Neuroscience Ph.D. Programme

NTU Neuroscience Ph.D. Programme

The goal of our Programme is to develop outstanding young Neuroscientists who receive in-depth training in both the conceptual foundations and the most advanced technologies of the field. Our emphasis is on multidisciplinary training: our students will come from a broad range of academic disciplines that can include – but are not limited to - cellular/molecular biology, neurobiology, chemistry, engineering, computational sciences, artificial intelligence, cognitive science (including psychology and linguistics), medicine and other areas such as biophysics and mathematics. The Neuroscience Ph.D. Programme includes more than 80 faculty in 10 different schools from throughout NTU. Close interactions with these faculty, as well as their graduate student peers from a wide range of disciplines, create rich training and research opportunities for our students. Our students also are eligible to attend classes at NUS, further diversifying their training experiences and intellectual foundations. Via such training experiences, Neuroscience Ph.D. students will receive exceptionally broad training that will be extraordinary preparation for their future scientific pursuits.

Programme highlights:

- **Inspiring Coursework** – Students will take interactive classes from some of the world's leaders in the Neuroscience field. These classes will include both core modules as well as a wide range of elective modules (see Programmes below). A total of 18 academic units of coursework is required (typically each module is 3 academic units).
- **Valuable Lab Rotation Experience** - Students can complete up to 3 rotations in the laboratories of any Neuroscience Programme faculty member. This will provide exposure to different conceptual approaches and experimental techniques, as well provide experience that will help identify their Ph.D. mentor and home laboratory. These rotations are optional, so that students who have already identified a faculty mentor are not required to participate in rotations.
- **Cutting-edge Research** – After completing their coursework and laboratory rotations, Neuroscience Ph.D. students decide on a research project and defend their Ph.D. thesis. Research projects can be done in the laboratories of any Neuroscience Programme faculty member and will be identified by the student, in close consultation with their faculty mentor. Students have the option of performing research projects that span more than one research field and benefit from mentoring by faculty in different disciplines.
- **Efficient, Cost-Free Research Training** – Full-time Neuroscience students will receive their Ph.D. within 4 years. All students are eligible for full financial support, including payment of their tuition and a stipend to cover their living expenses.

Programmes

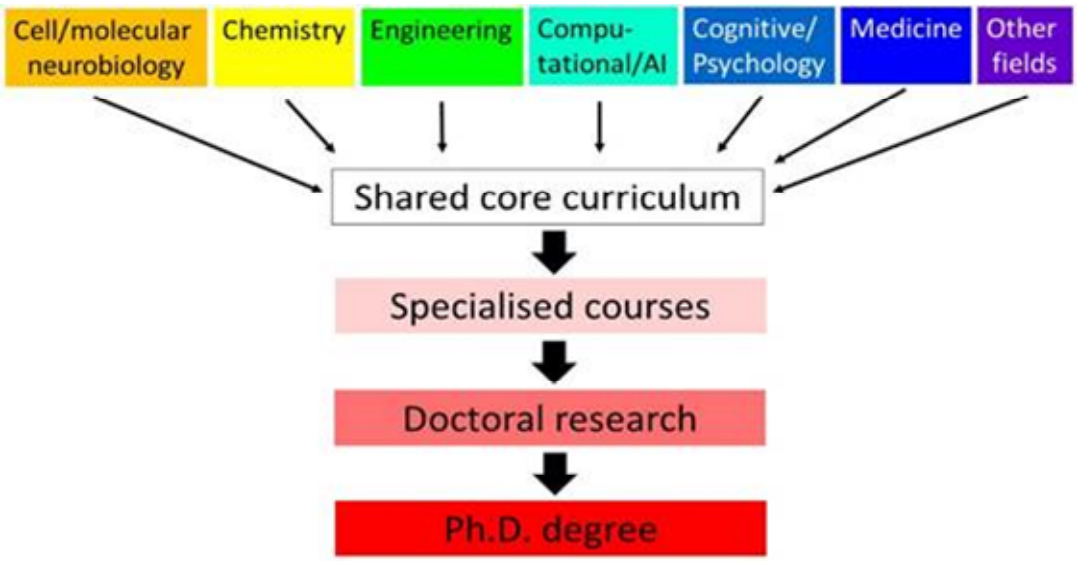
The overall structure of the curriculum for students in the Neuroscience Ph.D. Programme is the following:

1) Coursework to be carried during the first 1.5 years (minimum of 18 academic units in Neuroscience-related coursework);

2) Rotations in up to 3 different laboratories, across NTU colleges and schools (concurrent with coursework), that is completed within the first year;

3) Focused research, which starts during the first 1-1.5 years, in parallel with coursework and after concluding any laboratory rotations. Research becomes the primary activity in years 2-4 after completing the Qualifying Examination.

Coursework - Given that students enter with diverse academic backgrounds, the initial goal of the Neuroscience Ph.D. Programme is to expose students to a wide spectrum of neuroscience-related fields. Thus, during their first year in the Programme, students will take modules from a shared core curriculum prior to taking more advanced elective coursework in their area of research specialization:



To ensure a broad-based education, core modules are divided into two different themes; students are required to take at least 2 modules from one theme and another module from the other theme. These themes and their constituent core modules (each 3 academic units) are shown here:

Theme A: Neuroscience based on biology or psychology

Introduction to Neuroscience: Cellular and Molecular Neuroscience (MD9104)

Introduction to Neuroscience: Neural Systems and Behaviour (MD9108)

Introduction to Neuropsychology

Theme B: Neuroscience based on engineering and/or technology

Engineering Approaches to Neuroscience

Computational/AI Neuroscience

Experimental Techniques in Neuroscience

After taking core modules, students complete their coursework requirements by taking 3 additional modules from the list shown below, in addition to taking a communication course and participating in a 3-minute Thesis Symposium. Students entering with a M.Sci. degree are eligible to receive credit for up to 9 academic units for courses taken during their M.Sci. training.

Lee Kong Chian School of Medicine

MD9103 – Biological Imaging

MD9110 – Advanced Genetics in Diseases, Ageing & Cancer

Nanyang Business School

NS9001 - Management Neuroscience: Incorporating Cognitive and Neuroscience Research to Management

MG9003 - Theory Construction & Experimental Methods in Behavioral Research

School of Biological Sciences

BS7001 – Foundation Course in Molecular & Cell Biology

BS7107 – Computational Biology and Modelling

BS7414 – Practical Course in Advanced Microscopy

School of Chemical & Biomedical Engineering
CH7102 - Cell Therapeutics Engineering

School of Computer Science and Engineering

CE7412 - Computational Biology

CE7429 - Computational Intelligence: Methods & Applications

CE7454 - Deep Learning for Data Science

School of Mechanical and Aerospace Engineering
MA7511 – Design and Analysis of Experiments

School of Social Sciences

HP7001 - Advanced Research Design and Data Analysis

HP7108 - Pro-seminar in Cognitive Psychology

HP7209 - Multisensory Integration

HP7216 - Behavioral Decision Making

HP7212 - Applied Functional Neuroscience

HP7218 - Language in Perception and Thought

HP7227 - Primate Psychology

HP7237 - Comparative Physiology of Social Interaction: Clinical and Technological Applications

National University of Singapore
GS6004 - Vision and Perception
GSN6501 - Neuronal Signaling

GSN6503 - Techniques in Neuroscience

GSN6504 - Behavioural & Cognitive Neuroscience

GSN6505 - Brain Disorders and Repair

GSN6506 - Computational Neuroscience and Neuroengineering

Laboratory rotations - Neuroscience Ph.D. students are encouraged to complete up to 3 laboratory rotations. The goals of these rotations are to provide exposure to different conceptual approaches and experimental techniques, as well as to expose students to several laboratories to help them identify their Ph.D. mentor and home laboratory. Each lab rotation should last approximately 2 months and should be completed during the first year in the Programme, These rotations are optional, so that students who have already identified a mentor are not required to participate in rotations. At the beginning of each academic year, a list of mentors willing to host rotation students will be complied and this list will be provided to aid selection of laboratory rotations.

Research project and mentoring – After completing coursework and laboratory rotations, a Neuroscience Ph.D. student will decide on a research project and successfully complete their Qualifying Examination by the end of their second year. Students should plan to defend their Ph.D. thesis within 4 years. A research project will be identified by the student, in close consultation with their mentor. Students have the option of performing research projects that span more than one research field and benefit from mentoring by faculty in different disciplines.

The mentor will also have primary responsibility for supervising the research progress of a student. All Neuroscience Ph.D. Programme students, along with their mentors, will be expected to identify a Thesis Advisory Committee that will interact regularly and meaningfully with each student to provide academic and scientific guidance. The Director of the Neuroscience Ph.D. Programme will provide initial guidance to students prior to selection of a faculty mentor and Thesis Advisory Committee.

Faculty

Dozens of faculty are engaged in neuroscience research in numerous schools across the NTU campus; the list below includes more than 80 faculty who are at NTU and are eager to serve as mentors for Neuroscience Ph.D. Programme students. These faculty provide a very broad and strong pool of teachers for Neuroscience modules as well as being prospective research mentors for Neuroscience Ph.D. Programme students.

These Neuroscience faculty are organized here according to their research interests:

Neurotechnology

Name	Research Interest
Arindam Basu	brain machine interface and dendritic modelling
Balázs Gulyás	neuroimaging in the field of basic neuroscience, cognitive neuroscience, neurology and psychiatry
Xiaodong Chen	Biocompatible conformal devices for neurotechnology
Guan Cuntai	I am interested in applying machine learning, data analytics, signal processing, and computer science to building neuro-technologies (especially Brain-Computer Interfaces) for the treatment, diagnosis and monitoring of brain disorders and mental health.
Domenico Campolo	Human-machine interaction; motor planning and execution; kinematic and muscular synergies; geometric methods for computational neuroscience
K. Jimmy Hsia	Micro- and nanotechnologies for cell-based sensing
Hiroshi Makino	We study learning mechanisms of the brain and machine using state-of-the-art imaging technologies in animals and deep reinforcement learning algorithms in artificial intelligent agents.
Loo Say Chye Joachim	Oral drug delivery systems to sustain dopamine levels in the brain.
Lu Shijian	I have two research topics that are relevant to neuroscience as listed: 1) Computational modeling of visual attention: it aims to design and learn computational models for bottom-up saliency and top-down target search; 2) human-like learning by machines: it aims to design and learn deep neural network models in the similar way as how human learns.
CHEW Sing Yian	neural tissue engineering, remyelination, design of scaffolds and drug/gene delivery to treat traumatic nerve injuries in PNS and CNS
Wei Lei (Asst Prof)	Flexible and implantable multi-functional neural probes
Zhao Wenting (Asst Prof)	Nanotechnology for studying neurodevelopment and neurodegenerative disease.
Rajan Kashyap	Computational models designed were used to decipher brain behavior relationship. Machine learning approaches that could improve the prediction accuracy of the behavioral measures from resting-state fMRI. Neural basis of the abnormalities of the brain and the causal basis for the intervention approaches like tDCS and TMS
Abdulkadir C. Yucel	Bio-electromagnetic analysis techniques and device design for deep brain stimulation (such as transcranial magnetic stimulation and transcranial direct current stimulation) and electroencephalogram (EEG)
Tsukasa Kamigaki	Brain-wide circuit mechanisms for executive function and learning

Cellular/Molecular Neuroscience

Name	Research Interest
Yusuf Ali	Neuroendocrine research specifically with regards to release of metabolic hormones.
George Augustine	synaptic molecular mechanisms
CHNG Toh Hean	Molecular and cellular neurobiology of learning and memory
Foo Jia Nee	Genetic and genomic approaches to understand neurological diseases.
Yasunori Saheki	Cell biology and molecular neuroscience

Brain Disorders and Aging

Name	Research Interest
George Augustine	Circuit mechanisms of dementia
Annabel Chen Shen-Hsing	I have 3 main areas of research interest: (1) Higher Cognition in the Cerebellum; (2) Aging Neuroscience and Healthy Ageing; (3) Cognitive Neuroscience for Education (Science of Learning)
Balázs Gulyás	neuroimaging in the field of basic neuroscience, cognitive neuroscience, neurology and psychiatry
Anna Barron	Aging and neurodegenerative disease
Christine Cheung	My research is tangentially related, focusing on the vascular causes to neurological conditions like stroke and dementia.
Dean Nizetic	Using induced pluripotent stem cells, cerebral organoids and other cellular models, my group is studying the genetic factors modulating the severity and onset for Alzheimer's disease, using Down syndrome as its most common genetic form.
Foo Jia Nee	Genetic and genomic approaches to understand neurological diseases.
CHEW Sing Yian	neural tissue engineering, remyelination, design of scaffolds and drug/gene delivery to treat traumatic nerve injuries in PNS and CNS
Alicia Goodwill	Neuroplasticity, skill acquisition & lifelong learning, modifiable factors for brain health, research translation.
Kah Leong Lim	Neuroprotective and Neurorestorative Strategies for Parkinson's and other neurodegenerative diseases
Sarah Langley	Understanding neurological disorders through integrating multi-omics data with computational approaches;

Systems Neuroscience

Name	Research Interest
Ayumu Tashiro	Function of hippocampus in rodents
Ajai Vyas	Neuroendocrinology of fear.
Charles Or	I study visual perception (faces, motion, form, object recognition, etc.) using psychophysical, EEG, eyetracking and computational modelling methods.
Domenico Campolo	Human-Machine Interaction; Motor planning and execution; Kinematic and Muscular Synergies; Geometric Methods for Computational Neuroscience
Hiroshi Makino	We study learning mechanisms of the brain and machine using state-of-the-art imaging technologies in animals and deep reinforcement learning algorithms in artificial intelligent agents.
Gerrit Maus	Visual Perception, Eye Movements, Attention
Rupshi Mitra	Influence of environment on brain plasticity
Xu Hong	Neural mechanisms of face perception, self-motion/heading perception, and its application in navigation and way-finding.
Yusuf Ali	Neural control of endocrine glands
George Augustine	Role of cerebellum in movement and motor learning
Suresh Jesuthasan	Role of habenula in emotions
Tsukasa Kamigaki	Brain-wide circuit mechanisms for executive function and learning

Social Neuroscience

Name	Research Interest
Bobby K. Cheon	Social and cultural neuroscience.
Georgios Christopoulos	Decision making; neuroeconomics; social neuroscience; culture neuroscience; urban environment and neuroscience
Gianluca Esposito	Social and Affiliative Neuroscience
Ryo Kitada	Neural mechanisms underlying multisensory perception and social cognition
Victoria Leong	Social neuroscience of early learning
Suresh Jesuthasan	Chemical signalling between animals

Cognitive Neuroscience

Name	Research Interest
Alice Hiu Dan Chan	I do research on language and cognition, which includes and not limited to language learning across the lifespan.
Annabel Chen Shen-Hsing	I have 3 main areas of research interest: (1) Higher Cognition in the Cerebellum; (2) Aging Neuroscience and Healthy Ageing; (3) Cognitive Neuroscience for Education (Science of Learning)
Balázs Gulyás	neuroimaging in the field of basic neuroscience, cognitive neuroscience, neurology and psychiatry
O'BRIEN Beth Ann	Though I don't directly conduct brain-level research, I collaborate on projects which include neuroimaging and eeg methods. My main research interest is in language and literacy development in early to middle childhood, including bilingual development and atypical development (dyslexia).

Christina Chuang	I am interested in how emotions are processed on the neurological level in mental phenomena such as hypocrisy and self-deception.
Georgios Christopoulos	Decision making; neuroeconomics; social neuroscience; culture neuroscience; urban environment and neuroscience
Charles Or	I study visual perception (faces, motion, form, object recognition, etc.) using psychophysical, EEG, eyetracking and computational modelling methods.
Francis C. K. Wong	language and the brain; speech perception; biomarkers of language disorders
Luca Onnis	My research focuses on basic cognitive and neural mechanisms of inductive learning (statistical learning), both in young children and adult populations.
Randy John LaPolla	I am interested in the neurophysiology of inference, particularly abductive inference.
Ryo Kitada	Neural mechanisms underlying multisensory perception and social cognition
Suzy Styles	Neural Correlates of Language Development in Infancy
Gerrit Maus	Visual Perception, Eye Movements, Attention
Azi Jamaludin	Brain, Body, Cognition; Neural correlates of Games;
Anne Rifkin	Infant Development; Parenting
Fannie Khng	Applied Cognition; Multimodal methodologies for Science of Learning (EEG, Deep breathing)
Ng Ee Lynn	Stress and Anxiety; Multimodal methodologies for Science of Learning (e.g cortisol)
Stella Tsotsi	Neurocognitive and emotional risk factors
Erik Jahner	Resting State FC; fMRI
Vahid Aryadoust	Complex Dynamic Systems; Near-infrared Spectroscopy
Betsy Ng	Motivation; Multimodal methodologies for Science of Learning (e.g cortisol)
Tan Seng Chee	Science of Learning Translation; Analytics; Eye-tracking technology
Alicia Goodwill	Neuroplasticity, skill acquisition & lifelong learning, modifiable factors for brain health, research translation.
Wu Chiao-Yi (Joyce)	Neurobiological basis of learning, lifelong development of reading and arithmetic skills, detection and intervention for learning disabilities, second language acquisition and bilingualism, cognitive training
Tsukasa Kamigaki	Brain-wide circuit mechanisms for executive function and learning
Farhan Ali	Science of learning; emotions and cognition; EEG/fNIRS and multimodal technologies; AI/data science for learning and assessment
Teo Wei Peng	Motor neuroscience, Skill Acquisition, Neurorehabilitation, Non-invasive Brain Stimulation