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Subject	Credit	About the course
Mind Sciences Research Method Ⅰ (Research Survey) 心の科学研究法Ⅰ（研究サーベイ）	2	Research in Master's Program develops findings, technologies, and ways of thinking that are recognized as widely useful in a given field. Therefore, it is necessary to understand through which means research is carried out in the field of modern sciences of the mind, and estimate the direction of future research by understanding the flow of research until now. This course provides students with knowledge in order to position their own research in the world and continue on to planning the next step to take in their research, by teaching them methods to read and organize literature related to the sciences of the mind.
Mind Sciences Research Method Ⅱ (Research Planning) 心の科学研究法Ⅱ（研究計画）	2	Research is a method of providing new experiences and knowledge through observations, analysis, and experimentation on existing findings. Research requires that existing knowledge and knowledge that one hopes to obtain are rigorously classified. It also requires strict and logical planning and implementation in order to obtain truly new knowledge. This course provides students with methodologies to reliably prepare research on the sciences of the mind through close discussion between students and faculty advisors. Students must have obtained credit for the "Mind Sciences Research Methods Ⅰ (Research Survey) course" in order to take this course.
Research Presentation Research Presentation	2	Presenting a talk or poster in English at a scientific organization or research society allows one to show their research results, and is important as a means of exchanging information. This lecture advises students on how to best understand the gist of sample research papers and accurately transmit the information to someone else, from the point of view of a scientist or engineer. Participants will select a representative example of literature in their own fields, will understand the gist of the paper with guidance from the lecturer, and will present the paper themselves. They will then receive advice on how to improve. Advice is given on such topics as creating slides, establishing points, presenting in English, and finding points to question in the presentations of others. Therefore, students participate not only as presenters, but from the standpoint of those listening to and discussing the presentation.
Mathematical Brain Science 脳の数理	2	Human and animal brains can extract important information from huge sensory information, and can learn appropriate behavior through experience. This ability is impossible for current computers to perform. This lecture introduces various interesting phenomena in neuroscience and psychology, while mathematically describing the phenomena and exploring mechanisms behind the phenomena. Students will learn using concrete examples in which mathematics plays a role in exploring these mechanisms, and cultivate mathematical skills.
Brain-Machine Interface ブレインマシンインタフェース（BMI）	2	This course explains technologies how the brain and computers communicate and exchange information. The technologies include, neuronal encoding and decoding methods in order to implement a Brain-Machine Interface, as well as findings related to multivariate analysis for neuronal activity, BOLD signals or EEG signals. I will also introduce mechanisms how the brain control arms, legs, eyes, and other parts of the body. Students will also learn about electrode technologies used to obtain various information obtaining from nerve and brain activity, and about machine learning methods from these neural data into voluntary movements.

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Cognitive Developmental Robotics 知能発達ロボティクス	2	This course introduces more advanced content related to cognitive robotics and the latest research developments. Various technologies are related to robotics technology, such as machinery, electronics, and information technology, and we believe that artificial-intelligence technology is important in combining all of these. The objective of this course is for students to acquire knowledge and deepen their understanding regarding granting robots intelligence and autonomy, by considering elemental technologies such as image processing, motion generation, and situated reasoning, and how to combine these with a focus on developing intelligence in robots. In particular, students will consider the implementation of robots that behave autonomously while interfacing with environments in the real world, from the perspective of learning algorithms.
Advanced Mind Sciences (Brain Informatics) 心の科学先端セミナーA（脳情報科学）	2	The purpose of this class is for students to understand the current progress of brain informatics research in the world; learn computational approaches with related theories and practices; understand technologies to apply and evaluate analytical methods, theories, and computational models in their own research. In order to achieve these purposes, this class is held in a seminar style, in which invited researchers give talks about advanced topics in brain informatics and related fields. This seminar is partly conducted in the Brain Science Retreat.
Brain Science and Humans 脳科学と人間	2	The fundamental question, “what is human being,” has traditionally been addressed in the fields of philosophy and literature. From the viewpont of natural sciences, it is the brain that makes us human. Neuroscience has developed remarkably over the past few decades, and we are now able to investigate human brain functions scientifically. Through this class, students will better understand the structure of the human brain, the methodologies to study human brain functions, a variety of results from neuroscience, and the possibility of change in understanding human being on the basis of neuroscience.
Molecular Life Science 分子生命科学	2	Molecular biological research methods are put into practice in a wide variety of life science research fields from basic biology to applied sciences including medical science. In this lecture, students first learn basic knowelde of molecular biology that crucial for researchers involved in the life sciences. Then, they attempt to clarify to what degree brain functions are clarified at molecular levels, by reading recent research papaers in which molecular biological techniques are used.
Decision Neuroscience 意思決定の神経科学	2	In this lecture, students will understand mathematical models of decision-making, as well as the related brain areas and neuronal activities involved in decision-making in animals and humans. In particular, I introduce the basics of reinforcement learning theories from the classical and operant conditioning in the psychological theory. The course will explain the anatomy and physiology of the parietal cortex, prefrontal cortex, and basal ganglia, which have important functions in decision making. Additionally, advanced students will learn through reading review literature in related own current research related to decision making.
Advanced Mind Sciences (Neuroscience) 心の科学先端セミナーB（神経科学）	2	The objective of this lecture is for students to gain a neuroscientific understanding that is conscious of the “hierarchical nature” of the brain, in order to understand the framework and working of the mind. In particular, students will focus on the neural circuitry of the brain's hierarchical structure, and will take note of the structural and functional relationships between it and the nerve cell level below, as well as the levels between brain areas above. Students will learn research methods that are best suited for each level, and will consider what can and cannot be clarified on a fundamental level. Furthermore, students will discuss how neuroscientific findings on the cellular, circuit, and regional levels are connected with understanding the framework and working of the mind. The mind is presented from a scientific point of view in this way. This seminar is partly conducted in the Brain Science Retreat.

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Developmental Science of Mind 心の発達科学	2	The goal of this class is to deepen understanding of the primary factors related to mechanisms of child development from a scientific perspective. Students will discuss and consider establishing developmental science research topics and their application, while obtaining wide-ranging knowledge in developmental psychology, cognitive science, brain science, and neurophysiology.
Educational Science 心の教育科学	2	Students aim to interpret activities at childcare and educational sites based on psychological findings, widen their view of human understanding, and deepen their understanding. In particular, students will grasp childrearing and educational processes based on the latest research developments, and will investigate to what degree "teaching" activities (thought to be unique to humans) support these childrearing and educational processes. Additionally, students will consider how these activities at childcare and educational sites are inseparable from culture and situational relationships. Specifically, students will engage in discussion while interpreting the latest research, and will investigate childcare and educational practices from a standpoint based on research results.
Psycholinguistics 心の言語心理学	2	Students will deepen their understanding related to human language utilization, namely, production, comprehension, writing and reading, from dimensions such as basic cognitive mechanisms, acquision, and evolution. They will also consider clinical and engineering applications.
Advanced Mind Sciences (Human Science) 心の科学先端セミナーC（人間科学）	2	In this seminar, we conduct talk series of scientists who are well-known throughout the world in cutting edge in the field of neuroscience, psychology, and social science. The seminar will invite scientists from neuroscience and the behavioral sciences, because "the sciences of the mind" are composed from both of these fields. Participants will not only learn the cutting edge of the latest research, but also will attempt to obtain a wider perspective on their own field by gaining a wider point of view bridging understanding across the nervous, behavioral, and social levels that form the bases of the sciences of the mind, and discussing these with researchers working in a variety of fields. This seminar is partly conducted in the Brain Science Retreat.
Systems Neuroscience システム神経科学	2	The higher brain functions, such as sensory perception and cognition, goal-directed action, emotion, judgment, and thinking are performed via nerve cells (of which there are over ten billion in the cerebral cortex alone) forming a unique network in the brain and carrying out the expression and processing of neural information based on brain's operating principles. In "Systems Neuroscience", students will organize knowledge about neuronal mechanisms of feature extraction and object recognition through sensory systems, control of behavior, learning and memory, emotion and motivation, and decision-making. Students will learn how to integrate knowledge of systems neuroscience and that of psychology and computational theories.
Systems Neuroscience Method システム神経科学技術	2	In this lecture, students will systematically learn such topics as the goals, basic principles, examples, and history of anatomical and physiological experiments and technologies, as a neuroscientific approach necessary to understand the framework and working of the mind. For anatomical experimental techniques, students will learn standard observation techniques of the structure of the brain using the naked eye and microscopes. For physiological experimental techniques, students will learn standard recording methods to measure the electrical activity of individual nerve cells and groups of cells. Students will come to understand the characteristics of each experimental technique, and will gain the ability to think of techniques suitable to their research goals.

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Human Cognitive Neuroscience ヒト認知神経科学論	2	The primordial question, "what is humanity," has traditionally come from the fields of philosophy and literature. The essential organ that makes us human from natural sciences point of view is the brain. Neuroscience has developed remarkably over the past few decades, and we have become able to examine the functions of the human brain scientifically. Students will deepen their understanding of the structure of the human brain, scientific methodologies for studying the functions of the human brain, results that have been obtained in neuroscience to date, and the possibility of change in human understanding based on neuroscience.
Neuroimaging Analysis 脳イメージ解析学	2	The objective of this course is to understand basic knowledge and technologies necessary in functional MRI (fMRI) research. Students will come up with basic problems in order to measure brain activity using fMRI, will carry out fMRI experiments using these problems, and will analyze fMRI data. Additionally, the course will explain more complicated analysis techniques (correlated analysis and network analysis). Students will learn of the brain functions that can be understood using neuroimaging (as well as its limitations), and will obtain knowledge to allow them to accurately understand research papers in which fMRI was used.
Cognitive Science 認知科学	2	Cognitive science is a field of scientific study that views human cognitive functions such as memory, thought, and problem-solving as a kind of "information processing" system; uses both the construction of information processing models as well as the analysis based on observation and experiments; and clarifies human cognitive function mechanisms. The objective of this lecture for students is to learn about the knowledge expression through a computer. The knowledge expression is a basic concept of cognitive science, and is essential for deepening the understanding of learning and problem-solving mechanism. In particular, topics such as the memory model, knowledge expression, knowledge acquisition, problem-solving, and metacognition will be raised.
Social Psychology 社会心理学	2	Social psychology is an academic discipline that investigates the workings of the human mind in mainly interpersonal situations. This course will not only deepen students' understanding of which environmental factors have an effect on social behaviors, but will deepen their understanding of how they are processed within the individual by introducing important behavioral experiments in social psychology and touching upon social neuroscience, where much experimentation has been conducted recently. Specifically, the objective of this course is to deepen students' understanding related to the neural bases of social behaviors by introducing experiments that use functional magnetic resonance imaging (fMRI).
Neural KANSEI Science 神経感性科学	2	We acquire information about music by listening and communicate it to other people using a natural language. The correspondence between musical entities and verbal expressions that designate them is to some extent arbitrary, however. Therefore the verbal communication of musical information may cause much misunderstanding, which in turn makes the data processing of the information by computers problematic. Drawing on the latest music theory, analytic philosophy, formal logic, and cognitive science, this course discusses the categorization and the formation of notions of musical entities and examines the relationships between the knowledge representation of music and natural languages.

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Philosophy of Mind 心の哲学	2	Students will survey the history of philosophy, investigate recent controversies, and confirm what has been clarified as of now, in order to deepen their understanding of the mind and body, particularly their relationships with the brain. Students will also consider what is necessary for animals other than humans and systems to have a mind. In this lecture, students will confirm the basic concepts of philosophy, while cultivating a comprehensive view of the mind as they continue to take in findings in such fields as biology, psychology, sociology, and linguistics. As the lecture continues with a focus on student discussion, students will write a final report under the guidance of the instructor.
Neuroethics Research ニューロエシックス研究	2	Neuroethics was established with the development of neuroscience. What does it ask? What does it reveal? In this lecture, students will understand the basic concepts of neuroethics while confirming and surveying background information on recent controversies. In addition, students will gather materials, make presentations, exchange opinions, and write a report focusing on concrete issues such as “the brain enhancement,” “free will,” “crime,” “mental disorders,” and “moral judgments.” Furthermore, students will confirm if any ethical issues have occurred with the progress of brain sciences research, and will investigate ways to cope with them.
Comparative Ethology 比較行動学	2	The mind cannot be physically held, so one valid means to understand it is to examine observable behaviors created through the wroking of the mind. In Comparative Ethology, we will consider how the mind is formed in the evolution as well as in the environments and societies of humans and animals, by learning human and animal behaviors through observations and experiments, and highlighting their similarities and differences. In this lecture, students will learn many topics from basic behaviors such as perception and memory to social behaviors (including developmental changes) among humans and animals through introducing basic comparative ethology methods and research papers. Students will aim to develop a deep human understanding from multiple viewpoints.
Behavior Analysis 心の行動分析学	2	The aim of this lecture is to understand how to measure the human mind scientifically. Especially we focus on the methods and analyses about the function of the mind in the social situations. We learn about the methods of social psychological research (experimental method, survey method, and observation method) and learn about how to make the experimental materials, the effective experimental design, and the procedures of the experiment through the experience of social psychological experiment with economic games. We learn about basic statistical analysis in the second half of the lecture.
Advanced Biological Defense 生体防御特論	2	Living things maintain homeostasis through various complicated functions. The maintenance of homeostasis involves mainly metabolic adjustment mechanisms and biological defense mechanisms. In this lecture, students will learn about these metabolic adjustment mechanisms and biological defense mechanisms in understanding the maintenance of homeostasis in living things. Students will become able to explain mammalian immunological responses from the molecular level to the level of the organism, with the reactions of living things to outside stimuli as an example. The objective of this course is for students to gain the ability to analogize similarities with other fields.
Applied Bioorganic Chemistry 応用生物有機化学	2	In order to manufacture agricultural chemicals and drugs with a high degree of safety, it is important to first discover both lead compounds (which are the keys to new agricultural chemicals and drugs) and prototype compounds by screening and synthesizing many natural resources. The objective of this lecture is to deepen understanding of what should be considered when discovering new agricultural chemicals and drugs. Additionally, students in this lecture will consider the basics of medicinal chemistry. Finally, students will aim to understand the basics of what should be considered in drug discovery.

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Cellular Signal Transduction 細胞情報伝達論	2	Multicellular organisms maintain homeostatis of their internal environments in response to external stimuli and the external environment. Signal transduction mechanisms in and between cells are essential in order to maintain the organism's vital functions. In this lecture, students will aim to deepen their understanding of the signal transduction mechanisms in the cells of multicellular organisms. Students also aim for a general understanding of the names and activation frameworks of proteins that take part in signal transduction.
Applied Bioinformatics 応用バイオインフォマティクス	2	This course will explain new biological research methods that use the latest informatics technologies and their applications, and will carry out practical training that makes use of computers in familiar topics that can be utilized in day-to-day research activities. In particular, students will understand and gain knowledge of important technologies in bioinformatics, such as gene sequencing analysis, promoter design, gene expression analysis, and gene network analysis. Furthermore, students will attempt to construct models according to their research topics in systems biology (an attempt to understand life as a system based on biophysics), a new and challenging field in the life sciences. Students will understand the way of thinking, main techniques, and applications in biology for bioinformatics. Finally, students will aim to be able to independently carry out analysis that makes use of bioinformatics technologies using a computer.
Research Ethics 研究者倫理	2	Scientific development relies on trueness, trust and fairness of research practice. Scientific misconduct -violation of these norms- hampers the sound development of science. We discuss scientific misconduct and questionable research practice through case study and cultivate research ethics as practical wisdom.
Internship インターンシップ	2	With the goal of connecting the specialized knowledge and skills they have gained thus far in their learning with the knowledge and skills required by society, students will aim to carry out work experience related to their fields of specialty or to their future careers at places of employment such as corporations or research institutions. Through internships, students further increase their specialized knowledge, and at the same time become able to design accurate learning goals for acquiring wide-ranging and related specialized knowledge, by understanding relations and gaps in their own research topics.
Mind Sciences Research Method Ⅲ (Data Analysis) 心の科学研究法Ⅲ（データ解析）	2	In addition to targeted phenomena, errors are introduced in data obtained through surveys and experiments as a result of a variety of factors. The research process requires researchers to eliminate these factors one-by-one, and grasp the true characteristics that show the sought phenomena. This course discusses models for experimental data and analysis methods used in the sciences of the mind, and guides students in how to think about constructing theories and models for phenomena in the sciences of the mind through discussion on surveys and experiment data with faculty advisors. Students must have obtained credit for the "Mind Sciences Research Methods Ⅰ (Research Survey)" and "Mind Sciences Research Methods Ⅱ (Research Planning)" courses in order to take this course.
Mind Sciences Research Method Ⅳ (Thesis Writing) 心の科学研究法Ⅳ（論文作成）	2	Research first becomes significant when intentions, methodologies, and results are shown, interpretations of the results have been deeply discussed, and it has all been recorded as an original research paper with novelty and validity that anyone would recognize. While writing a research paper on the sciences of the mind wherein readers will understand one's intent and acknowledge its novelty is not an easy task, it is the standard technique to have one's research recognized. In this course, faculty advisors individually guide students on these methods. Students must have obtained credit for the "Mind Sciences Research Methods Ⅰ (Research Survey)," "Mind Sciences Research Methods Ⅱ (Research Planning)," and "Mind Sciences Research Methods Ⅲ (Data Analysis)" courses in order to take this course.