Undergraduate Program in Brain & Cognitive Sciences
Tiered curriculum system

Our intensive undergraduate program is a tiered system that builds on the expertise gained at each preceding level. It begins with a first year introduction to neuroscience, cognitive science and computation, with a particular emphasis on courses that hone critical skills in programming and statistics. Students can focus on individual areas of interest as they progress through the program.

Tier III
Advanced

Tier II
Core lecture and Labs

Tier I
Intro

Majoring in brain and cognitive sciences is so much more than just neuroscience and psychology. You can work with mice, you can work with computers, you can code— you’re really taking multiple disciplines and forging your own path. And after you’re done, you can take the skills you’ve learned here and work anywhere in the world, doing anything.”

- BCS undergraduate Ian Zaun
## TIER ONE: Foundation Courses
Required for all Majors

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall &amp; Spring</td>
<td>6.0001/6.0002</td>
<td>Introduction to Computer Science &amp; Programming</td>
</tr>
<tr>
<td>Fall</td>
<td>9.01</td>
<td>Introduction to Neuroscience</td>
</tr>
<tr>
<td>Spring</td>
<td>9.00</td>
<td>Introduction to Psychological Science</td>
</tr>
<tr>
<td>Spring</td>
<td>9.40</td>
<td>Introduction to Neural Computation</td>
</tr>
</tbody>
</table>

### 6.0001 Introduction to Computer Science Programming in Python (first half of term)
Introduction to computer science and programming for students with little or no programming experience. Students learn how to program and how to use computational techniques to solve problems. Topics include software design, algorithms, data analysis, and simulation techniques. Assignments are done using the Python programming language. 6; REST

### 6.0002 Introduction to Computational Thinking and Data Science (second half of term)
Introduction to computer science and programming for students with little or no programming experience. Students develop skills to program and use computational techniques to solve problems. Topics include the notion of computation, Python, simple algorithms and data structures, testing and debugging, and algorithmic complexity. 6; REST

### 9.00 Introduction to Psychological Science
A survey of the scientific study of human nature, including how the mind works, and how the brain supports the mind. Topics include the mental and neural bases of perception, emotion, learning, memory, cognition, child development, personality, psychopathology, and social interaction. Consideration of how such knowledge relates to debates about nature and nurture, free will, consciousness, human differences, self, and society. 12; HASS-S

### 9.01 Introduction to Neuroscience
Introduction to the mammalian nervous system, with emphasis on the structure and function of the human brain. Topics include the function of nerve cells, sensory systems, control of movement, learning and memory, and diseases of the brain. 12; REST; Prerequisite: Physics II (GIR)

### 9.40 Introduction to Neural Computation
Introduces quantitative approaches to understanding brain and cognitive functions. Topics include mathematical description of neurons, the response of neurons to sensory stimuli, simple neuronal networks, statistical inference and decision making. Also covers foundational quantitative tools of data analysis in neuroscience: correlation, convolution, spectral analysis, principal components analysis. Mathematical concepts include simple differential equations and linear algebra. 12; Prerequisite: 6.0002 & 9.01

### 9.07 Statistics for Brain and Cognitive Sciences
Provides students with the basic tools for analyzing experimental data, properly interpreting statistical reports in the literature, and reasoning under uncertain situations. Topics organized around three key theories: probability, statistical, and the linear model. Probability theory covers axioms of probability, discrete and continuous probability models, law of large numbers, and the Central Limit Theorem. Statistical theory covers estimation, likelihood theory, Bayesian methods, bootstrap and other Monte Carlo methods, as well as hypothesis testing, confidence intervals, elementary design of experiments principles and goodness-of-fit. The linear model theory covers the simple regression model and the analysis of variance. Places equal emphasis on theory, data analyses, and simulation studies. 12; Prerequisite: 9.40
Choose Your Own Adventure:

- **Interested in a Cellular/Molecular Neuroscience concentration go to page 7**
  
  Example careers of our alumni who went into Cell/Molecular Neuroscience:
  
  - Pharmaceutical Scientist
  - Senior Research Scientist
  - Project Manager
  - Graduate school or Medical School

- **Interested in a Cognitive Science concentration go to page 9**
  
  Example careers of our alumni who went into Cell/Molecular Neuroscience:
  
  - Pharmaceutical Scientist
  - Senior Research Scientist
  - Project Manager
  - Graduate school or Medical School

- **Interested in a Systems Neuroscience concentration go to page 8**
  
  Example careers of our alumni who went into Systems Neuroscience:
  
  - Data Scientist
  - Research Technician
  - Senior Business Analyst
  - Graduate school or Medical School

- **Interested in a Computation concentration go to page 10**
  
  Example careers of our alumni who went into Computational Neuroscience:
  
  - Computational Neuroscientist
  - Software Developer
  - Computational Modeling and Machine Intelligence Scientist
  - Data Analytics Specialist

Brain and Cognitive Sciences – Class Recommendations

**Cellular/Molecular Neuroscience**

9.URG Undergraduate Research

Tier 2

- 9.05J Cellular and Molecular Neurobiology
- 9.16J Cellular Neurophysiology
- 9.18J Developmental Neurobiology

Laboratory

- 9.12J Experimental Molecular Neurobiology

Tier 3

- 9.24J Disorders and Diseases of the Nervous System
- 9.26J Principles and Applications of Genetic Engineering for Biotechnology and Neuroscience
- 9.28J Current Topics in Developmental Neurobiology
- 9.32J Genes, Circuits and Behavior

Restricted Electives

- 7.03J Genetics
- 7.05J General Biochemistry

**Engineering/Chemistry/Biology**

- 5.07J Biological Chemistry I
- 5.08J Biological Chemistry II
- 6.021J Cellular Neurophysiology
- 6.802 J Foundations of Computational and Systems Biology
- 7.06 J Cell Biology
- 7.15 J Experimental Molecular Genetics
- 7.22 J Developmental Biology
- 7.28 J Molecular Biology
- 7.32 J Systems Biology

An image of neurons in a mouse hippocampus taken with expansion microscopy. Ed Boyden, Fei Chen, Paul Tillberg. Synthetic Neurobiology Laboratory.
White matter fiber tracts in the adult human brain, visualized using a diffusion-weighted MR imaging scan. Zeynep Saygin, Gabrieli and Kanwisher laboratories

### Brain and Cognitive Sciences – Class Recommendations

#### Systems Neuroscience

9.URG Undergraduate Research

**Tier 2**
- 9.10 Cognitive Neuroscience
- 9.20 Animal Behavior
- 9.16 Cellular Neuropathology
- 9.31 Neurobiology of Learning and Memory
- 9.34J Biomechanics and Neural Control of Movement
- 9.54 Computational Aspects of Biological Learning

**Laboratory**
- 9.17 Systems Neuroscience Laboratory

**Tier 3**
- 9.26J Principles and Applications of Genetic Engineering for Biotechnology and Neuroscience Math

#### Engineering/Physics/Chemistry

**Restricted Electives**
- 2.003J Dynamics and Control I
- 5.07J Biological Chemistry I
- 6.12 Organic Chemistry I
- 6.01 Introduction to EECS 1
- 6.002 Circuits and Electronics
- 6.003 Signals and Systems
- 6.034 Artificial Intelligence
- 6.045J Automata, Computability, and Complexity
- 7.03 Genetics
- 7.05 General Biochemistry
- 20.309J Instrumentation and Measurement for Biological Systems

#### Cognitive Science

9.URG Undergraduate Research

**A student interested in language:**

**Tier 2**
- 9.66J Computational Cognitive Science
- 9.85 Infant and Early Childhood Cognition

**Laboratory**
- 9.59J Laboratory in Psycholinguistics

**Restricted Electives**
- 6.003 Signals and Systems
- 18.510 Introduction to Mathematical Logic and Set Theory
- 24.902 Language and Its Structure II: Syntax
- 24.903 Language and Its Structure III: Semantics and Pragmatics

**A student interested in cognitive development:**

**Tier 2**
- 9.66J Computational Cognitive Science
- 9.85 Infant and Early Childhood Cognition

**Laboratory**
- 9.59J Laboratory in Psycholinguistics

#### Restricted Electives
- 6.034 Artificial Intelligence
- 24.211 Theory of Knowledge
- 24.900 Introduction to Linguistics

**A student interested in cognitive neuroscience:**

**Tier 2**
- 9.10 Cognitive Neuroscience
- 9.31 Neurobiology of Learning and Memory
- 9.35 Perceptual Systems
- 9.66J Computational Cognitive Science
- 9.85 Infant and Early Childhood Cognition

**Laboratory**
- 9.59J Laboratory in Psycholinguistics

**Tier 3**
- 9.46 Neuroscience of Morality
- 9.71 Functional MRI Investigations of the Human Brain

#### Restricted Electives
- 6.003 Signals and Systems
- 6.034 Artificial Intelligence
- 6.803 Machine Vision
- 20.309J Instrumentation and Measurement for Biological Systems

### Brain and Cognitive Sciences – Class Recommendations

#### Restricted Electives
- 6.034 Artificial Intelligence
- 24.211 Theory of Knowledge
- 24.900 Introduction to Linguistics

**A student interested in cognitive neuroscience:**

**Tier 2**
- 9.10 Cognitive Neuroscience
- 9.31 Neurobiology of Learning and Memory
- 9.35 Perceptual Systems
- 9.66J Computational Cognitive Science
- 9.85 Infant and Early Childhood Cognition

**Laboratory**
- 9.59J Laboratory in Psycholinguistics

**Tier 3**
- 9.46 Neuroscience of Morality
- 9.71 Functional MRI Investigations of the Human Brain

#### Restricted Electives
- 6.003 Signals and Systems
- 6.034 Artificial Intelligence
- 6.803 Machine Vision
- 20.309J Instrumentation and Measurement for Biological Systems
Brain and Cognitive Sciences – Class Recommendations

**Computation**
- 9.URG Undergraduate Research

**Neuroscience**
- Tier 2
  - 9.16 Cellular Neurophysiology
  - 9.54 Computational Aspects of Biological Learning
  - 9.66J Computational Cognitive Science
  - 9.19 Computational Psycholinguistics

**Laboratory**
- 9.17 Systems Neuroscience Laboratory

**Restricted Electives**
- 6.002 Circuits and Electronics
- 6.003 Signals and Systems
- 18.03 or 18.034 Differential Equations
- 18.06 Linear Algebra
- 18.404J Theory of Computation
- 18.510 Introduction to Mathematical Logic and Set Theory
- 20.309J Instrumentation and Measurement for Biological Systems

**REFERENCE: Course 9 Subjects Offered**

**AY 2016 - 2017**

(Updated 7/2016)

**Tier 1 Subjects (all five subjects required):**
Transfer credit will not be given for 9.00, 9.01, or 9.40

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA &amp; SP</td>
<td>6.0001/6.0002</td>
<td>Introduction to Computer Sciences &amp; Programming</td>
<td>12; REST</td>
</tr>
<tr>
<td>SP</td>
<td>9.00</td>
<td>Introduction to Psychological Science</td>
<td>12; HASS-S</td>
</tr>
<tr>
<td>FA</td>
<td>9.01</td>
<td>Introduction to Neuroscience</td>
<td>12; 6.0036, 9.01</td>
</tr>
<tr>
<td>SP</td>
<td>9.40</td>
<td>Introduction to Neural Computation</td>
<td>12; 6.0002, 9.01</td>
</tr>
<tr>
<td>FA</td>
<td>9.07</td>
<td>Statistics for Brain and Cognitive Sciences</td>
<td>12; 9.40</td>
</tr>
</tbody>
</table>

**Tier 2 Subjects: three subjects required; up to seven may be taken**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>9.09J</td>
<td>Cellular and Molecular Neurobiology</td>
<td>12; 7.05 or 9.01</td>
</tr>
<tr>
<td>SP</td>
<td>9.10</td>
<td>Cognitive Neuroscience</td>
<td>12; 9.01</td>
</tr>
<tr>
<td>FA</td>
<td>9.16</td>
<td>Cellular Neurophysiology</td>
<td>12; 9.40</td>
</tr>
<tr>
<td>SP</td>
<td>9.18J</td>
<td>Developmental Neurobiology</td>
<td>12; 9.01, 7.03, 7.05, or permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.19</td>
<td>Computational Psycholinguistics</td>
<td>(TBA – new offering proposed for SP 2017)</td>
</tr>
<tr>
<td>FA</td>
<td>9.20</td>
<td>Animal Behavior</td>
<td>12; HASS-S, 9.00</td>
</tr>
<tr>
<td>FA</td>
<td>9.31</td>
<td>Neurobiology of Learning and Memory</td>
<td>12; 9.01</td>
</tr>
<tr>
<td>SP</td>
<td>9.34J</td>
<td>Biomechanics and Neural Control of Movement</td>
<td>12; 2.004, 2.04A, or permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.35</td>
<td>Perceptual Systems</td>
<td>12; 6.0036, 6.041B, 9.40, 18.05, or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.66J</td>
<td>Computational Cognitive Science</td>
<td>12; HASS-S, CI-M, 9.00</td>
</tr>
<tr>
<td>FA</td>
<td>9.85</td>
<td>Infant and Early Childhood Cognition</td>
<td>12; HASS-S, CI-M, 9.00</td>
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</table>
### Laboratory: one subject required

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>9.12</td>
<td>Experimental Molecular Neurobiology</td>
<td>12; LAB, CI-M, 9.01, Biology (GIR)</td>
</tr>
<tr>
<td>FA</td>
<td>9.17</td>
<td>Systems Neuroscience Laboratory</td>
<td>12; LAB, CI-M, 9.40, Coreq 9.07</td>
</tr>
<tr>
<td>SP</td>
<td>9.59J</td>
<td>Laboratory in Psycholinguistics</td>
<td>12; LAB, CI-M, 9.03 or 24.900</td>
</tr>
<tr>
<td>FA</td>
<td>9.63</td>
<td>Laboratory in Visual Cognition</td>
<td>12; LAB, CI-M, 9.00</td>
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</tbody>
</table>

### Research: one subject required: Laboratory cannot be double counted

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
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<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>9.12</td>
<td>Experimental Molecular Neurobiology</td>
<td>12; LAB, CI-M, 9.01, Biology (GIR)</td>
</tr>
<tr>
<td>FA</td>
<td>9.17</td>
<td>Systems Neuroscience Laboratory</td>
<td>12; LAB, CI-M, 9.40, Coreq 9.07</td>
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<tr>
<td>FA</td>
<td>9.41</td>
<td>Research and Communication in Neuroscience &amp; Cognitive Science</td>
<td>12; CI-M, 9.URS, permission of instructor</td>
</tr>
<tr>
<td>FA &amp; SP</td>
<td>9.05J</td>
<td>Research in Brain &amp; Cognitive Sciences</td>
<td>12; CI-M, 9.00, permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.63</td>
<td>Laboratory in Psycholinguistics</td>
<td>12; LAB, CI-M, 9.00</td>
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### Tier 3: Up to four subjects

<table>
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<th>Term</th>
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<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>9.24</td>
<td>Disorders and Diseases of the Nervous System</td>
<td>12; 9.00, 9.01, 9.09</td>
</tr>
<tr>
<td>SP</td>
<td>9.26J</td>
<td>Principles &amp; Applications of Genetic Engineering for Biotechnology and Neuroscience</td>
<td>12; 7.28, 7.32, or 20.020, 9.01 or 9.09</td>
</tr>
<tr>
<td>SP</td>
<td>9.28</td>
<td>Current Topics in Developmental Neurobiology</td>
<td>9; CI-M, Coreq 9.18</td>
</tr>
<tr>
<td>SP</td>
<td>9.32</td>
<td>Genes, Circuits and Behavior</td>
<td>12; 9.08, 9.10, 9.16, or 9.16U</td>
</tr>
<tr>
<td>SP</td>
<td>9.42</td>
<td>The Brain and Its Interface with the Body</td>
<td>7.28, 9.01, 9.09, or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.46</td>
<td>Neuroscience of Morality</td>
<td>12; CI-M, 9.00, 9.01, 9.10, 9.20, or 9.85</td>
</tr>
<tr>
<td>FA</td>
<td>9.71</td>
<td>Functional MRI Investigations of the Human Brain</td>
<td>12; CI-M, 9.07, 18.05, or permission of instructor</td>
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</table>

### Restricted Electives: Up to four subjects

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>907JU</td>
<td>Statistics for Neuroscience Research</td>
</tr>
<tr>
<td>FA</td>
<td>903JU</td>
<td>Neurotechnology in Action</td>
</tr>
<tr>
<td>SP</td>
<td>928JU</td>
<td>Neural Coding and Perception of Sound</td>
</tr>
<tr>
<td>SP</td>
<td>915JU</td>
<td>Robotics</td>
</tr>
<tr>
<td>SP</td>
<td>930JU</td>
<td>Neural Plasticity in Learning and Memory</td>
</tr>
<tr>
<td>FA</td>
<td>942JU</td>
<td>Principles of Neuengineering</td>
</tr>
</tbody>
</table>

The following graduate subjects in Course 9 have been approved by the Education Committee and may substitute for a Restricted Elective, with the approved pre-requisite. Please note undergraduate and graduate versions of the same subject cannot both be taken, or counted twice.
Department events

Year round

MIT Colloquium on the Brain and Cognition
The Colloquium on the Brain and Cognition is the flagship seminar series of the BCS community, providing an opportunity for faculty, students, and postdocs to be exposed to a wide variety of speakers and topics. The series runs each Thursday during the academic term from 4-5 pm. All students are welcome to attend.

Fall Semester

MIT’s Family Weekend
Families of MIT students are welcomed to campus each fall to attend various campus-wide events and exciting programs. This year, the department will be hosting a number of lab tours. We are excited to welcome families of Course 9 students to come learn about the cutting-edge research in building 46.

BCS Fall Undergraduate Dinner
This informal fall event is a chance for the department’s undergraduate students to enjoy delicious food while having an opportunity to connect with peers and the department’s faculty.

Spring Semester

BCS Spring Undergraduate Awards Dinner
All department undergraduates are invited to join their fellow students and BCS faculty for an evening of food and celebration. Academic and Research awards will be presented to selected recipients.

MIT Campus Preview Weekend
Students who have been accepted to MIT are invited along with their families to attend various receptions and events coordinated across campus. This spring, the department will host a number of lab tours. Course 9 students interested in CPW with the department are welcome to stop by the BCS HQ academic office for more information on how they can become involved.

As part of the weekend, the department’s student group, the BCS Society, also hosts a fun event each year for both current majors and prospective students.

BCS Commencement Luncheon
Each year, the department hosts a congratulatory luncheon after commencement. Friends and families welcome!

For more information about these and other department sponsored events, please visit our event calendar at bcs.mit.edu/events