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/Seminar
  - Mind
  - Brain
  - Programming

Tier II
- Core lecture and Labs
  - 9.00
  - 9.01
  - 6.00

Tier I
- Intro
  - Spring
    - 9.00
    - 9.40
  - Fall
    - 9.01
    - 6.00

“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>Fall &amp; Spring</th>
<th>6.00 Introduction to Computer Science and Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>9.01 Introduction to Neuroscience</td>
</tr>
<tr>
<td>Fall</td>
<td>9.07 Statistics for Brain and Cognitive Sciences</td>
</tr>
<tr>
<td>Spring</td>
<td>9.00 Introduction to Psychological Science</td>
</tr>
<tr>
<td>Spring</td>
<td>9.40 Introduction to Neural Computation</td>
</tr>
</tbody>
</table>

6.00 Introduction to Computer Science and Programming

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. 12; 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

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: Physics II (GIR), 6.00, 9.01; or permission of instructor

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: 6.00

On right: Kara Presbrey, an undergraduate researcher in Kay Tye’s lab, uses optogenetic techniques to manipulate and record neural activity in cell type and projection-specific manners.

Far right: Optrodes used in optogenetics
Choose Your Own Adventure:

- Interested in a Cellular/Molecular Neuroscience concentration go to page 7
  Example careers of our alumni who went into Cellular/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 Cognitive Science:
  - Psychologist
  - Clinical Research Coordinator
  - Management Consultant
  - Analyst
  - Graduate 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 Computational Neuroscience 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
  - Graduate school

Brain and Cognitive Sciences – Class Recommendations

**Cellular/Molecular Neuroscience**

9.07J Undergraduate Research

Tier 2

- 9.09J Cellular and Molecular Neurobiology
- 9.16J Cellular and Synaptic Neurophysiology
- 9.18J Developmental Neurobiology Laboratory

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
- 6.802J Foundations of Computational and Systems Biology
- 7.05J Cell Biology
- 7.15J Experimental Molecular Genetics
- 7.22J Developmental Biology
- 7.28J Molecular Biology
- 7.32J Systems Biology

An image of neurons in a mouse hippocampus taken with expansion microscopy. Ed Boyden, Fei Chen, Paul Tillberg, Synthetic Neurobiology Laboratory.
## Brain and Cognitive Sciences – Class Recommendations

### Systems Neuroscience
9.URG Undergraduate Research

#### Tier 2
- 9.20 Animal Behavior
- 9.16 Cellular and Synaptic Neurophysiology
- 9.31 Neurobiology of Learning and Memory

#### Laboratory
- 9.17 Systems Neuroscience Laboratory

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

### Restricted Electives
- 18.03 or 18.034 Differential Equations
- 18.06 Linear Algebra
- 18.40J Theory of Computation
- 18.510 Introduction to Mathematical Logic and Set Theory

### Engineering/Physics/Chemistry

#### Restricted Electives
- 2.034J Dynamics and Control I
- 5.07J Biological Chemistry I
- 5.12 Organic Chemistry I
- 6.01 Introduction to EECS 1 – not officially a restricted elective in BCS
- 6.02 Circuits and Electronics
- 6.03 Signals and Systems
- 6.034 Artificial Intelligence
- 6.045J Automata, Computability, and Complexity
- 7.03 Genetics
- 7.08 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
- 9.19 Computational Psycholinguistics
- 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 neuroscience:

#### Tier 2
- 9.11 The Human Brain
- 9.31 Neurobiology of Learning and Memory
- 9.35 Perceptual Systems

#### Laboratory
- 9.59J Laboratory in Psycholinguistics

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

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

#### A student interested in cognitive neuroscience:

#### Tier 2
- 9.11 The Human Brain
- 9.31 Neurobiology of Learning and Memory
- 9.35 Perceptual Systems

#### Laboratory
- 9.59J Laboratory in Psycholinguistics

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

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

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*White matter fiber tracts in the adult human brain visualized using a diffusion weighted MRI imaging scan. Zeynep Saygin, Gabrieli and Kanwisher laboratories.*
# Brain and Cognitive Sciences – Class Recommendations

## Computational Neuroscience
- 9.URG Undergraduate Research
- **Neuroscience**
  - **Tier 2**
    1. 9.16 Cellular and Synaptic Neurophysiology
    2. 9.54 Computational Aspects of Biological Learning
    3. 9.66J Computational Cognitive Science
    4. 9.19 Computational Psycholinguistics
    5. 9.21 Cellular Neurophysiology and Computing

## 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
- 18.40J Theory of Computation
- 18.510 Introduction to Mathematical Logic and Set Theory
- 20.309J Instrumentation and Measurement for Biological Systems

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### REFERENCE: Course 9 Subjects Offered
**AY 2017 - 2018**

#### 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>6.00</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</td>
</tr>
<tr>
<td>FA</td>
<td>9.01</td>
<td>Introduction to Neuroscience</td>
<td>12; REST, 6.00</td>
</tr>
<tr>
<td>SP</td>
<td>9.40</td>
<td>Introduction to Neural Computation</td>
<td>12; Physics II (GIR); 6.00, 9.01; or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.07</td>
<td>Statistics for Brain and Cognitive Sciences</td>
<td>12; 6.00</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>9.00J</td>
<td>Cellular and Molecular Neurobiology</td>
<td>12; 7.01 or 9.01</td>
</tr>
<tr>
<td>SP</td>
<td>9.11</td>
<td>The Human Brain</td>
<td>12; 9.00 or 9.01 (pending approval - new offering proposed for SP18); 12; CM 7.29 or 9.01, or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.15</td>
<td>Neural Circuits, Neuromodulatory, and Neuroendocrine Systems</td>
<td>12; 9.40</td>
</tr>
<tr>
<td>FA</td>
<td>9.16</td>
<td>Cellular and Synaptic Neurophysiology</td>
<td>12; 6.00, 6.041B, 9.40, or 24.300; or permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.19</td>
<td>Computational Psycholinguistics</td>
<td>12; Physics II (GIR); 18.03, 2.005, 6.002, 6.003, 6.071, 10.301, 20.110, or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.21</td>
<td>Cellular Neurophysiology and Computing</td>
<td>12; 9.01</td>
</tr>
<tr>
<td>FA</td>
<td>9.31</td>
<td>Neurobiology of Learning and Memory</td>
<td>12; 9.00, 9.01; or permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.36</td>
<td>Perceptual Systems</td>
<td>12; 9.00, 9.01; or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.66J</td>
<td>Computational Cognitive Science</td>
<td>12; 6.00B, 6.06B, 6.041B, 9.40, 18.05; or permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.85</td>
<td>Infant and Early Childhood Cognition</td>
<td>12; HASS-S, CM 9.00</td>
</tr>
</tbody>
</table>

(Updated 8/2017)
### Laborator: 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, Coley 9.07</td>
</tr>
<tr>
<td>SP</td>
<td>9.09J</td>
<td>Laboratory in Psycholinguistics</td>
<td>12; LAB, CI-M, 9.00 or 24.000</td>
</tr>
<tr>
<td>SP</td>
<td>9.60J</td>
<td>Machine Motivated Human Vision</td>
<td>12; LAB, CI-M, 9.00, 9.07 pending approval – new offering proposed for SP18</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA</td>
<td>9.17</td>
<td>Experimental Molecular Neurobiology</td>
<td>12; LAB, CI-M, 9.01, Biology (GIR)</td>
</tr>
<tr>
<td>FA</td>
<td>9.41</td>
<td>Research and Communication in Neuroscience</td>
<td>18; CI-M, 9.LURP, permission of instructor</td>
</tr>
<tr>
<td>FA</td>
<td>9.50J</td>
<td>Research in Brain &amp; Cognitive Science</td>
<td>12; 9.00, permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9.09J</td>
<td>Laboratory in Psycholinguistics</td>
<td>12; LAB, CI-M, 9.00 or 24.000</td>
</tr>
<tr>
<td>SP</td>
<td>9.60</td>
<td>Machine Motivated Human Vision</td>
<td>12; LAB, CI-M, 9.00, 9.07 pending approval</td>
</tr>
<tr>
<td>FA</td>
<td>9.123J</td>
<td>Undergraduate Research</td>
<td>12; no prerequisites required</td>
</tr>
</tbody>
</table>

### Tier 3: Up to four subjects

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<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>9.32</td>
<td>Genes, Circuits and Behavior</td>
<td>12; 9.08J, 9.10, 9.16, or 9.18J</td>
</tr>
<tr>
<td>SP</td>
<td>9.42</td>
<td>The Brain and It’s 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 Mobility</td>
<td>12; CI-M, 9.00, 9.01, 9.10, 9.20, or 9.86</td>
</tr>
</tbody>
</table>

### Restricted Electives: Up to four subjects

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00JU</td>
<td>Dynamics and Control</td>
<td>12; 8.03, 6.00X or permission of instructor</td>
</tr>
<tr>
<td>2.184</td>
<td>Biomechanics and Neural Control of Movement</td>
<td>12; 8.07</td>
</tr>
<tr>
<td>5.07J</td>
<td>Biological Chemistry I</td>
<td>12; 7.05 – NOT both</td>
</tr>
<tr>
<td>5.12</td>
<td>Organic Chemistry I</td>
<td>12; 9.07</td>
</tr>
<tr>
<td>5.13</td>
<td>Organic Chemistry II</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>6.003</td>
<td>Signals and Systems</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>6.034</td>
<td>Artificial Intelligence</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>6.04JU</td>
<td>Automata, Computability, &amp; Complexity</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>6.046</td>
<td>Design and Analysis of Algorithms</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>6.141</td>
<td>Robotics: Science and Systems</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>7.03</td>
<td>Genetics</td>
<td>12; 7.07</td>
</tr>
<tr>
<td>7.05</td>
<td>General Biochemistry (or 5.07 – NOT both)</td>
<td>12; 7.07</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 prerequisites. Please note, undergraduate and graduate versions of the same subject cannot both be taken or counted twice.

<table>
<thead>
<tr>
<th>Term</th>
<th>Course #</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>9018</td>
<td>Acoustics, Production and Perception of Speech</td>
<td>12; 8.03, 6.00X or permission of instructor</td>
</tr>
<tr>
<td>SP</td>
<td>9019</td>
<td>Statistics for Neuroscience/Research</td>
<td>12; 8.07</td>
</tr>
<tr>
<td>SP</td>
<td>9240J</td>
<td>Neuroscience in Action</td>
<td>12; 8.07</td>
</tr>
<tr>
<td>SP</td>
<td>9206</td>
<td>Neural Coding and Perception of Sound</td>
<td>12; 9.03, 9.40</td>
</tr>
<tr>
<td>SP</td>
<td>9424J</td>
<td>Robotics</td>
<td>12; 9.03, 9.40</td>
</tr>
<tr>
<td>SP</td>
<td>9303J</td>
<td>Neural Plasticity in Learning and Memory</td>
<td>12; 9.31</td>
</tr>
<tr>
<td>SP</td>
<td>9422J</td>
<td>Principles of Neuroengineering</td>
<td>12; 9.31</td>
</tr>
</tbody>
</table>
Department events for undergraduates

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 OPIN 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