

## **Department of Psychology and Neuroscience Graduate Training Program in Behavioral, Psychiatric and Statistical Genetics (BPSG)**

Behavioral genetics is an area of specialization devoted to the study of genetic and environmental influences on behavior. In behavioral genetics, principles and techniques from biochemical genetics, developmental genetics, evolutionary genetics, molecular genetics, pharmacogenetics, and quantitative genetics are applied to the analysis of behavior. Students in the graduate training program are expected to achieve competence in genetics relevant to their special research interests. Departmental faculty are currently applying the concepts and tools of behavioral genetics to such diverse areas as aging, alcohol abuse and addiction, cognitive development, drug abuse and addiction, learning disabilities, neurological diseases, nicotine tolerance and withdrawal, personality/temperament, and psychopathology.

Within the BPSG graduate training program, students can arrange a course of studies that incorporates elements of the other training programs in the Department of Psychology and other academic units within the University (e.g., the Department of Ecology and Evolutionary Biology, the Department of Molecular, Cellular, and Developmental Biology, and the Department of Integrative Physiology). A graduate Interdisciplinary Certificate in Behavioral Genetics is available in the University of Colorado, Boulder, Graduate School and is administered through the Institute for Behavioral Genetics (IBG).

NOTE: In this document, the word “semester” refers to the Fall or Spring semester. It does not refer to Maymester, Summer Session or Augmester.

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## **I. Academic Advisor, Research Experience, Student Record, the Advisory and Examination Committees, and Sets of Requirements**

### **I.A. Academic Advisor**

On being admitted, the student will be assigned a BPSG area major advisor to supervise the training program leading to advanced degrees. If a change of interests or circumstances necessitates a change of advisor, students should obtain written consent from the faculty member with whom they wish to work and the approval of the Director of the BPSG training program.

### **I.B. Research Experience**

Each semester of their graduate career, students will be required to engage in research under the supervision of a faculty member. Usually the faculty member is the student's advisor but it may also include other faculty. It is expected that the first year of this research will be in the form of a research apprenticeship.

### **I.C. Student Record**

A file of each student's achievements in coursework, research, and other requirements and achievements towards degree completion will be kept in the office of the Graduate Program Assistant in the Department of Psychology and Neuroscience and at the Institute for Behavioral Genetics. This file also should include copies of all papers, published and unpublished, for which the student desires credit during evaluation procedures.

It is the student's responsibility to keep this file up to date by submitting every spring after meeting with the student's advisory committee (see Section I.D) a brief description of the research and teaching experience gained during the previous year.

### **I.D. Advisory and Examination Committees**

In the first or second semester of residence, the student and his/her advisor should establish a faculty advisory committee consisting of the advisor and two faculty in the area of behavioral genetics. At the end of the second semester and each year thereafter, the student will meet with the advisory committee to review progress and plan for the forthcoming year. This evaluation may include a written examination. The advisory committee will then recommend to the BPSG area and the Department one of the following courses of action: continuation, continuation with conditions, or termination.

For the Doctor of Philosophy (Ph.D.) comprehensive exam, the Ph.D. dissertation proposal and the Ph.D. defense, the student's advisor—usually with input from the student—will establish examination committee of at least five members. Usually, the advisory committee constitutes three of these members. These committees must have at least two graduate faculty members from the BPSG area and at least one faculty member from a department other than Psychology and Neuroscience. Often, this examination committee also acts as an advisory committee for the purpose of

planning and executing the Master's and Ph.D. requirements. Also, the comprehensive exam, dissertation proposal and defense committees are usually comprised by the same people and is referred to as the doctoral committee.

The three-person advisory committee is sufficient for the defense and comprehensive exam for the Master's degree (see Section II.D). Most students, however, combine this defense and comprehensive exam with the Ph.D. comprehensive exam (see Section III.D).

### **I.E. Sets of Policies, Rules and Requirements**

For both the Masters of Art's degree and the Ph.D. degree, there are three sets of policies, rules, and requirements. The first set is the program requirements contained in this document. The second is the set of the Department of Psychology and Neuroscience currently available at <https://www.colorado.edu/psych-neuro/sites/default/files/attached-files/departamental-graduate-student-rules.pdf>. The third set includes the rules of the Graduate School of the University of Colorado currently available from the links at <https://www.colorado.edu/graduateschool/current-students> and <http://www.colorado.edu/GraduateSchool/policies>. It is the student's responsibility to be familiar with these policies, rules, and requirements.

The procedures and rules in this document pertain to those pursuing graduate training in the BPSG program in the Department of Psychology and Neuroscience. A related set of rules and procedures exists for those pursuing the Institute for Behavioral Genetics (IBG) Interdisciplinary Certificate in Behavioral Genetics which may be found by searching "certificate" at <https://www.colorado.edu/ibg/>. The certificate applies to graduate students in other programs in the Department of Psychology and Neuroscience and to graduate students in other Departments. (It is possible, albeit redundant, for a student in the BPSG program to also gain the certificate). The only large substantive difference between the certificate and the BPSG program arises when a student petitions to substitute coursework for required courses or the lists of elective courses. Students in the BPSG program petition to their advisory or examination committees. Students in the certificate program, including those in the BPSG program, must petition the IBG Training Committee.

## **II. Program Leading to the Master of Arts Degree**

The Master of Arts' (M.A.) degree is a prerequisite for the Ph.D. degree.

### **II.A. Master's Degree: Coursework**

The student must complete 30 semester hours of graduate work for the M.A. degree with a grade of C or better. If the student chooses to write the first-authored publishable paper in the form of a master's thesis (see Section II.B), then the student must register for the appropriate number of thesis hours required by the Graduate School.

A student may petition the advisory or examination committee to substitute another course for a required course. If the student wishes to pursue the IBG Certificate, then the petition must also be made to the IBG Training Committee in addition to the advisory/examination committee.

**II.A.1. Required Courses****II.A.1.1. Physiological Genetics (PSYC 5200, IPHY 5200, 3 credits; Stitzel).**

This requirement may be waived for students who have had an equivalent course in molecular genetics or substituted by another graduate molecular genetics course. Examples of other graduate molecular genetics courses are:

- MCDB 5220, Molecular Genetics, 3 credits
- MCDB 5230, Gene Expression, 3 credits
- MCDB 5471, Mechanisms of Gene Regulation in Eukaryotes, 3 credits
- MCDB 5520, Bioinformatics and Genomics, 3 credits

**II.A.1.2. Introduction to Behavioral Genetics (PSYC 5102, 3 credits; Carey).****II.A.1.3. Statistics**

This must be a graduate-level course in statistics (of at least one semester), approved by the student's advisory committee. The following courses are examples:

- PSYC 5741, 5751 (Graduate Statistics, 4 credits)
- PSYC 5741 (Quantitative Methods in Neuroscience, 4 credits)
- IPHY 5800, (Advanced Statistics and Research Methods in Integrative Physiology, 5 credits)

**II.A.1.4. Scientific ethics (PSYC 5112, 3 credits; Rhee).****II.A.2. Electives**

The remaining courses are electives. Most students will choose these from the electives and suggested courses for the Ph.D. listed below in Sections III.A.2.1 and III.A.2.2.

**II.B. Research Paper**

The student must submit and defend to the Master's faculty committee (or to the Ph.D. comprehensive exam committee, if the M.A. and Ph.D. comprehensive exam are taken together) either (1) one first-authored paper of publishable quality or (2) a suitable graduate fellowship application such as an F31 that has been submitted to the relevant funding agency. The topic of paper and the fellowship as well as the agency for the fellowship must be preapproved by the committee. Details of the defense are given below in Sections II.D.

The student may choose to format the paper as a Master's thesis. If this option is chosen, then the thesis must agree with the all rules of the Graduate School. Note that one rule is that the student must have completed the appropriate number of thesis credit hours required by the Graduate School.

## **II.C. Advisory Meeting**

Yearly, after the end of the Spring semester, the student must schedule a meeting with the Advisory committee to review progress for the past year and to plan for the forthcoming year. The student and the advisory committee should submit a written account of this meeting to the Graduate Program Assistant in the Department of Psychology and Neuroscience and to appropriate staff member at the Institute for Behavioral Genetics.

## **II.D. Master's Degree: Examinations and Evaluations**

At the end of the fourth semester or beginning of the fifth semester, the student will schedule the comprehensive final examination for the Master's. The examination may be written, oral or both and must cover the first-authored publishable paper or the submitted graduate fellowship. The comprehensive examination for the Master's degree is almost always combined with the Ph.D. comprehensive examination request of the student and the approval of the student's advisory committee. If so, the examination shall be written and oral and shall be administered by the five-person committee described in Section I.D. It is the student's responsibility to ensure that all Graduate School requirements for the Master's degree have been met prior to this time.

## **II.E. Master's Degree: Rules of the Graduate School**

Students are responsible for compliance with the rules of the Graduate School which may be found at <http://www.colorado.edu/GraduateSchool/policies> and <http://www.colorado.edu/GraduateSchool/academics/#graduation>. One important rule is that the students must be registered for credits the semester (including summer sessions) in which the master's defense—including, if relevant, the Ph.D. comprehensive exam—is taken.

## **II.F. Presentations**

Students are expected to present at the following three forums:

### **II.F.1. Journal Club**

Students must participate in the weekly journal club and colloquia series at the Institute for Behavioral Genetics. For the Master's Degree, the student must present at journal club at least one time.

### **II.F.2. Orientation Poster Session**

At the end of the first year and every year thereafter, the student must present at the annual IBG orientation poster session at the beginning of the Fall semester.

### **II.F.3. Mini Conference**

The student will attend and present at the annual mini conference after the end of the Spring semester.

### **III. Program Leading to the Ph.D. Degree**

Students are admitted into the Ph.D. program and are expected to work towards this degree immediately. They are, however, considered by the Graduate School to be official “candidates” for the degree only after successful completion of the Master’s degree and passing the Ph.D. comprehensive examination.

None of the stipulations of the BPSG training program is in conflict with normal Graduate School requirements. It is the student's responsibility to see that these requirements, including total credit hours, advanced registration for examinations, etc., are met. Students should arrange for the scheduling of examinations with their major advisor and the Director of Graduate Studies in the Department of Psychology and Neuroscience. The student should pay careful attention to the rules governing the various examinations, thesis preparation, residence requirements, etc., as they are set forth in the Graduate School Bulletin. The Graduate School mandates completion of the Ph.D. in six years. Students failing to meet this deadline must receive an approved extension from the Graduate School in order to continue in the program. A written request for extension should specify the extenuating circumstances necessitating the extension.

The current rules of the Graduate School and requirements for graduation can be found on the web at <http://www.colorado.edu/GraduateSchool/policies> and <http://www.colorado.edu/GraduateSchool/academics/#graduation>.

#### **III.A. Ph.D. Degree: Coursework**

Department of Psychology and Neuroscience Ph.D. students in the behavioral genetics area are required to: (1) complete the required courses for the M.A. degree; (2) select some elective courses from a longer list of options; and (3) and to select courses from other electives to complete a total of 30 credit hours of coursework at the 5000 level or above. Each course must be passed with a grade of C or better. At least 20 of these hours must be taken at courses at the University of Colorado, Boulder.

Also, trainees with predoctoral fellowships are required to take one or more courses in the area of their fellowship. As many courses are not taught every year, it is the student’s responsibility to take relevant courses when offered.

A student may petition the advisory or examination committee to substitute another course for a required course or for one of the courses in the list of electives. If the student wishes to pursue the IBG Certificate, then the petition must also be made to the IBG Training Committee in addition to the advisory/examination committee.

##### **III.A.1. Required Courses**

Because the Master’s degree is a requirement for the Ph.D., the student must have completed the required courses for the Masters listed in Section II.A. They are reproduced here.

**III.A.1.1. Physiological Genetics (PSYC 5200, IPHY 5200, 3 credits; Stitzel).**

This requirement may be waived for students who have had an equivalent course in molecular genetics or substituted by another graduate molecular genetics course. Examples of other graduate molecular genetics courses are:

- MCDB 5220, Molecular Genetics, 3 credits
- MCDB 5230, Gene Expression, 3 credits
- MCDB 5471, Mechanisms of Gene Regulation in Eukaryotes, 3 credits
- MCDB 5520, Bioinformatics and Genomics, 3 credits

**III.A.1.2. Introduction to Behavioral Genetics (PSYC 5102, 3 credits; Carey).****III.A.1.3. Statistics**

This must be a graduate-level course in statistics (of at least one semester), approved by the student's advisory committee. The following courses are examples:

- PSYC 5741, 5751 (Graduate Statistics, 4 credits)
- PSYC 5741 (Quantitative Methods in Neuroscience, 4 credits)
- IPHY 5800, (Advanced Statistics and Research Methods in Integrative Physiology, 5 credits)

**III.A.1.4. Scientific ethics (PSYC 5112, 3 credits; Rhee).****III.A.2. Electives**

Note that some courses listed below have generic titles in the University of Colorado Course Catalog. These include PSYC 5112 (Concepts in Behavioral Genetics), PSYC 7102 (Seminar in Behavioral Genetics), and IPHY 6010 (Seminar). The topics of these courses will change every semester. Students must register for the course under the appropriate topic given in the lists below.

**III.A.2.1. Students must take three courses from the following list:**

1. Quantitative Genetics (PSYC 5122, 3 credits; Stallings).
2. One course in Molecular Genetics/Genomics. These include:
  - IPHY 5102, 2 credits; Johnson;
  - PSYC 5232, Molecular Genetics and Physiology 3 credits;
  - MCDB 5220, Molecular Genetics, 3 credits;
  - MCDB 5230, Gene Expression, 3 credits;
  - MCDB 5471, Mechanisms of Gene Regulation in Eukaryotes, 3 credits
3. Biometrical Methods in Behavioral Genetics (PSYC 5242, 3 credits; Hewitt).
4. Bioinformatics and Genomics (IPHY 5262, PSYC 5262, 3 credits; Ehringer).
5. One course in Behavioral Neuroscience. These include:
  - NRSC 5100, Introduction to Neuroscience I, 2-5 credits



- NRSC 5110, Introduction to Neuroscience II, 3 credits
- NRSC 5032, Neurobiology of Learning and Memory, 3 credits
- NRSC 5052, Behavioral Neuroscience, 3 credits
- NRSC 5072, Clinical Neuroscience, 3 credits
- NRSC 5132, Neuropharmacology, 3 credits
- NRSC 5092, Behavioral Neuroendocrinology, 3 credits

**III.A.2.2. Students must take two courses (at least four credit hours) from the following list:**

1. Genetics of Psychopathology (PSYC 7102, 2 credits; Rhee). **Note: this course is required of NIMH trainees.**
2. Genetics and Substance Use Disorders (PSYC 7102, 2 credits; Stallings). **Note: NIDA trainees are required to take at this or NRSC 5545 (Neurobiology of Addiction)**
3. Neurobiology of Addiction (NRSC 5545, 3 credits, Bachtell). **Note: NIDA trainees are required to take at this or PSYC 7102 (Genetics and Substance Use Disorders)**
4. Benchmark Papers in Behavioral Genetics (PSYC 7102, 2 credits; Hewitt).
5. Developmental Psychopathology (PSYC 5453, 3 credits, Willcutt)
6. Population Genetics in the Modern Genomics Era (PSYC 7102, 2 credits; Keller)
7. Aging and Neurodevelopmental Disorders (IPHY 6010, 3 credits, Hoeffler)
8. Geroscience and Anti-Aging Medicine (IPHY 6010, 3 credits, Johnson)
9. Structural Equation Modeling (PSYC 5761, 3 credits, Friedman)
10. Topics in Advanced Structural Equation Modeling (PSYC 6761, 3 credits, Friedman)
11. Statistical Programming in R (PSYC 7102, 2 credits, Keller)

**III.A.3. Thesis Hours**

The student must complete 30 semester hours of Psychology 8991 – Doctoral Thesis Research. Note that five of these hours must be completed in the semester(s) after admission to candidacy.

**III.B. Master of Arts Degree**

The Master of Arts degree is a prerequisite for the Ph.D. degree. See Section II for the Master's requirements.

**III.C. Advisory Meetings**

Yearly, after the end of the Spring semester, the student must schedule a meeting with the Advisory committee (or, if the student has been admitted to Ph.D. candidacy, the doctoral committee) to review progress for the past year and to plan for the forthcoming year. The student and the advisory committee should submit a written account of this meeting to the Graduate Program Assistant in the Department of

Psychology and Neuroscience and to appropriate staff member at the Institute for Behavioral Genetics.

### **III.D. Comprehensive Exam**

Before admission to candidacy for the Ph.D. degree, the student must pass a comprehensive examination in the field of concentration and related fields before a five-member examination committee (the doctoral committee). This written examination will test the student's mastery of a broad field of knowledge, not merely the formal course work completed. Each committee member will submit two written questions and the student will select one to answer. The committee member has the prerogative to determine whether the candidate answers the questions in an open or closed book manner. Following the written part of the exam, the student will be questioned orally on both the content of the answers as well as other areas in behavioral, psychiatric, and statistical genetics. Typically, this examination is performed in conjunction with the Master's defense and Master's comprehensive exam.

### **III.E. Dissertation Proposal**

Following completion of the comprehensive examination, the student must submit a written doctoral research proposal, including a review of the pertinent literature, to all members of the doctoral committee. Approximately 2 weeks later, the committee will meet with the student to evaluate and provide feedback on the proposal.

### **III.F. Dissertation Defense**

The student will present an overview of the dissertation and defend the dissertation before the doctoral committee. At the discretion of the student and the committee, other interested parties may be invited to the defense. The committee will deliberate in executive session to make recommendations on pass, fail, or need for revisions.

### **III.G. Teaching Experience**

The student is required to obtain at least one semester of teaching experience. This requirement is usually met by successful performance as a teaching assistant.

### **III.H. Presentations**

Students are expected to present at the following four forums:

#### **III.H.1. Journal Club**

Students must participate in the weekly journal club and colloquia series at the Institute for Behavioral Genetics. For the Ph.D., the student must present at journal club at least three times.

### **III.H.2. Orientation Poster Session**

At the end of the first year and every year thereafter, the student must present at the annual IBG orientation poster session at the beginning of the Fall semester.

### **III.H.3. Mini Conference**

The student will attend and present at the annual mini conference after the end of the Spring semester.

### **III.H.4. Exit Colloquium**

All students are expected to do an exit colloquium at the conclusion of their training program. This presentation should be modeled as a 'job talk,' not a repeat of the final defense.