20 of which must be taken at Teachers College. This means that, if you wish to, you can take up to 12 of your credits at other locations in the university such as Columbia Graduate School of Arts and Sciences (GSAS), Columbia Medical School (College of Physicians and Surgeons), etc. For example, courses taken in the Psychology Department on the Main Campus are GSAS rather than Teachers College. Such courses must be registered through TC, but require permission of the instructor, so make sure you are prepared in advance. Columbia College undergraduate courses at the entry level (1000, 2000 level) cannot be used to fulfill graduate degree requirements. Advanced undergrad courses (3000 level) can be petitioned for program course credit with the Registrar, but approval is not automatic. Graduate courses (4000 and above) can count for credit in the program. If you are considering enrolling in advanced graduate courses in neuroscience,

biology, etc. outside of TC, please be sure that you have the sufficient prerequisites and background training to handle the content. Many of these courses are very rigorous, requiring a solid preparation in the area of study. If in doubt, be sure to consult with the instructor and with your academic advisor.

2. The program requirements consist of the following. Please note that requirements may overlap, and individual courses may satisfy multiple requirements:

**A. Core Requirements: At least 20 credits of courses in BBSN Neurosciences courses (includes BBSN methods courses).** These are primarily offered in the Neuroscience and Education program (BBSN prefix).

- **In their first Fall Term** students should take *BBSN 4001 Foundations of Neuroscience I: Anatomy and Physiology*, and *BBSN 4002 Foundations II: Systems Neuroscience*. These courses will be offered twice a week for the first and second half of the term, respectively. In addition, students should take *Neuroscience Methods* (*BBSN 4005*).
- *Students with very strong preparation in neuroscience (e.g., neuroscience undergraduate majors) may test out of some of the foundation courses, but it is expected that most students will take this sequence regardless of their previous training. If you wish to test out please contact Dr. Alisha Holland.*
- **In the Spring Term**, *BBSN 5044, Current Issues in Neuroscience and Education* is required for all students in the program. Students should also take *BBSN 5003, Cognitive Neuroscience* and / or *BBSN 5070 Developmental Cognitive Neuroscience* unless they have previous training in these areas.
- Students entering the program in the Spring or Summer Term should take breadth and methods courses, and begin the foundational sequence in their first Fall Term. Do not take Brain and Behavior I or II for intro courses, since these are not tailored for neuroscience students.

**B. At least 9 credits in Methods and Data Analysis.** Methods courses offered in the Neuroscience program (BBSN) count toward both A. and B. requirements here. Previous undergraduate or graduate coursework in this area may be petitioned to fulfill these requirements, but credits cannot be transferred from other institutions. For example, the methods requirement might be reduced to 6 credits if the student has previously taken a Statistics sequence. Please consult your advisor if you wish to fulfill requirements in this way. Courses for this component can include *BBSN 4005 Research Methods in Neuroscience*. Other courses that satisfy this component

include methods courses involving EEG, fMRI, neuropsychological testing, eye tracking (see course listing below.) In addition, statistics courses offered in the measurement program (HUDM) would satisfy this requirement. If you have no previous training in statistical methods, we highly recommend that you take the master's-level courses offered.

- **fMRI training:** Students who wish to obtain hands-on training in fMRI methods are encouraged to enroll in the one week workshop offered by the Martinos Center in Boston. Optional credit for this training may be obtained by registering for practicum credits, but students will also need to pay the \$1000 student fee for the workshop itself.

**C. Breadth Courses:** At least 6 credits of breadth courses outside of BBSN. Most *out of program* courses (i.e., non BBSN) qualify for this requirement, and students should consider more than the minimum 6 credits to combine a content area with their neuroscience training. Teachers College presently requires that two breadth courses (6 credits) must be taken at Teachers College outside of BBSN although Biobehavioral Science courses with prefixes: BBSQ (Communication Sciences & Disorders), BBSR (Movement Science) count as breadth courses.

**D. Psychology Requirements:** Students who have not previously taken courses (undergraduate or graduate) in Developmental and Cognitive Psychology should register for courses in these areas as part of their breadth requirements, typically offered in Human Development/Cognitive Science in Ed. (HUDK XXXX). Cognitive Neuroscience (BBSN 5003) and Developmental Cognitive Neuroscience (BBSN 5070) may also be used to satisfy this requirement.

**E. The Integrative Project** is required to be completed by all students before graduation. This is a journal-style article in APA format that either reports on research conducted during training or practicum, or is a review article that consists of an integrated analysis of an area of focus. Review articles should be proposing a hypothesis or point of view in the analysis and should not just be a listing or previous research in the area. The review-format may also include research proposals for specific experiments to address questions raised in the analysis, but

this should be an addendum to the review section itself, not the main content. Students are strongly encouraged to enroll in **BBSN 5500 Neuroscience and Education Capstone** in their final Spring Term. This course provides guidance and feedback in the development and writing of the integrative project. Students who are receiving guidance from other faculty members that they are working with do not need to take this course. Also, students who are co-authors on a journal article resulting from practicum experience during their studies at TC may submit the article in lieu of their integrative project, but they must have been actively involved in the writing of the article.

**F. BBSN 4904** is strongly recommended for all students, especially those pursuing a research/scientific approach to their studies. Typically this consists of working/volunteering in a research lab or treatment center in the city or elsewhere. Such experiences can be very rewarding and are extremely useful for future employment and can often lead to publications if the student is highly engaged in a lab project. Students who are engaged in practicum should register for the practicum for 0-3 points. A zero-point enrollment allows the student to get credit for participation without paying tuition.

## G. Careers in Science

*The goal of the Careers in Science course is to introduce students to the options available for a career in science after you complete your graduate degree at TC. This is an interactive series where students get to ask questions related to their specific interests, share information about potential career and educational opportunities, and learn from past TC students/peers about their diverse and interesting professional endeavors after completing their Masters in Neuroscience and Education. After completing the series, students are expected to have an understanding of what a career in the sciences in academia entails, how to apply for a PhD program, and what alternative careers exist in science. Students will also complete a template for professional documents including a cover letter, a CV, a resume, and an introduction email that can be customized for future needs. As part of a group assignment, students will serve as, and benefit from, peer reviewers to provide feedback and advice on the professional documents created in the series.*

This course will be offered on 4 Saturdays during the Fall Term and may be taken for 1 credit.

## **EXCLUDED COURSES:**

*Undergraduate courses generally cannot count toward the graduate degree (as noted above.) Courses that do not fulfill the program aims of connecting neuroscience to a content area may not count toward the degree. Also, courses that offer non-traditional or alternative approaches to neuroscience may not be allowed to count toward your degree if they are not considered by program faculty to be scientifically rigorous. Students should consult with their advisor if in doubt.*

Please note that to remain in good standing, students are expected to obtain a grade of B or better in the intro-level courses in neuroscience (*Foundations I and II*, and *Cognitive Neuroscience/Developmental Cognitive Neuroscience*). Students who fail to obtain a B grade in these courses will be required to repeat them or retake relevant exams with the agreement of the instructor. **Advanced students (those with previous neuroscience degrees) may take Neuroscience courses outside of TC upon approval.**

# Application Information

Applications will be considered throughout the year. Applications are available online by clicking on “Prospective Students” on the TC main website. GRE scores are not required but may be submitted by the applicant if available.

## Faculty List

### Faculty

LISA A EDMONDS

Associate Professor in Communication Sciences and Disorders

KAREN FROUD

Associate Professor of Speech & Language Pathology

ANDREW MICHAEL GORDON

Professor of Movement Sciences

PETER GORDON

Associate Professor of Neuroscience and Education

### Lecturers

ALISHA C. HOLLAND

Lecturer

### Adjunct

ANLYS OLIVERA

Adjunct Assistant Professor

ERIKA SHIELD LEVY

Associate Professor in Communication Sciences and Disorders

KIMBERLY G NOBLE

Associate Professor of Neuroscience and Education

STEPHEN ALAN SANDS

Adjunct Associate Professor of Neuroscience

## **Course List**

### **BBS 5069 Brain and behavior II: Perception, emotion, memory and cognition**

An introduction to brain processes associated with perception, emotion, memory and cognition. Consequences of damage to these neurobehavioral processes are examined through reading and discussion of clinical case studies.

### **BBSN 5010 Neuroscience of Reading**

This is a one-semester introduction to the neuroscientific investigation of reading, its development, and its disorders. Theoretical frameworks are outlined to provide a foundation for discussion of the neurological underpinnings of sub-processes in reading. Experimental findings from the field of neuroscience are presented to provide information about the organization of these sub-processes across the lifespan and across linguistic communities. Developmental and acquired disorders of reading are discussed, and the influence of neuroscientific investigations on remediation and intervention is described.

### **BBSN 4001 Foundations in Neuroscience I: Anatomy & Physiology**

This course provides an introduction to the mammalian nervous system with emphasis on the structure and function of the human brain. The course is intended to provide foundational knowledge for students with little or no background in neuroscience. Topics to be covered include the function of nerve cells, intra and intercellular communication, and the anatomy of the human nervous system. Note that this is a half-semester course.

### **BBSN 4002 Foundations in Neuroscience II: Systems Neuroscience**

This course provides an introduction to the systems of the mammalian brain, with emphasis on the structure and function of the human brain. The course is intended to provide foundational knowledge for students with little or no background in neuroscience. Topics to be covered include sensory and motor systems, as well as the circuitry underlying complex behaviors including motivation, emotions, and memory. Note that this is a half-semester course.

### **BBSN 4005 Research Methods in Neuroscience**

This course is intended to provide an overview of the scientific methods used in the field of neuroscience. We will be discussing the basic tenets of

experimental design and statistical analysis as they are used by all behavioral and cognitive scientists. We also will work to apply those design and analysis concepts to the specific methodologies used by neuroscientists.

### **BBSN 5500 Neuroscience and Education Thesis Capstone**

This course is intended to guide students through the process of developing a written thesis, one of the degree requirements for the Neuroscience and Education program. The thesis will be written as a journal-style article in APA format that either reports on research conducted during training or is a review article that consists of integrated analysis of an area of focus.

### **BBSN 4904 Research practicum and independent study: Neuroscience and Education**

Students may register for this course if they are involved in a practicum experience such as working in a lab, an educational setting, or clinical treatment setting doing research independently, such as research toward writing the thesis. The course also covers students who are taking external workshops such as brain imaging courses at the Martinos Center. The course can be registered for 0 to 3 credits depending on the level of commitment and/or financial constraints --registering for zero credits is at no tuition cost to the student.

### **BBSN 5000 Electroencephalography (EEG) Lab Methods**

This course provides basic understanding of electroencephalography (EEG) and event-related potential (ERP) methods as they are used in investigations of language and cognitive processes. The course covers the neurophysiology of EEG, principles of experiment design, and some methods for preliminary data processing.

### **BBSN 5003 Cognitive neuroscience**

This course explores the cognitive and neural processes that support attention, object recognition, language, social cognition, and memory. It introduces basic neuroanatomy, functional imaging techniques, and behavioral measures of cognition. We consider evidence from patients with neurological diseases (e.g., Balint's syndrome, amnesia, and focal lesions from stroke) and from healthy human participants.

### **BBSN 5005 Evaluation of neuropsychological instruments for research**

This course will examine various neuropsychological testing instruments and their role in research and the evaluation of neuropsychological disorders in children and adults. The course will focus on the basic theoretical and clinical foundations of neuropsychological testing.

### **BBSN 5007 Neuroscience Applications to Education**

This course will survey the application of current neuroscience research to educational practice. We will discuss how neuroscience can (and cannot) inform current pedagogical methodologies, including neuroethical issues as they pertain to education, as well as educational “neuromyths.” We will cover the neural bases of selected cognitive and academic systems (including literacy, math, and self-regulation), as well as the current science of intervention in these domains. We discuss experience-based brain plasticity across a variety of contexts (sleep, physical activity, stress, bilingualism, socioeconomic status, music exposure). Finally, we will discuss the future of neuroeducational research and policy. Throughout the course, we focus on the ability to evaluate, critique, and interpret scientific evidence as it relates to educational practice and policy.

### **BBSN 5019 Human Functional Neuroanatomy**

This hybrid course will review neuroanatomical terminology and identify structure and function of major landmarks and pathways in the human brain, peripheral nervous system, and spinal cord using clinical cases, MRI images, brain models, and preserved human brain specimens. We will also discuss neurological disorders and pathology as is relevant to each structure.

### **BBSN 5022 Eye Tracking Methods**

This course aims to explore the applications, methods, neurophysiology, and psychometrics associated with the use of eye tracking in cognitive, linguistic, developmental and clinical research. Students will learn to use TOBII eye trackers and will explore the use of other head mounted systems as well. Students will design, run and analyze an experiment employing these technologies. In addition, we will learn to use other dynamic event recording systems, including ELAN, MACSHAPA/DATAVYU, PRAAT and CHILDES. These systems are designed for coding video, sound, speech, language and other event based data sets. We will also explore the contents of the shared datasets on CHILDES and DATABERY (as it comes on line).

### **BBSN 5044 Current Issues in Neuroscience and Education**

This course is based around a series of talks by visiting speakers who represent the current, cutting-edge work of neuroscience researchers, typically in and around the New York metro area. The course is intended to introduce current neuroscience research to graduate students, and to provide experience in engaging with scientists in a professional arena. Each week students will be required to read some background papers that describe aspects of the work presented by a visiting speaker, and the group will submit questions / topics of interest for discussion after the talks. Assignments are designed to support students' reflections on the inter-relationships between current research and their intersectional experiences of neuroscience.

### **BBSN 5070 Developmental Cognitive Neuroscience**

This course examines neurophysical development from conception through adulthood and its relation to changes in cognitive and linguistic functioning. Topics include visual development, attention, development of action/motor systems, language and reading development, executive function, and social cognition. In addition, the course covers developmental disorders related to specific cognitive, linguistic, and social functions, and theoretical approaches to mental representation and the emergence of cognitive functions.

### **BBSN 5080 Affective Neuroscience**

Emotion and cognition have traditionally been studied in isolation from one another, but these processes typically interact with each other in interesting and unique ways. Understanding these interactions is critical to understanding human behavior: affect can modulate our attention, guide our decision making, bias our perception, and influence our memories. Affective neuroscience utilizes the tools typically used to study cognitive neuroscience to better understand how emotion interacts with these and other aspects of cognition.

### **BBSN 5122 Psychoneuroimmunology**

Psychoneuroimmunology (PNI) is a field that integrates behavioral sciences, cellular neuroscience, endocrinology, and immunology to explain how immune-brain interactions can affect health and behaviors. The course will begin by introducing the principles of neuroscience, immunology, endocrinology, and research methods in PNI. We will then survey foundational work and current research related to brain-immune interactions and how they influence health and disease including topics that are relevant to cognitive neuroscience and education such as learning, memory, and cognitive disorders.

## **BBSN 5152 Neuroscience, Ethics, and the Law**

As our ability to measure and understand the functioning of the human brain has rapidly advanced, so too has our need to grapple with the ethical and legal implications of these neuroscientific tools and discoveries. This seminar will introduce students to the emerging fields of Neuroethics and Neurolaw and create a forum for discussion and debate about a range of timely topics. Topics will include brain development in adolescence (related to issues of driving laws, school start times, and adolescents being tried as adults in courts of law); the use of neuroimaging as “brain reading” technology (and its applicability in court); the neurobiology of memory and its legal application; the use of neuropharmacological agents and brain stimulation for cognitive enhancement; the neurobiology of addiction (and implications for the voluntary control of behavior); and death, unconsciousness, and the law. Throughout the course, we focus on the ability to evaluate, critique and interpret scientific evidence as it relates to ethical and legal practice and policy.

With each topic we consider, our goal will not be to achieve consensus on what’s right and what’s wrong but rather to understand the ethical quandaries and to think critically about ways that the field could go about addressing them. Students should leave this course with an enhanced appreciation of the many ways in which our work impacts society and a heightened commitment to public engagement.

## **BBSN 5193 Neuroscience of Adversity**

This course will survey the state-of-the-art research into what happens to our brains following the experience of adversity. We will consider adversity broadly defined, including common forms of adversity such as poverty, as well as more extreme forms of adversity, such as abuse and institutionalization. We will consider adversity across the lifespan and will also focus on plasticity and resilience. Throughout this course, we focus on the ability to evaluate, critique, and interpret scientific evidence as it relates to the neuroscience of adversity.

## **BBSN 6904 Research and independent study: Neuroscience and Education**

n/a

## **BBSN 9910 Advanced research and independent study: Neuroscience and Education**

n/a