



**Teachers College**  
COLUMBIA UNIVERSITY

# Academic Catalog 2025-2026

## Biobehavioral Sciences

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# The Department of Biobehavioral Sciences

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## Our 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).

If you plan to work in a state other than New York, we recommend that you review the state's licensing board or teacher certification website for that state's qualifications. The Office of Teacher Education will complete any necessary forms and/or letters for out-of-state certification on the completion of your approved teacher preparation program.

# Communication Sciences and Disorders

Department of Biobehavioral Sciences

## Program Description

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.

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. Carol Scheffner 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 coughing); 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). Dr. Gemma Moya-Gale's research is aimed at: 1) improving voice, communication, and social connectedness in people with Parkinson's disease within an inclusive framework, and 2) developing new technologies, through the use of automatic speech recognition, to foster independence in people with Parkinson's disease. Dr. Victoria Tilton-Bolowsky's research is aimed at (1) enhancing aphasia treatment outcomes and (2) eliminating bias in clinical and research practices.

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.

## Degrees

### Master of Science

#### Communication Sciences and Disorders

Master of Science | NY State Initial: Speech and Language Disabilities K-12

**Points/Credits:** 55

**Entry Terms:** Fall

**Certification:**

- NY State Initial: Speech and Language Disabilities K-12

#### Degree Requirements

This degree program incorporates academic and clinical practicum requirements for the American Speech-Language-Hearing Association's Certification of Clinical Competence (ASHA CCC-SLP) and the New York State Education Department (NYSED) requirements 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 NYSED Teacher of Students with Speech and Language Disabilities Certificate (TSSLD). New York State Education Department (NYSED) mandates teacher certification requirements that are needed for program completion and graduation which are listed in the Office of Teacher Education section of the catalog.

Students are admitted to the program with undergraduate degrees in speech and language pathology or with all required prerequisite 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 TSSLD. 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.

## Communication Sciences and Disorders - Bilingual Extension: Dual Certification

Master of Science | NY State Initial: Speech and Language Disabilities K-12 with Bilingual Option

**Points/Credits:** 58

**Entry Terms:** Fall

**Certification:**

- NY State Initial: Speech and Language Disabilities K-12 with Bilingual Option

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### Degree Requirements

This degree program incorporates academic and clinical practicum requirements for the American Speech-Language-Hearing Association's Certification of Clinical Competence (ASHA CCC-SLP) and the New York State Education Department (NYSED) requirements 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 NYSED Teacher of Students with Speech and Language Disabilities Certificate (TSSLD) and the NYSED bilingual extension to the TSSLD. New York State Education Department (NYSED) mandates teacher certification requirements that are needed for program completion and graduation which are listed in the Office of Teacher Education section of the catalog.

Students are admitted to the program with undergraduate majors in speech and language pathology or with all required prerequisite 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 TSSLD. 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.

## Doctor of Philosophy

### Communication Sciences and Disorders

Doctor of Philosophy

**Points/Credits:** 75

**Entry Terms:** Fall

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### Degree Requirements

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 degree program. There is no foreign 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 website.

## Advanced Certificate

### Bilingual Extension Institute (Speech Language Pathology)

Advanced Certificate | Bilingual SLP Extension

**Points/Credits:** 6

**Entry Terms:** Summer, Fall

**Certification:**

- Bilingual SLP Extension

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### Degree Requirements

## Weekend Content

("Areas covered" sections correspond to NYSED requirements)

Weekend I (May). Bilingual/Bicultural Language Development. Theories and Models of Bilingual Education.

Compare normal language development to bilingual/bidialectal language development. Identify normal processes of second language acquisition. Introduce theories and models of bilingual education. Introduce sociolinguistic parameters of topic, participant, setting, and function, and home/school gap. Discuss dialect and language stigmatization and code-switching.

Areas covered. Sociolinguistics and psycholinguistics. Bilingualism. Theories of bilingual education and bilingualism. Impact of home/school mismatch in meeting the New York State Learning Standards. Multicultural perspectives in education.

Weekend II (June). Speech-language Assessment of Preschool Children.

Review current assessment materials and discuss how to use these materials effectively. Identify the "Critical Questions" for evaluations. Analyze the impact of home/school mismatch on the differential diagnosis of a language or speech disorder and a difference. Study the validity of current assessment materials and technology based upon current research, and technology. Analyze language differences and sociolinguistics on the assessment of culturally and linguistically diverse preschool children.

Areas covered: Methods of teaching Native Language Arts and English Language Arts to bilingual ELLs, including literacy and other content areas, for meeting the New York State Learning Standards. Sociolinguistics and Psycholinguistics. Bilingualism.

Weekend III (September). Speech-Language Assessment of School-Age Students.

Identify factors to distinguish differences from a disorder. Use of published tests, technology, and alternative and curriculum-based strategies in assessment. Impact of bilingualism and sociolinguistics on the assessment of culturally and linguistically diverse children. Role of speech language clinician in "early intervening services" and Response to Intervention. Implications of Hehir report findings. Impact of IDEA on assessments.

Areas Covered. Methods of teaching English Language Arts to bilingual English Language Learners, including literacy and other content areas and of using the native language and English, for meeting the New York State Learning Standards. Sociolinguistics and Psycholinguistics. Bilingualism.

Weekend IV (October). Speech-Language Intervention for Preschool Children.

Delivery of appropriate assessment to ensure optimal pre-academic success for ELLS and non-native speakers of General American English. Factors to consider when deciding the language of instruction, review of current research on impact of bilingualism on language development of children with language disorders. Effectiveness of education programs for ELLS including CALLA and ALERTA in the development of academic English.

Areas covered. Methods of teaching English Language Arts to bilingual English Language Learners, including literacy and other content areas, using the native language and English, for meeting the New York State Learning Standards. Multicultural perspectives in education.

Weekend V (November). Speech-language intervention for School-age Students.

Review and analysis of research of most effective methods for developing social and academic language to meet the curriculum standards. Analysis of impact on language acquisition, literacy development, and development of other content areas when an ELL has a communication disorder. Focus on developing collaborative relationships with parents and teachers of ELLS.

Areas covered. Methods of teaching English Language Arts to bilingual English Language Learners, including literacy and other content areas, using the native language and English, for meeting the New York State Learning Standards. Multicultural Perspectives in Education. Sociolinguistics.

Weekend VI (December). Ethical Considerations, Bilingual Phonology, Neuroscience of Bilingualism.

Analyze development of phonological awareness and its relationship to development of literacy in ELLS. Identify ethical concerns in the assessment and treatment of bilingual/bicultural children. Review current practice in assessment from birth through 21 based upon federal law, current research, and preferred practice. Review of current research on neurolinguistics of bilingualism and its clinical impact.

Areas covered. Methods of teaching English Language Arts to bilingual English Language Learners, including literacy, using the native language and English, for meeting the New York State Learning Standards for students. Sociolinguistics and psycholinguistics. Multicultural perspectives in education.

## **Institute Projects**

(May be done in groups)

- (1) Contrastive linguistic analysis of English and the student's non-English language
- (2) Speech-Language Evaluation. Submit one bilingual speech-language evaluation for a typically developing bilingual preschool child, between 2-4 years old.
- (3) Speech-Language Evaluation. Submit one bilingual speech-language evaluation for a typically developing bilingual school-age child, preferably 9 yrs or older.
- (4) Speech-Language Evaluation. Submit one bilingual speech-language evaluation for a bilingual child who is suspected (or it is known) of having a language disorder.
- (5) College-supervised field experience/Collaborative journal. This journal maintains a record of the 50 hours of speech-language services for clients from 3 through 21 years including a description of the treatment plan and what was done in individual sessions.
- (6) Inservice: Give an inservice presentation to colleagues about what the student learned in the Institute. Students may work together on the inservice project in the same school district.



## Bilingual Extension Institute (Speech Language Pathology) (Online)

Advanced Certificate | Bilingual SLP Extension

**Points/Credits:** 6

**Entry Terms:** Summer

**Certification:**

- Bilingual SLP Extension

### Degree Requirements

Online Curriculum Outline

#### **Weeks 1-12, 3-credit course. Foundations and Preschool assessment and treatment**

Unit 1 (weeks 1-4): Bilingual language development: Second language acquisition, social vs academic language, sociolinguistics (code-switching, dialect, etc.)

Unit 2 (weeks 5-9): Preschool bilingual speech-language assessment

Unit 3 (weeks 10-12): Preschool bilingual intervention

#### **Weeks 13-24, 3-credit course. Bilingual motor speech disorders, cognitive disorders including TBI, school age assessment, school age intervention**

Unit 1 (weeks 13-14): Bilingual motor speech disorders assessment and treatment (weeks 15-16) Bilingual cognitive disorders and TBI

Unit 2 (weeks 17-20): School-age bilingual speech-language assessment (disorder vs difference, typical vs disordered language)

Unit 3 (weeks 21-24): School-age bilingual speech-language intervention (early bilingual literacy development, intervention for low incidence populations, functional IEP goals)

## Faculty

### Faculty

- Catherine J **Crowley** Professor of Practice of Communication Sciences and Disorders
- Erika Shield **Levy** Professor of Communication Sciences and Disorders

- Gemma **Moya-Gale** Assistant Professor of Communication Sciences and Disorders
- Victoria **Tilton-Bolowsky** Assistant Professor Communication Sciences and Disorders
- Michelle Shevon **Troche** Professor of Speech and Language Pathology

### **Emeriti**

- Carol J **Hammer** Professor of Communication Sciences and Disorders

### **Professors of Teaching**

- Panagiota Demetra **Tampakis** Assistant Professor of Teaching

### **Adjunct Faculty**

- Lisa Anna Marie **Edmonds** Adjunct Professor

### **Instructors**

- Bernadine Rae **Gagnon** Director of the Edward D. Mysak Clinic for Communication Disorders

## **Courses**

### **BBS 4032 - Neuroscience of Speech and Language**

This is a 2-credit course that provides an introductory overview of the neuroanatomical and neurophysiological correlates of aspects of speech, language, and cognition, with an introduction to disorders of communication related to neurologic impairments due to various etiologies. Students will learn through assigned reading, lectures, discussion, class participation, guided self-study, review sessions, discussion and case study review, with a focus on neurological underpinnings of communication disorders.

### **BBS 4035 - Clinical Practice in the Medical Setting**

Prerequisite: BBS 4032. This course introduces the student to principles and clinical practices of rehabilitation specialists within the medical setting. Students will be introduced to various types of healthcare settings and the

healthcare professionals whom they will encounter within the medical practice. Medical terminology and documentation will be reviewed. Additionally, students will be exposed to basic clinical information on assessment and treatment of complex patients with communication and swallowing difficulties seen within medical environments. Success in this course requires a strong foundation in Neuroscience.

### **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 4010 - Grammar Fundamentals for a Pluralistic Society**

Pre-requisites: None. This course teaches fundamental features of American English grammar including those features several varieties of English.

### **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 5009 - Cognitive Disorders**

This class provides a comprehensive overview of traumatic brain injury, right hemisphere disorders, and dementia. Theoretical, practical, and evidence-based approaches to assessment and intervention will be presented.

### **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 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 and Phonological 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**

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

### **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 - Phonetics**

This course is designed to present specialized knowledge relevant to the understanding of speech communication. Through text, lecture, and a variety of multi-media sources, students will be introduced to the theoretic basis of how speech sounds are produced and perceived in human languages. In addition, this course will assist students in developing the clinical ability to discriminate the sounds used in standard American English and how these sounds are represented symbolically according to the International Phonetic Alphabet (IPA). This course will also present information to assist students in discriminating and transcribing speech relevant to communication disorders. The course will also discuss cross linguistic considerations of phonetics including dialectal differences.

### **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 - Aural Habilitation**

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 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. This course requires a minimum of 27 hours per week of out-of-classroom work.

### **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.

### **BBSQ 5312 - Applied Clinical Course in Speech-Language Pathology**

Assessment and evaluation. Assessment planning and implementation for clients across the full range of disabilities and across the lifespan.

### **BBSQ 5315 - Therapy Practicum**

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 5316 - Therapy Practicum**

Summer B: 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 5331 - Introduction to Clinic Methods**

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. This course requires 27 out of classroom hours per week.

### **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 5343 - Hearing Measurement**

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

### **BBSQ 5501 - Seminar in Transcultural SLP (Latin America)**

This course is required for students who go on the international trip to Latin America. It covers cultural, linguistic, and socioeconomic issues and how those relate to the provision of speech-language pathology services in the country and region.

### **BBSQ 5502 - International Transcultural Seminar**

This seminar is required for all students who travel for the International Practicum in Speech-Language Pathology.

### **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 (TSSLD) 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**

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

### **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**

The purpose of this course is to provide a strong foundation in assessment and management of motor speech disorders in children and adults. We will explore acquired and progressive disorders of the motor speech system from neurological, theoretical, and clinical perspectives. Clinical research in the field will be reviewed and best assessment and management/treatment practices will be discussed. For doctoral students, the course will also address the development of their dissertation study (literature review, research questions, design). Doctoral students must ask the instructor for permission to be in the course. Success in this course requires a strong foundation in speech science (or equivalent, e.g., an acoustic phonetics class) and knowledge of neurological bases of speech production –Prerequisites: BBSQ 4030 or equivalent, and previous course on neurological bases of speech.

### **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. This course requires a minimum of 27 hours per week of out of classroom work.

### **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. This course requires a minimum of 27 hours per week of out of classroom work.

### **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.

# Movement Science and Education

Department of Biobehavioral Sciences

## 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, and Motor Learning and Control. The programs have a long tradition of excellence that have grown out of ground-breaking programs in physical education and health, applied physiology, motor learning, and kinesiology, as well as a long succession of highly recognized faculty and influential researchers. All programs are designed to allow flexibility in curriculum planning, and in consultation with an advisor, students may arrange a program of study tailored to their interests that cut across specializations in the movement sciences.

### Overview of Movement Science and Education and Kinesiology Program Sub-concentrations

- The Applied (Exercise) Physiology concentration involves the study of the integrative physiology of exercise, focusing on the acute and chronic adaptations to exercise across the lifespan. The effects of exercise training on physical fitness, sports performance and physical and mental health are emphasized. The program emphasizes the application of scientific evidence to the practice of exercise physiology and related fields, and the program offers ample opportunities for problem based learning and “hands-on” experiences
- The Motor Learning and Control concentration focuses on the behavioral, biomechanical, and neural bases of development, acquisition, and performance of functional movement skills across 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. Our program has a long history of shaping the field of movement sciences, including promoting the application of motor learning principles to applied professions such as physical education, coaching, and physical rehabilitation.

- **Movement Science Doctoral Programs** with concentration in Physical Therapy and Occupational Therapy (EdD). The Physical and Occupational Therapy tracks are programs designed for licensed physical and occupational therapists who are seeking post-professional doctoral-level education. The programs utilize the rich academic resources already available within the Movement Sciences Program at Teachers College, and provide students with additional knowledge on the application of movement sciences to content areas within physical and occupational therapy. These tracks provide an additional array of specialized clinical and field-based research courses within the specialization of physical and occupational therapy that are taught by the faculty in physical therapy at Columbia University Irving Medical Center. Students can choose to concentrate in Motor Learning and Control, or Applied Physiology.
- **Kinesiology Doctor of Philosophy (Ph.D.)** is awarded under an agreement with Columbia University Graduate School of Arts and Sciences and has special requirements; students are referred to the doctoral degree requirements (See “Requirements for the Degree of Doctor of Philosophy” in the bulletin from the Office of Doctoral Studies). The Ph.D. program is a research-intensive degree, and students are expected to engage in full-time study, which includes a series of approximately three successively independent research projects or the equivalent (such as a large intervention or multi-year study) during their program of study. Preliminary studies may be published prior to graduation, but the final study may be published only after the awarding of the degree. Candidates for the Doctor of Philosophy are expected to have high-quality research experience in movement and exercise sciences, including a written document, such as a Master’s Thesis or research article as the primary author, prior to admission to the program. Students in the Ph.D. program can concentrate in Applied Physiology, or Motor Learning and Control. Additional information is available under the subspecialty pages.

## Degrees

### Master of Arts

#### Applied Physiology

**Points/Credits:** 32**Entry Terms:** Spring, Summer, Fall

## Degree Requirements

The Applied (Exercise) Physiology concentration involves the study of the integrative physiology of exercise, focusing on the acute and chronic adaptations to exercise across the lifespan. The effects of exercise training on sports performance and physical and mental health are emphasized. The program emphasizes the application of scientific evidence to the practice of exercise physiology. Students in the Applied Physiology program study physical activity behavior, the physiological and psychological effects of acute and chronic exercise, how exercise influences physical and mental health, sports performance, and the promotion of physical activity in community, clinical, and public health settings. Students can apply their academic work to jobs that involve exercise testing and training, including programs designed to improve sports performance, health and physical fitness in healthy individuals, in people with or at risk for chronic illness or disability, movement arts, and in community, clinical, research, and public health settings. The program also may serve as a stepping-stone to medical studies, 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 credits) 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 a Kinesiology/Movement Science-related field--are strongly advised to start the program during a summer semester. Full-time students choosing the comprehensive exam option (instead of the integrative project) typically take the comp exam in the first summer session of their program of study.

The Program has five components:

1. Substantive study of theory and scientific 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 at Teachers College in an area of your choice.
5. A culminating examination or project integrating material from Applied Physiology coursework.

### SPECIAL ADMISSION REQUIREMENTS/ACADEMIC PREREQUISITES

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, movement arts, biology, chemistry, nutrition, nursing, health sciences, public health, health education, neuroscience, 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.

Prospective students should 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 credits of study as a non-matriculated student is permitted.

## 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 academic 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 degree program requirements, and it is strongly recommended they start during a 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:

<https://www.tc.columbia.edu/registrar/students/degree-information--degree-audit/degree-requirements/>

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 of B- or below will need to retake those courses or an alternate course with approval of the program director and will incur additional tuition charges.

- BBSR 4095 Applied Physiology I (3)
- BBSR 5594 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)

### Electives in Movement Sciences and Education (BBSR) (9-12 points)

Students are required to take at least three additional BBSR courses (for a minimum of 9 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 4002 Visual Methods and Education (3)
- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4050 Biomechanical Analysis of human movement (3)
- BBSR 4060 Motor learning (2-3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBSR 4900 Research and Independent Study in Movement Science and Education (1-3)
- BBSR 5028 Motor Development (2-3)
- 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 Health and Fitness 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 programs in Applied Physiology 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, or these courses were taken in previous study. 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 currently no specific course requirements to take the examination beyond the core course requirements, however, there may be elective courses that will add to your preparation such as the courses listed below:

- BBSR 4005 Applied anatomy and biomechanics (3) OR BBSR 4050 Biomechanical Analysis of Human Movement (3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBS 5060 Neuromuscular Responses and Adaptation to Exercise (2),
- BBSR 5096 Advanced Exercise and Physical Activity Prescription (3)

Further information about the CSCS certification can be found here: <https://www.nasca.com/cscs-exam-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 (minimum of 6 points)

Breadth elective courses must be taken in any academic program or department at Teachers College, except Movement Sciences (BBSR) courses. 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 University 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 4000 Cognitive Neuroscience (3)
- BBSN 4003 Foundations of Neuroscience (3)
- BBSN 5122 Psychoneuroimmunology and Education (3)

#### Research Seminar (minimum of 3 points)



Registration and attendance at a research seminar is required for all who choose the Integrative Final Project option. Students should expect to register for seminar during all semesters when working on an integrative project, with at least 3 credits over one or more semesters. Students who have selected the comprehensive examination option and who are interested in research may elect to attend the research seminar; this course can count toward the Movement Science (BBSR) 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:

- BBS 5040 Neuroscience of Adolescence (3)
- BBSR 4005 Applied Anatomy and Biomechanics (3)
- BBSR 4060 Motor Learning (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 one semester (ideally 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 taken 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.

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

- A scholarly review of research in applied physiology and movement sciences within a topical area drawing application to practice
- 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

## Motor Learning

Master of Arts

**Points/Credits:** 32

**Entry Terms:** Spring, Summer, Fall

### Degree Requirements

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 degree 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, as well as 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. degree 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 departments at Teachers College in areas such 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. degree 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. degree 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 additional 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)
BBSR	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) Note: BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points
BBSR	5028	Motor Development Across the Lifespan (3 points)
BSR	4050	Biomechanical Analysis of Human Movement (3 points)

BBSR	5504	Research Training Seminar (Section 02) (2 points)
		Note: 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.

### Substantive Study (minimum 3 credits)

BBS	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)
BSRR	5095	Exercise and health (3)
BBSR	4070	Psychosocial aspects of sports and exercise (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 Program (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 University 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.

## Master of Education

### Applied Physiology

Master of Education

**Points/Credits:** 60

**Entry Terms:** Spring, Summer, Fall

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### Degree Requirements

The Applied (Exercise) Physiology concentration involves the study of the integrative physiology of exercise, focusing on the acute and chronic adaptations to exercise across the lifespan. The effects of exercise training on sports performance and physical and mental health are emphasized. The program emphasizes the application of scientific evidence to the practice of exercise physiology. Students in the applied physiology program study physical activity behavior, the physiological and psychological effects of acute and chronic exercise, how exercise influences physical and mental health, sports performance, and the promotion of physical activity in community, clinical, and public health settings. Students can apply their academic work to jobs that involve exercise testing and training, including programs designed to improve sports performance, health and physical fitness in healthy individuals, in people with or at risk for chronic illness or disability, movement arts, 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.) degree 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 across 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 coordinator;
- Preparation as for advanced practice of exercise physiology
- Preparation for additional study in health professions including physical therapy, physician assistant, and other medical professional roles;
- Preparation for study towards the doctoral degree (e.g., Ph.D., Ed.D., D.Ph., or M.D.).

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 at Teachers College and Columbia University in an area of your choice.
5. A culminating project integrating material from your coursework.

#### SPECIAL ADMISSION REQUIREMENTS/ACADEMIC PREREQUISITES

While students have come from a variety of fields, the following backgrounds are most appropriate: kinesiology, movement sciences, exercise science, movement arts, physical therapy, occupational therapy, physical education, athletic training, biology, chemistry, nutrition, nursing, health sciences, public health, health education, neuroscience, 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 Ed.M. degree.

Prospective students should 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.

#### 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 our academic program. In addition, students who enter the program without prior formal study in Kinesiology or in Movement or Exercise Sciences or closely-related fields 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 a 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.

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 or an alternate course with approval of the program director and will incur additional tuition charges.

- BBSR 4095 Applied Physiology I (3)
- BBSR 5594 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)

#### Electives in Movement Sciences and Education (BBSR) (12-15 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 4005 Applied Anatomy and Biomechanics (3)
- BBSR 4050 Biomechanical Analysis of Human Movement (3)
- BBSR 4060 Motor Learning (2-3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBSR 4900 Research and Independent Study in Movement Science and Education (1-3)
- BBSR 5028 Motor Development (2-3)
- 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 pursuing 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 60 point requirement to meet the requirements to sit for some professional certifications.

Students in the Ed.M. program in Applied Physiology 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, or these courses were taken in previous study. 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 currently no specific course requirements to take the examination beyond the core course requirements; however, there may be elective courses that will add to your preparation such as the courses listed below:

- BBSR 4005 Applied Anatomy and Biomechanics (3) OR BBSR 4050 Biomechanical Analysis of Human Movement (3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBS 5060 Neuromuscular Responses and Adaptation to Exercise (2)
- BBSR 5096 Advanced Exercise and Physical Activity Prescription (3)

Further information about the CSCS certification can be found here: <https://www.nsca.com/cscs-exam-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 (3)
- HUDM 4122 Probability and statistical inference (3)
- HUDM 4050 Introduction to Measurement (3)



- HUDM 5122 Applied Regression Analysis (3)
- HUDM 5123 Linear Models and Experimental Design (3)
- HUDM 5026 Introduction to Data Analysis in R (3)
- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences and Education (3)
- BBSR 4002 Visual Methods and Education (3)
- Other TC/CU graduate research methods/ statistics courses with approval of advisor

#### Research Seminar (minimum 4 points)

Registration and attendance at a research seminar is required for all Ed.M. 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 academic program or department at Teachers College, except Movement Sciences (BBSR) courses. 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 Health Education (HBSS), Nutrition (HBSV), Diabetes Education (HBSD), and Neuroscience and Education (BBSN). Please note that courses taken at Columbia University 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 4000 Cognitive Neuroscience (3)
- BBSN 4003 Foundations of Neuroscience (3)
- BBSN 5122 Psychoneuroimmunology and Education (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:

- BBS 4054 Anatomy and Physiology (3)
- BBSR 4005 Applied anatomy and biomechanics (3)
- BBSR 4060 Motor Learning (2-3)
- 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 (at least 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

## Motor Learning

Master of Education

**Points/Credits:** 60

**Entry Terms:** Spring, Summer, Fall

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## Degree Requirements

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 preparation as a "scholar of practice" able to translate research and theory into appropriate clinical or educational strategies. Students considering application to doctoral programs can begin their course of study with the Ed.M. degree. Students intending to continue study towards the doctoral degree should arrange their Ed.M. program to include core courses required for doctoral specialization.

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. degree and may involve one of two options:

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

#### 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)
BBSR	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)  Note: BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points
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)  Note: 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.

### Substantive Study (minimum 9 credits)

BBS	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)
BSRR	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)**

BBS	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)

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

Students should take 2-3 credits outside the Movement Sciences Program (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 University 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 the Program in Movement Sciences (BBSR) that you use to fulfill core degree requirements and/or research methods requirements can also count toward the breadth requirement.

## **Individual program (minimum 12 points)**

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

### Applied Physiology

Doctor of Education

**Points/Credits:** 75

**Entry Terms:** Spring, Fall

### Degree Requirements

The Applied (Exercise) Physiology concentration involves the study of the integrative physiology of exercise, focusing on the acute and chronic adaptations to exercise across the lifespan. The effects of exercise training on sports performance and physical and mental health are emphasized. The program emphasizes the application of scientific evidence to the practice of exercise physiology. Students in the applied physiology program study physical activity behavior, the physiological and psychological effects of acute and chronic exercise, how exercise influences physical and mental health, sports performance, and the promotion of physical activity in community, clinical, and public health settings. The Doctor of Education (Ed.D.) is a full- or part-time program that prepares leaders who are scholars of practice, able to draw valid applications from research presently available in Movement Sciences and Education. Graduates of the Ed.D. program go on to have successful careers as educators in higher education settings, clinicians, researchers, and leaders in the field.

#### Doctor of Education in 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 project 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 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 conjunction with the advisement of Movement Science 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.

#### Advisement and Program Planning

Prior to registration, newly admitted students meet individually with their faculty advisor to plan the initial phases of their programs of study. 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. 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 work, address school-related concerns, discuss research, or other issues.

### Program of Study

Doctoral study is a multifaceted undertaking. It includes: course work, field and/or laboratory projects, tutorial conferences, informal seminars and colloquia, apprentice research, peer analyses and review, independent library and laboratory research, and informal interchanges among students and faculty. The Ed.D. program in Movement Sciences/ Kinesiology is flexible, allowing students to develop skills that will help them reach their career goals. Each student develops competencies in Movement Sciences/Kinesiology. In addition, they gain experience and expertise in conducting research in the field. Courses across Teachers College and Columbia University supplement coursework within the program of the movement sciences (such as Neuroscience and Education, Nutrition Education, Health Education, and others).

### Ed.D. Program Requirements

The following Doctor of Education in Applied Physiology program description concentrates on describing course requirements. It is important to recognize that these are the formal features of the program. There is also an expectation of research-related activities as part of the degree requirements. These are outlined in the Program of Study guides distributed yearly. A minimum of 75 credits of relevant graduate coursework is required for the degree, 45 credits of which must be completed at Teachers College or Columbia University. Students who complete a master's degree at another university typically transfer approximately 20-30 credits and enroll for approximately 45 credits of coursework at Teachers College during their doctoral program. Students should check with the Office of Doctoral Studies periodically to ensure they are meeting all College-wide requirements for the degree. In addition, students should be familiar with the most recent version of the document entitled, "Requirements for the Degree of Doctor of Education" for additional college-wide requirements (available at: [https://www.tc.columbia.edu/form-library/office-of-doctoral-studies/requirements-for-the-degree-of-doctor-of-education-edd/files/Ed.D.\\_Requirements\\_Bulletin\\_2024.pdf](https://www.tc.columbia.edu/form-library/office-of-doctoral-studies/requirements-for-the-degree-of-doctor-of-education-edd/files/Ed.D._Requirements_Bulletin_2024.pdf)).

Courses are chosen in consultation with an advisor. Previously completed graduate course work may be substituted, as appropriate, for the recommended experiences listed below when approved by the advisor. Each student and the advisor develop a program plan that will help the student meet their goals and successfully complete the dissertation.

Students are required to be in continuous enrollment for a minimum of 3 credits of Teachers College course credit or dissertation advisement, in each fall and spring term, starting with the term following the successful completion of the certification examination, or following the term in which the dissertation proposal was approved in a departmental hearing, whichever comes first, and continuing until all requirements for the degree are met. If registering for course work to meet the continuous registration requirement, students will register for the research seminar in applied physiology. Certification examinations are not given in the summer except in exceptional circumstances, and students who take the examination in the summer term are not usually evaluated by program faculty until the fall term. Consequently, these students will not be obligated for continuous enrollment until the following spring term. The obligation to register continuously ends after the dissertation has received final approval. The following is a list of the minimal requirements for the Ed.D. degree in Applied Physiology.

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

Students are required to complete the core courses required of M.A. and Ed.M. students or the equivalent in previous graduate studies with a grade of B or better. Students who earn grades B- or below will need to retake those courses or an alternate course with approval of the program director and will incur additional tuition charges.

- BBSR 4095 Applied Physiology I (3)
- BBSR 5594 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)

#### Electives in Movement Sciences and Education (BBSR) (minimum of 15 points)

Students are required to take at least five additional BBSR courses (for a minimum of 15 points) in addition to the core required courses. These electives may include, but are not limited to, the following BBSR courses:

- BBSR 4005 Applied Anatomy and Biomechanics (3)
- BBSR 4050 Biomechanical Analysis of Human Movement (3)
- BBSR 4060 Motor Learning (2-3)
- BBSR 4070 Introduction to Psychosocial Aspects of Sports/Exercise (2-3)
- BBSR 4900 Research and Independent Study in Movement Science and Education (1-3)
- BBSR 5028 Motor Development (2-3)
- 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)

#### Research Methods and Statistics (minimum of 12 points)

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

- HUDM4120 Basic concepts in statistics (if no undergraduate statistics) (3)
- HUD 4120 Methods of Empirical Research (3)
- HUDM 4122 Probability and statistical inference (3)
- HUDM 4050 Introduction to Measurement (3)
- HUDM 5122 Applied Regression Analysis (3)
- HUDM 5123 Linear Models and Experimental Design (3)
- HUDM 5026 Introduction to Data Analysis in R (3)
- BBSR 4001 Qualitative Research Methods in Biobehavioral Sciences and Education (3)
- BBSR 4002 Visual Methods and Education (3)
- Other TC/CU graduate research methods/ statistics courses with approval of advisor

#### Research Seminar (1-3 points each semester)

Registration and attendance at a research seminar is required for all Ed.D. students during all semesters of enrollment, unless there is an approved reason for non-enrollment, such as a course scheduling conflict, with a maximum of 18 points counted toward degree requirements. Students should expect to register in seminars during all semesters for 1-3 points, depending on the proposed work to be completed as agreed with the seminar instructor. Note that if this course is being used to satisfy continuous registration requirements, seminar may be taken for 3 points

- BBSR 5595 Research Seminar in Applied physiology (1-3)

## Elective Cognate Courses at Teachers College, Columbia University or through the Inter-University Doctoral Consortium

Students take elective courses in cognate areas to develop additional competencies that will help them reach career goals or gain deeper understanding of the theoretical and scientific bases for their dissertation research —there are many courses from which to select at Teachers College and Columbia University. In addition, students may take graduate courses at other Universities through the Inter-University Doctoral Consortium (IUDC). IUDC registration is open to TC doctoral students who are beyond their first year of study. Popular elective courses for students in Applied Physiology have included courses Health Education (HBSS), Nutrition (HBSV), Diabetes Education (HBSD), and Neuroscience and Education (BBSN).

Further information about policies and procedures for cross registration Inter-University Doctoral Consortium (IUDC) are available at the Registrar's Office or website:

## CERTIFICATION

When students have completed at least 55-60 of the total points required for the Ed.D. degree and have completed a pilot research study and literature review, 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, a literature review, and submit a program plan. A review committee assesses the student's entire record. The decision of the committee is then forwarded to the Office of Doctoral Studies for the Teachers College Ed.D. Committee to take final action on the candidate's certification. (See "Requirements for the Degree of Doctor of Education" for more information.

## DISSERTATION

Each student completes a dissertation that focuses on a research question in applied physiology. Students develop the skills to complete the dissertation through coursework, the research seminar, working as an apprentice in a faculty lab or with advanced doctoral and post-doctoral fellows, . Many research 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, one of which may be a systematic review.

Throughout the process, the student works closely with their 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.

## Motor Learning

Doctor of Education

**Points/Credits: 75**

## Degree Requirements

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.

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. 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.

## Core Coursework (23 Credits)

BBS	5060	Neuromuscular Response and Adaptation to Exercise (2 points)
BBSR	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)  Note: BBSR 4161 is a co-requisite of BBSR 4060 if taken for 2 points
BBSR	5028	Motor Development across the lifespan (3 points)
BSR	4050	Biomechanical Analysis of Human Movement (3 points)
BBSR	5504	Research Training Seminar (Section 02) (2 points)  Note: (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 (3)
BBSR	4055	Neuromotor Process (3)
BBSR	4070	Introduction to Psychosocial Aspects of Sport/Exercise (3)
BBSR	5050	Neurophysiology of Motor control and electromyography (3)
BBSR	5057	Movement Disorders (3)
BBSR	5251	Fieldwork seminar in Motor Learning Motor Control (1-2)

### Three topical seminars (9)

BBS	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 (3)
HUDM	5122	Applied Regression Analysis (3)
HUDM	5123	Linear Models and Experimental Design (3)

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

ORLD 4053 Facilitating Adult learning

ORLJ 5310 Preparation for Coaching

ORLD 5063 Online Teaching and Learning: Applying adult learning principles

ORLD 4055 How Adults Learn

ORLD 5057 Adult Learning and Education: Theory and Practice

ORLD 4815 Developing critical thinkers

### Individual program and electives (16)

Part-time paid research or laboratory assistantships may be available for students in their middle to advanced stage of study.

## Movement Sciences in Education (Occupational Therapy)

Doctor of Education

**Points/Credits:** 75

**Entry Terms:** Spring, Summer, Fall

### Degree Requirements

ioral processes underlying the learning and control of movements, the neural processes underlying motor learning, motor development, and performance of functional motor action. The program also focuses on translating basic science information to design and evaluate interventions to target impairments of the motor system in order to prevent or improve activity limitations and participation restrictions.

This degree is directed toward preparing the current and the next generation of leaders in Occupational Therapy with interests in movement and daily function. These leaders will assume professorial roles in universities and colleges within departments of Occupational Therapy. The degree may lead to:

- Tenure-track faculty position in Occupational Therapy departments emphasizing teaching and applied research
- Research Coordinator (university, hospital, clinic)
- Director/Administrator (university, teaching hospital)

### Coursework

The Occupational Therapy track utilizes the rich academic resources already available within the Movement Sciences Program at Teachers College, and provides students with additional knowledge on the application of movement sciences to content areas within occupational therapy. The track provides an additional array of specialized clinical and field-based research courses within the specialization of occupational therapy that are taught by the faculty in Occupational Therapy at Columbia University Irving Medical Center.

The program consists of three major components:

1. Didactic Coursework: Students are expected to complete required and elective coursework in the following content areas: movement science foundations, biostatistics and research methods, movement science applications to occupational therapy, and elective courses in movement science, occupational therapy and related areas.
2. Certification Exam and Pilot Study: While completing didactic coursework, students will be expected to begin research training with a faculty member and enroll in research training seminar. During research training seminar students present their ongoing research to faculty and peers. Each student will be required to complete a pilot study in preparation for the dissertation. Each student will complete a certification exam in the content area pertaining to his/her research.
3. Dissertation proposal and dissertation: After completing a pilot study, each student will defend a dissertation proposal to a faculty committee consisting of at least three members. Following defense of the dissertation proposal, students will register for Dissertation Advisement (BBSR8900) for completing the dissertation.

The total number of credits required for the proposed program will be 75 credits of didactic courses and dissertation, post-baccalaureate. Teachers College accepts a maximum of 30 credits for transfer from a Masters degree. The coursework entails 45 credits at Teachers College/CUIMC and we expect students with a Masters degree in Occupational Therapy to transfer the remaining 30 credits.

### Movement Sciences (Occupational Therapy) Coursework

The required coursework includes the following:

- Movement science foundations (15 credits)
- BBSR 4060 Motor learning (2 credits)
- BBSR 4161 Motor learning laboratory (1 credit)
- BBSR 4050 Analysis of human movement (3 credits)
- BBSR 6564 Advanced topics in neuromotor processes (3 credits)
- BBSR 5860 Motor Learning Conference (1 credit)
- BBSR 6563 Movement sciences conference seminar (2 credits)
- BBSR 5504 Research Training in Motor Learning & Control (3 credits) (to be taken semester of dissertation defense for 3 credits in conjunction with zero credits of 8900).

Biostatistics and research methods (9 credits)

- BBSR 5582 Research design in the movement sciences (3)
- HUDM 4122 Probability and statistical inference (3)
- HUDM 5122 Applied regression analysis (3)
- HUDM 5123 Linear Models and Experimental design (3)

Occupational Therapy (15 points to be taken in the OT program)

Required (9 points selected in consultation with advisor)

- OTM8101 Advanced theories of intervention (3)
- Clinical Reasoning (3)
- Applied Clinical Reasoning Seminar (3)
- Advanced Evidenced Based Practice (3)

Electives at Teachers College in consultation with supervisor (6 credits)

Electives

- OTM 8100 Theory in a Practice Profession (2)
- OTM8520 Administrative Practicum (3)
- OTM8520 Teaching Practicum (3)

- OTM8550 Advanced Theories of Pediatric Intervention (3)
- OTM 8140 Indirect Service (2)
- OTM8110 Thesis Seminar (1)
- Occupational Science (3)
- HP8530 Multidimensional assessment of older adults (3)
- PH6230 Overview of Geriatrics / Gerontology (3)
- PH6530 Principles of Admin. & Program Dev. (3)

## **Movement Sciences in Education (Physical Therapy)**

Doctor of Education

**Points/Credits:** 75

**Entry Terms:** Spring, Summer, Fall

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### **Degree Requirements**

The Physical Therapy track in Movement Sciences will prepare scholars to conduct research on critical issues related to movement habilitation and rehabilitation. The degree program focuses on behavioral processes underlying the learning and control of movements, the neural processes underlying motor learning, motor development, and performance of functional motor action. The degree program also focuses on translating basic science information to design and evaluate interventions to target impairments of the motor system, in order to prevent or improve activity limitations and participation restrictions.

On completion of the Doctoral Program the student will:

- Possess the theoretical and scientific knowledge to perform original basic and applied (clinical) research leading to scientific presentations, peer-reviewed publications, and compete for extramural funding through grant writing.
- Possess a breadth and depth of knowledge in the musculoskeletal or neuromuscular specialty areas as they relate to impairment, activity limitations, and participation restrictions.
- Possess theoretical and practical skills required to teach at the professional entry-level and post-professional levels within the academic community.

Coursework



The Physical Therapy track utilizes the rich academic resources already available within the Movement Sciences Program at Teachers College, and provides students with additional knowledge on the application of movement sciences to content areas within physical therapy. The track provides an additional array of specialized clinical and field-based research courses within the specialization of physical therapy that are taught by the faculty in physical therapy at Columbia University Irving Medical Center.

The program consists of three major components:

1. **Didactic Coursework:** Students are expected to complete required and elective coursework in the following content areas: movement science foundations, biostatistics and research methods, movement science applications to physical therapy, and elective courses in movement science, physical therapy and related areas.
2. **Certification Exam and Pilot Study:** While completing didactic coursework, students will be expected to begin research training with a faculty member and enroll in research training seminar. During research training seminar students present their ongoing research to faculty and peers. Each student will be required to complete a pilot study in preparation for the dissertation. Each student will complete a certification exam in the content area pertaining to his/her research.
3. **Dissertation proposal and dissertation:** After completing a pilot study, each student will defend a dissertation proposal to a faculty committee consisting of at least three members. Following defense of the dissertation proposal, students will register for Dissertation Advisement (BBSR8900) each term while completing the dissertation.

#### Movement Sciences (Physical Therapy) Coursework

The required course includes the following:

- Movement science foundations (12 credits)
- Movement science applications to physical therapy (15 credits)
- Biostatistics and research methods (9 credits)
- Teaching and Learning (3 credits)
- Physical Therapy Doctoral Seminar (minimum 6 credits)

The EdD in Movement Sciences (Physical Therapy) can be taken full-time or part-time to accommodate practicing physical therapists. The expected length of the full-time program is 4 years, and part-time 6 years.

## Doctor of Philosophy

### Kinesiology

Doctor of Philosophy

**Points/Credits:** 75

**Entry Terms:** Fall

### Degree Requirements

We offer a full-time PhD in Kinesiology with students specializing either in motor learning and control or applied physiology. 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 the 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 College or School 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 plan of study 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 Andrew Gordon at [kinesiology@tc.columbia.edu](mailto:kinesiology@tc.columbia.edu). For students electing the Applied Physiology concentration of the Kinesiology program, please contact Professor Kevin Heffernan for more information at [ksh2001@tc.columbia.edu](mailto:ksh2001@tc.columbia.edu).

# Faculty

## Faculty

- Carol Ewing **Garber** Professor of Movement Science and Education
- Andrew Michael **Gordon** Professor of Movement Science and Education
- Kevin Scott **Heffernan** Associate Professor of Movement Science and Education
- Lori **Quinn** Professor of Movement Science and Kinesiology

## Emeriti

- Stephen **Silverman** Professor Emeritus of Education

## Adjunct Faculty

- Julie Beth **Fineman** Adjunct Assistant Professor
- Paul Michael **Gallo** Adjunct Associate Professor
- Richard **Magill** Adjunct Professor
- Matthew A. **Stults-Kolehmainen** Adjunct Associate Professor

# Courses

## BBS 4054 - Human Anatomy and Physiology

An introductory survey of the anatomy of major organ systems and their physiology. Suitable for a wide variety of professionals in fields that involve science, physical education, nursing, health, nutrition, and the arts.

## 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. Prerequisite: BBS 5068

### **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.

### **BBSR 4050 - Biomechanical Analysis of Human Movement**

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.

### **BBSR 4054 - Human Anatomy and Physiology (This will change to BBS4054)**

This is an introductory survey course of the human physiology with content in anatomy of major organ systems. Suitable for a wide variety of professionals in fields that involve science, movement sciences, kinesiology, nursing, health, nutrition, and the arts.

### **BBSR 4060 - Motor Learning**

This course is designed to acquaint the student with principles associated with the acquisition and motor control of functional movement skills. Principles and theories will provide the student with selected concepts of skill development and a framework for their application in clinical practice, coaching and teaching.

### **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 physical activity, exercise, and sport. The focus is on the key theoretical psychosocial principles that are well-known to govern exercise and sports behavior, including the physical, affective (emotional), and cognitive aspects. The course explores theoretical, methodological, and applied approaches to a variety of topics including stress, motivation, cognition, mood, emotion, perceptions of the self, mental illness, exercise adherence, self-regulation and self-control, goal setting, arousal and performance, group dynamics, coaching, and burnout. There will be an emphasis on two major areas of inquiry; consequently, there will be a particular emphasis on stress and motivation.

### **BBSR 4090 - Physical Fitness, Weight Control, and Relaxation**

This course is intended to explore general physiological and nutritional concepts as they apply to physical fitness and overall well-being throughout life. The course is designed for teachers, counselors and others who desire an introduction to basic concepts of physical fitness and nutrition.

### **BBSR 4095 - Applied Physiology I**

Recommended: previous coursework in human physiology. This course is the first of a two-semester sequence of the study of the physiological bases of exercise. Lectures concerning the effects of acute and chronic exercise on the major physiological systems (cellular, cardiovascular, thermoregulatory, pulmonary, renal, body fluids, hormonal) with a focus on application to practice.

### **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. Corequisite: BBSR 4060.

### **BBSR 4195 - Applied Physiology Lab I**

This course will provide students with the theoretical background and practical laboratory and field-based skills to collect data related to human physiology and performance. This course will help students learn to identify appropriate tests to address specific needs of various participants. The emphasis of the course is on hands-on laboratory experience. Topics include body composition, risk assessment, and hemodynamics.

### **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 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**

This course will provide a comprehensive overview of theories of motor control, including a historical review of early theories to more contemporary models. The course will emphasize behavioral analysis of movement with implications for how to optimize motor skill attainment in various populations. We will cover the physiological and psychological foundations of motor control, as well as an overview of various activity systems including walking, posture, reaching and speech.

### **BBSR 5095 - Exercise and Health**

This course focuses on the role of physical activity and exercise in the primary and secondary prevention of common chronic diseases. A survey of the epidemiologic evidence for health and fitness benefits, and the application of scientific evidence-based guidelines for physical activity, exercise evaluation, prescription, and community interventions will be emphasized.

### **BBSR 5096 - Advanced Exercise and Physical Activity Prescription for Health**

This course will review the scientific literature on exercise prescription for physical activity and exercise in people with chronic diseases, conditions such as pregnancy, and in special populations such as older adults and people with disabilities. Through readings and discussion of recent scientific and clinical literature, students will become familiar with the current recommendations for exercise prescription and the application of these recommendations to individuals with complex conditions. The translation of the science to practice will be a focus of this course.

### **BBSR 5101 - Scientific Basis of Exercise for Weight Management**

Weight management and obesity is a problem of energy balance: caloric intake versus expenditure. In this introductory course, students will learn the fundamentals of the role of exercise and physical activity in weight management. This course will discuss the practice and science of using exercise and physical activity for the purpose of managing and maintaining body weight, particularly as part of an integrated multi-disciplinary program. Sometimes, gaining weight is needed (or desired); therefore, there will be some emphasis on gaining lean mass. It is also important to note that exercise is extremely beneficial for health, even when no weight is lost.

### **BBSR 5102 - Electrocardiography & Clinical Exercise Test Interpretation**

This is an online course designed to teach students the fundamentals of reading an electrocardiogram (ECG) and the interpretation of clinical exercise tests. The course content will include 1) the basics of the underlying physiology of the normal and abnormal ECG; 2) how to read the resting and exercise ECG and to recognize common abnormalities; 3) basic pharmacology of commonly prescribed drugs that may affect the ECG and

exercise test responses; and 4) interpretation and application of clinical data as part of the interpretation of the clinical exercise test. The course covers some of the requisite content on the American College of Sports Medicine Clinical Exercise Physiologist certification examination.

### **BBSR 5151 - Introduction to the Analysis of Biomechanical Signals**

Introduction to 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 or other programs. Applications of programming 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 these skills in their own research.

### **BBSR 5194 - Applied Physiology Laboratory II**

This course will provide students with the theoretical background and practical laboratory and field-based skills to collect data related to human physiology and performance. This course will help students learn to identify appropriate tests to address specific needs of various participants. The emphasis of the course is on hands-on laboratory experience. Topics include cardiorespiratory fitness, metabolic testing, anaerobic testing, and field tests.

### **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 students taking practical experience in the field. Field placement arrangements under faculty advisement.

### **BBSR 5251 - Fieldwork Seminar in Motor Learning and Motor Control**

This seminar aims to provide students discussion-based forum for presenting, problem-solving, and implementing practice issues in Movement Science through individualized case studies from their field practice settings. Students will have the opportunity to apply the theoretical and research-based concepts learned in the core coursework of the Movement Sciences Program. These include, but are not limited to the areas of motor skill acquisition, learning & control, motor development, biomechanical and observational analysis of movement,

promotion of physical activity and health, assessment methods, goal-setting, and the development of appropriate movement instruction plans (treatment, training or education plans) to reach those goals.

### **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. Students are expected to be conducting research outside of class in partial fulfillment of their degree requirements for at least 2.5 days (20 hours) per week. Students must meet individually with their advisors(s) within the first three weeks of the semester to discuss written goals to be achieved during the semester.

### **BBSR 5505 - Tutorials in Motor Learning**

This course will cover special topics of motor control. Topic vary .

### **BBSR 5595 - Rsch Sem in Applied Physiology**

Research training for students in Applied Physiology (PhD, EDD, EDM, and M.A.) carrying out research projects. Content includes presentations, research writing, ethics, and other topics that may vary from semester to semester.

### **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 6563 - Seminar in Neuromotor Processes: Analysis of Typical and Atypical locomotion**

This course will focus on the neural and biomechanical control of locomotion, examine techniques for measurement, and explore conditions that result in dysfunction in locomotion. Emphasis is placed on understanding the scientific basis of locomotion, and clinical decision-making based on evidence for individuals with a variety of motor disorders. The course will primarily use a seminar format, whereby we will read and discuss both classic and current journal papers and review articles. These will include human neural, behavioral, biomechanical, and clinical studies.

### **BBSR 6564 - Advanced Topics in Neuromotor Processes**

Advanced topics in motor learning and control. Topic changes annually.



**BBSR 6900 - Research and Independent Study in Movement Science and Education**

Advanced masters and doctoral students in Movement Sciences or Kinesiology will register for this class while working on their Master's level integrative project or dissertation research. Requires a minimum of 27 hours per week of out-of-classroom work. Instructor's approval required.

**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

## Program Description

The M.S. in Neuroscience and Education offers students an opportunity to explore how the brain, examined through molecular, cellular, and systems perspectives, influences development, learning, and behavior. The program equips students to synthesize research across disciplines to provide a neuroscientific framework that informs practice, research, and innovation across diverse settings.

Students build a strong foundation in neuroscience, research methods, and the application of brain science to real-world challenges in education, health, and human development. We offer a broad range of electives, including courses in cognitive development, psychoneuroimmunology, neuroscience ethics and the law, lab methods, the neuroscience of reading, adolescence, and adversity. Together, these allow students to customize their academic path around their interests and career goals.

Each student completes a faculty-guided thesis, exploring a topic of personal or professional relevance in depth. Many also gain hands-on experience through research or independent study. Graduates are prepared to contribute meaningfully in schools, research labs, clinical environments, policy, or industry, with a strong foundation for applying brain science to create transformative impact.

## Degrees

<b>Master of Science</b>
<b>Neuroscience and Education</b>

**Points/Credits:** 32**Entry Terms:** Fall

## Degree Requirements

Explore the connections between brain science, learning, and real-world impact.

Founded in 1979, our program was the first in the country to bring together neuroscience, education, and clinical practice. Today, that pioneering spirit continues. We offer a unique experience for students who want to understand how brain function relates to behavior, learning, and development – an area of study that requires integrating knowledge from neuroscience, psychology, education, and related fields. This understanding prepares them to make meaningful contributions in schools, research labs, clinical settings, industry, or policy work.

Students in our program learn to think across traditional boundaries. Through coursework, lab work, and applied experiences, they develop a deep foundation in brain-behavior relationships, with opportunities to specialize in areas that match their goals. Whether you're aiming for a career in research, preparing for medical or doctoral programs, or planning to return to teaching or clinical practice with stronger scientific grounding, this program offers a flexible and rigorous path.

The M.S. degree requires 32 credits of graduate study, with opportunities to engage in neuroscience research through affiliated labs. Students benefit from the rich educational resources available at Teachers College, with access to courses and mentorship in education, psychology, and related fields.

Graduates of our program go on to doctoral study, clinical training, teaching, educational leadership, industry positions, and research-focused careers. What they share is a strong ability to integrate neuroscience with applied disciplines and real-world practice, bringing scientific insights to complex questions about how people learn, grow, and thrive.

### Core Competencies

Our program emphasizes four core areas of growth and training:

#### 1. Interdisciplinary Knowledge and Skills

Students gain foundational knowledge in developmental and cognitive neuroscience at multiple levels: cellular, molecular, systems, and behavioral. They build a strong understanding of how neuroscience connects to real-world challenges in education, human development, and related domains, and how to think critically across disciplines.

#### 2. Research and Inquiry

Students develop the skills to read, evaluate, and contribute to primary neuroscience literature. They learn to design and interpret experiments, understand clinical research, and frame scientific questions that matter in real-world settings.

### 3. Diversity, Equity, and Inclusion

Students explore how neuroscience can inform more inclusive, equitable approaches to learning. They consider how brain research can be used to address disparities and support all learners in varied educational and cultural contexts.

### 4. Communication, Collaboration, and Leadership

Students learn how to communicate scientific findings to different audiences, across disciplines and beyond academia. They gain experience in writing, presenting, and translating neuroscience research in ways that make a difference for educators, clinicians, and communities.

## Degree Requirements: M.S. in Neuroscience and Education

The Master of Science (M.S.) degree requires 32 graduate-level credits. These are typically completed through a mix of core coursework, electives, and a culminating thesis. Most students complete the program in 3-4 semesters of full-time study.

### 1. Core Courses (Required)

You must complete all courses in the core course sequence listed below. All core courses require a minimum grade of B to remain in good standing.

- BBSN 4001 Foundations of Neuroscience I: Anatomy & Physiology (Fall only. Waiver exam available, permission required.)
- BBSN 4002 Foundations of Neuroscience II: Systems (Spring only. Waiver exam available, permission required.)
- BBSN 4005 Research Methods in Neuroscience (Fall only. Prior coursework may satisfy requirement if approved.)
- BBSN 4007 Neuroscience Applications to Education (Offered Fall and Spring. Take after the Foundations sequence.)
- BBSN 5500 Thesis and Professional Development (Take during your final Fall or Spring semester. Required for graduation.)

### 2. Cognitive / Psychological Neuroscience Cluster (minimum 3 credits)

Choose at least one course (3 credits) from the following group:

- BBSN 5003 – Cognitive Neuroscience (Spring)
- BBSN 5070 – Developmental Cognitive Neuroscience (Fall)
- BBSN 5080 – Social and Affective Neuroscience (Spring)
- BBSN 5005 – Neuropsychological Assessment Tools (Fall)
- BBSN 5010 – Neuroscience of Reading (Fall)

- BBSN 5055 – Neuroscience of Adolescence (Fall)

These courses may also count as in-program electives if not applied for this requirement (courses may not count twice).

### 3. In-Program Electives (minimum 6 credits)

You'll need at least 6 additional credits from elective courses within the Neuroscience and Education program.

These change from time to time. Recent offerings have included:

- EEG Lab Methods
- Eye Tracking Lab Methods
- Neuroscience of Reading
- Neuroscience of Adolescence
- Neuroscience of Adversity
- Psychoneuroimmunology & Education
- Neuroscience, Ethics, and the Law
- Neuroscience Perspectives for Educators

### 4. Breadth Requirement (minimum 6 credits outside the program)

You must complete at least 6 credits from outside BBSN, typically in education, psychology, or data analysis.

Recommended areas include:

#### Statistics and Data Handling

- HUDM 4120 – Basic Statistics
- HUDM 5026 – Intro to Data Analysis in R
- HUDM 5122 – Applied Regression (advanced)

#### Psychology and Human Development

- HUDK 5023 – Cognitive Development
- HUDK 5024 – Language Development
- HUDK 5029 – Personal and Social Development
- HBSK 5096 – Psychology of Memory
- HUDK 5040 – Developmental Psychopathology

Other options may include education policy, movement sciences, or nutrition. Always consult your advisor to ensure your selections meet program guidelines. Do not register for BBS 5068 or 5069, which are not designed for Neuroscience and Education students.

### 5. Additional Credits (to reach 32 total)

Most students meet the 32-credit requirement by exceeding the minimums above. Remaining credits can come from:

- Additional in-program electives
- Extra cognitive/psych cluster courses
- Additional breadth courses
- Research or independent study (see below)
- Graduate-level courses at Columbia, Barnard, or Columbia Medical School

#### 6. Thesis Requirement (3 credits, required for graduation)

All students must complete a thesis during their final regular semester (Fall or Spring) by enrolling in BBSN 5500. This course is Pass/Fail and carries full-time status.

Your thesis may take one of three forms:

- Systematic literature review
- Detailed experimental research proposal
- Empirical research report (only in rare cases, with approval and prior data access)

The thesis serves as a culminating demonstration of your scientific learning and communication skills. You will receive detailed guidance and feedback from your instructor and, if needed, a second reader.

#### 7. Optional: Research / Independent Study (BBSN 4904, 0–3 credits)

If you participate in significant experiential learning (e.g., lab work or applied projects), you may enroll in Independent Study for transcript credit. This option should be arranged in consultation with your advisor and your on-site supervisor.

## Faculty

### Faculty

- Peter **Gordon** Associate Professor of Neuroscience and Education
- Kay **James** Associate Professor of Neuroscience and Education
- Kimberly G **Noble** Professor of Neuroscience and Education

## Professors of Teaching

- Lisa Merideth **Levinson** Assistant Professor of Teaching

## Adjunct Faculty

- Adriel **Brown** Adjunct Assistant Professor
- Anlys **Olivera** Adjunct Professor
- Stephen Alan **Sands** Adjunct Professor

# Courses

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

This course is an introduction to the mammalian nervous system, emphasizing the structure and function of the human brain. It provides foundational knowledge for students with little or no background in neuroscience and an essential review for students with limited course work in neuroscience. Topics to be covered include the history of neuroscience, the function of brain cells, intra- and intercellular communication, and the anatomy of the human nervous system. This course takes a Flipped Learning approach to introduce the mammalian nervous system, emphasizing the structure and function of the human brain. It provides foundational knowledge for students with little or no background in neuroscience and an essential review for students with coursework in neuroscience. Topics to be covered include the history of neuroscience, the function of brain cells, intra- and intercellular communication, and the anatomy of the human nervous system. This course incorporates online lectures to emphasize essential topics from the text, weekly quizzes to support students' consolidation of material and gauge comprehension, in-class discussions to extend topics covered, discussion follow-up work, and group projects. You should expect to spend 7 to 10 hours each week outside of class engaging with course content.

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

This course is a continuation of the Foundations in Neuroscience series, and is intended for students who have completed Foundations I: Neuroanatomy & Physiology. The topics to be covered include the visual system, the auditory system, the somatosensory system, motor movement, chemical control of brain & behavior, and memory. This course takes a flipped learning approach, incorporating a weekly online lecture that emphasizes essential topics from the textbook alongside weekly quizzes to support students' consolidation of material and gauge comprehension. In-class discussions and activities extend topics covered and involve follow-up discussion

work. Group projects are assigned to support collaborative learning. You should expect to spend 7 to 10 hours each week outside of class engaging with course content.

### **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 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 the functional MRI training at MGH's Martinos Center. Registration is 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. Students should consult with their advisor prior to registration.

### **BBSN 5000 - Electrophysiology 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 reviews the history of cognitive neuroscience, provides an overview of the structure & function of the nervous system, and delves into the methods used to investigate the cognitive and neural processes that support visual object recognition, attention, language, memory, and cognitive control. We will consider evidence from healthy study participants as well as patients with neurological disorders. Students will be introduced to relevant theoretical perspectives and converging evidence for each covered topic. Students will work both independently and collaboratively to gain a deeper understanding of the topics covered by synthesizing the extant literature.

### **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 5010 - Neuroscience of Reading**

This course is an introduction to the neuroscience of reading, its development, and disorders. We will contemplate questions about the reading brain, including: What is reading? How do we make meaning of marks on a page? How does language development support reading development? What is the significance of this technology to society? How do we study the reading brain? What goes on in the brain when learning to read and in skilled readers? What is or isn't happening in the brains of children who struggle to read? We will consider theoretical frameworks and how they provide a foundation for discussing the neurological underpinnings of sub-processes supporting reading. Experimental findings from neuroscience and cognitive neuroscience will be reviewed and evaluated. The insights gathered from this work will help build an understanding of the sub-processes supporting reading across a lifespan and among linguistic communities. We will also review how developmental and acquired reading disorders have contributed to our understanding of the reading brain and its implications for instruction.

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

This 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 5055 - Neuroscience of Adolescence**

Join our in-person weekly course to explore the incredible world of adolescent brain development. Learn how neuroscience has expanded our understanding of this critical life stage, bridging childhood and adulthood. We'll examine adolescence through biological, cultural, evolutionary, and historical lenses and review theoretical models in light of current brain development research. Understand the differences and connections between puberty and adolescence and explore brain plasticity and its impact on cognitive growth. Key topics include: - Motivational systems and the social brain -The emergence of psychological disorders in adolescence - Vulnerabilities to drugs and alcohol during this developmental period Moreover, we'll delve into the practical applications of adolescent neuroscience for education and policy, equipping students to make meaningful contributions in these areas. Through collaborative projects, you'll synthesize the latest literature and deepen your understanding of the neuroscience of adolescence. Join us for an in-depth journey into the teenage brain and its complexities.

### **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 - Social and Affective Neuroscience**

Social and affective neuroscience are research disciplines in which researchers investigate how the brain mediates social and emotional behavior. In this course, we will discuss a broad- spectrum of topics related to socioemotional behavior that is evidenced by neuroscientific research. We will review foundational concepts in neuroscience including aspects of neuroanatomy, neurophysiology, neuropharmacology, and brain imaging techniques. Special topics will include the evolutionary origins of social intelligence, consciousness, emotion, motivation, interpersonal and group processes, and relationships. Through in-depth case study analyses, we will examine various socioemotional-related mental disorders including antisocial personality, bipolar, generalized anxiety, major depressive, obsessive-compulsive, posttraumatic stress, and schizophrenia spectrum disorders. Additionally, we will explore how mind-body practices can be used as treatments for socioemotional disturbances. Finally, students will have the opportunity to design a research study investigating a current issue in socioemotional neuroscience.

### **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 5500 - Neuroscience & Ed Thesis & Professional Development**

The goal of BBSN 5500 is to provide a structured approach to writing the thesis. Class meetings involve lectures on selecting and refining thesis topics, writing different sections of an academic paper, APA format and stylistic conventions, and grammar. Students make several presentations on their work over the course of the semester and provide substantive feedback to their peers. Once thesis drafts are completed, the course focuses on best practices for designing poster and professional presentations based on thesis work. This course requires a minimum of 36 hours per week of out of classroom work.

### **BBSN 6904 - Research and Independent Study: Neuroscience and Education**

Research and independent study.