

◆ Department of Earth and Planetary Sciences (プログラム名)

1. Program Outline (プログラム概要)

Phenomena covered by earth and planetary sciences are complex combinations of various factors ranging from nano- to tera-scale in space and time. This program provides a variety of learning opportunities to foster human resources challenging and solving such global and planetary-scale problems with scientific thinking and skills.

2. Course Outlines and Faculty (コース概要及び学習目標)

Students in this program are expected to acquire following abilities:

- Ability to get insight into the nature of complex phenomena in the earth and planets
- Ability to set a subject of research and to form a research plan
- Ability to build own expertise necessary for research accomplishment
- Ability to present research achievements and take an international leadership in an area of expertise

3. Guide to Study in Department of Earth and Planetary Sciences (学習内容)

Students in this program are expected to study by utilizing the following opportunities to obtain the abilities mentioned above:

- A) Laboratory seminar to learn basics of scientific approaches in earth and planetary sciences
- B) Interdisciplinary seminars to study a wide range of research topics
- C) Lectures and exercise lessons to improve basic academic skills
- D) Employment as a teaching assistant to experience the importance and difficulty in academic education

4. Graduation Requirements (修了要件)

Department of Earth and Planetary Sciences

【Master's degree】

- 30 credits or more from the Graduate school courses. (大学院授業科目)
- Research Courses (研究科目群)
 - (1) 8 credits from the Seminar Courses. (講究科目)
 - (2) 8 credits from the Graduate Research Courses. (研究関連科目)
- Courses by Departments (専門科目群)
 - (1) 10 credits or more from the Departmental Courses. (専攻専門科目)
 - (2) 2 credits or more from the Courses in Other Departments. (他専門科目)
- 2 credits or more from the Liberal Arts and General Education. (大学院教養・共通科目群)
- It passes master's-thesis examination and the final examination .

【Doctoral degree】

For a Doctoral degree a doctoral candidate must satisfy the following requirements:

- (1) Seminar (Seminar in Earth and Planetary Sciences 5-10) in each term must be taken.
- (2) The candidate must complete and upload a thesis for the degree, and take the final examination and evaluation of his/her thesis. Criteria for the evaluation are as follows:
 - The thesis must contain satisfactory originality and contribute to progresses in the field.
 - The publication of at least one research paper as the first author in a refereed journal is required.
 - Language skill enough for international research exchange is required.

The candidate who satisfies the above requirements and passes the final examination is awarded a Doctoral degree.

All students are strongly advised to consult with their own supervisors about the study plan.

5. Tables of Course Subjects

Research Courses (研究科目群)

Course Number	Category Remarks* (See footnotes)	Subject	Credit	Semester S: Spring A: Autumn	Learning Content** (See footnotes)	Remarks
18701	R	Seminar in Earth and Planetary Sciences 1	0-2-0	S	A	MC(1)
18702	R	Seminar in Earth and Planetary Sciences 2	0-2-0	A	A	MC(1)
18703	R	Seminar in Earth and Planetary Sciences 3	0-2-0	S	A	MC(2)
18704	R	Seminar in Earth and Planetary Sciences 4	0-2-0	A	A	MC(2)
18801	R	Seminar in Earth and Planetary Sciences 5	0-2-0	S	A	DC(1)
18802	R	Seminar in Earth and Planetary Sciences 6	0-2-0	A	A	DC(1)
18803	R	Seminar in Earth and Planetary Sciences 7	0-2-0	S	A	DC(2)
18804	R	Seminar in Earth and Planetary Sciences 8	0-2-0	A	A	DC(2)
18805	R	Seminar in Earth and Planetary Sciences 9	0-2-0	S	A	DC(3)
18806	R	Seminar in Earth and Planetary Sciences 10	0-2-0	A	A	DC(3)
18711	R	Exercise in Earth and Planetary Sciences 1	0-2-0	S	A, B	MC(1)
18712	R	Exercise in Earth and Planetary Sciences 2	0-2-0	A	A, B	MC(1)
18713	R	Exercise in Earth and Planetary Sciences 3	0-2-0	S	A, B	MC(2)
18714	R	Exercise in Earth and Planetary Sciences 4	0-2-0	A	A, B	MC(2)
18601		Exercise in Earth and Planetary Sciences 5	0-2-0	S	A, B	DC(1)
18602		Exercise in Earth and Planetary Sciences 6	0-2-0	A	A, B	DC(1)
18603		Exercise in Earth and Planetary Sciences 7	0-2-0	S	A, B	DC(2)
18604		Exercise in Earth and Planetary Sciences 8	0-2-0	A	A, B	DC(2)
18605		Exercise in Earth and Planetary Sciences 9	0-2-0	S	A, B	DC(3)
18606		Exercise in Earth and Planetary Sciences 10	0-2-0	A	A, B	DC(3)

* R: Required

** The alphabets indicate the items listed in “3. Guide to Study in Department of Earth and Planetary Sciences” in the previous page.

Courses by Departments (専門科目群)

Course Number	Remarks	Subject	Credit	Semester S: Spring A: Autumn	Learning Content* (See footnotes)	Opening year** A: Annually E: Even O: Odd (See footnotes)
18001		Tectonics of the Earth I	2-0-0	A	C	A
18002		Tectonics of the Earth II	2-0-0	S	C	O
18047		Dynamics of the Earth	2-0-0	S	C	A

18003		Material Researches on the Earth's Mantle	2-0-0	S	C	E
18004		Magmatology	2-0-0	S	C	A
18034		Chemistry of Volcanic Fluid	2-0-0	A	C	A
18012		Space Physics I	2-0-0	S	C	O
18013		Space Physics II	2-0-0	S	C	E
18028		Geophysical Prospecting I	2-0-0	S	C	O
18029		Geophysical Prospecting II	2-0-0	S	C	E
18016		Planetary Science I	2-0-0	A	C	E
18017		Planetary Science II	2-0-0	A	C	O
18031		Radio Astronomy	2-0-0	A	C	A
18024		Planetary Exploration	2-0-0	S	C	A
18046		Radiogenic Isotope Geochemistry	2-0-0	S	C	A
18011		Earth and Planetary Electromagnetism	2-0-0	S	C	A
18045		Physics of Planetary System Formation	2-0-0	A	C	A
18501- 18505		Special Lecture in Earth and Planetary Sciences I-V	2-0-0	S, A	C	A
18506- 18513		Special Lecture in Earth and Planetary Sciences VI-XIII	1-0-0	S, A	C	A
18122		GCOE Earths Colloquium	0-1-0	A	A, B	★
18123		GCOE Earths Status Report	0-1-0	A	A, B	★
18124		GCOE Earths Internship	0-0-4	A	A, B, D	★
18125		GCOE Earths Special Lecture 1	1-0-0	S	C	A
18126		GCOE Earths Special Lecture 2	1-0-0	A	C	A
18127		GCOE Earths Special Lecture 3	1-0-0	S	C	A
18128		GCOE Earths Special Lecture 5	1-0-0	S	C	A
18129, 18130		GCOE Earths International Lecture 1, 2	1-0-0	S, A	C	A
18131		GCOE Earths International	0-1-0	A	A, B	★
18132		GCOE Earths Tutorial	0-0-1	A	A, B	★
18133		GCOE Earths Outreach	0-1-0	A	A, B, D	★

* The alphabets indicate the items listed in “ 3. Guide to Study in Department of Earth and Planetary Sciences” in the previous page.

** There is a limitation on taking courses marked with ★.

Liberal Arts and General Education (大学院教養・共通科目群)

	Remarks
International Communication (大学院国際コミュニケーション科目) Interdisciplinary Courses (大学院総合科目) Interdepartmental Courses (大学院広域科目) Arts and Humanities (大学院文明科目) Career Development Courses (大学院キャリア科目) Courses for Developing Creativity (大学院創造性育成科目) Courses for International Students (大学院留学生科目) Designated by the Department (専攻指定) 18035 Cutting-Edge Topics in Earth and Planetary Sciences 1 0-1-0 S B, C 18036 Cutting-Edge Topics in Earth and Planetary Sciences 2 0-1-0 A B, C	

18037	Cutting-Edge Topics in Earth and Planetary Sciences 3	0-1-0	S	B, C	
18038	Cutting-Edge Topics in Earth and Planetary Sciences 4	0-1-0	A	B, C	

6. Syllabus of Course Subjects

18001

Tectonics of the Earth I

Autumn Semester (2-0-0)

Kenji OHTA

Reading some research papers regarding solid Earth science, and having discussion about dynamics and chemical reaction in deep Earth. Purpose of this course is to gain a deep understanding of the issues of the papers we read and to strengthen the ability to discuss scientific matters.

18002

Tectonics of the Earth II

Spring Semester (2-0-0)

Opening year: Odd

To be assigned

18047

Dynamics of the Earth

Spring Semester (2-0-0)

Hikaru IWAMORI

The active geological phenomena and movements of the solid Earth, including earthquake, volcanism, plate motion, mantle convection and geomagnetism that characterize our rocky planet, are explained and discussed in terms of their physical and chemical mechanisms.

18003

Material Researches on the Earth's Mantle

Spring Semester (2-0-0)

Not opened this year

Eiichi TAKAHASHI

18004

Magmatology

Spring Semester (2-0-0)

Eiichi TAKAHASHI

Genesis of magma in different tectonic environments (mid oceanic ridge, subduction zone, hot spot) will be discussed based on high-pressure experiments and petrological observation. Crystallization, magma mixing, and crustal assimilation that take place beneath active arc volcanoes will be discussed based on petrologic observation. Magmatism and igneous process in the Archean and those on the other planets will be discussed. Students are requested to read important articles and make review presentation on them.

18034

Chemistry of Volcanic Fluid

Autumn Semester (2-0-0)

Kenji NOGAMI

This course gives a lecture on basic knowledge on chemical phenomena occurred on volcanoes to understand

volcanic eruption prediction by chemically-based methods.

18012

Space Physics I

Spring Semester (2-0-0)

Opening year: Odd

Tsugunobu NAGAI

One of our goals in this lecture is to understand properties of plasma kinetic equation. Fluid treatment and MHD treatment would be derived from this equation. Several examples are examined in the kinetic, fluid, and MHD methods.

18013

Space Physics II

Spring Semester (2-0-0)

Opening year: Even

Tsugunobu NAGAI

This lecture provides several topics (magnetic reconnection, shock, particle acceleration, and magneto-rotational instability) in space physics. The limitation of the MHD treatment is evaluated.

18028

Geophysical Prospecting I

Spring Semester (2-0-0)

Opening year: Odd

Yasuo OGAWA, Wataru KANDA

Geophysical prospecting enables imaging the earth's interior. The course focuses on theories and applications of geophysical prospecting methods, in particular on electromagnetic methods. The latter half of the course includes presentations by the students on some relevant papers.

18029

Geophysical Prospecting II

Spring Semester (2-0-0)

Opening year: Even

Yasuo OGAWA, Wataru KANDA

Geophysical prospecting enables imaging the earth's interior. This course focuses on understanding of the "inverse problem" which infers model parameters from observed data. The course takes the form of seminars.

18016

Planetary Science I

Autumn Semester (2-0-0)

Opening year: Even

Hideko NOMURA

The objective of this course is to systematically study physical processes of formation and evolution of star and protoplanetary disks. Key topics are discussed through reading papers.

18017

Planetary Science II

Autumn Semester (2-0-0)

Opening year: Odd

Hideko NOMURA

The objective of this course is to study physical and chemical processes in protoplanetary disks and Solar System/exoplanetary system objects from the point of observations and modeling. Key topics are discussed through reading papers.

18031

Radio Astronomy

Autumn Semester (2-0-0)

Yoshimi KITAMURA

This lecture aims to give an outline of radio observations and theoretical works for star formation in nearby molecular clouds of our Milky Way Galaxy by focusing on basic physical processes in the interstellar space.

18024

Planetary Exploration

Spring Semester (2-0-0)

Manabu KATO

The lecture gives overviews of the solar system exploration including observation methods and science issues resolved by past planetary missions. The lecture also presents contents of ongoing and future missions and their science objects.

18046

Radiogenic Isotope Geochemistry

Spring Semester (2-0-0)

Tetsuya YOKOYAMA

Radioactive isotopes and their daughter nuclides are useful tracers in geochemistry for understanding the origin and evolution of planetary materials including the Earth. In this lecture, basic principle of radiogenic isotopes will be introduced, and the application of some isotope systematics (e.g., Rb-Sr, Sm-Nd, U-Th-Pb) in geochemistry will be discussed.

18011

Earth and Planetary Electromagnetism

Spring Semester (2-0-0)

Hideo TSUNAKAWA

This course gives a lecture on observations of magnetic fields of the earth and planets, their spatial and temporal properties, and their origins.

18045

Physics of Planetary System Formation

Autumn Semester (2-0-0)

Taishi NAKAMOTO

The process of formation of planetary systems including the solar system is described. Especially, the emphasis is put on the understanding of some basic and important processes at each stage.

18701-18704, 18801-18806

Seminar in Earth and Planetary Sciences 1-10

Each Semester (2-0-0)

Academic Adviser

Read and introduce research papers on earth and planetary sciences, gain a deep understanding of the contents of the papers, and train to achieve ability to discuss scientific matters.

18711-18714, 18601-18606

Exercise in Earth and Planetary Sciences 1-10

Each Semester (0-2-0)

Academic Adviser

Exercise and practical training in each research laboratory related to earth and planetary sciences

18501-18513

Special Lecture in Earth and Planetary Sciences I-XIII

Each Semester (2-0-0 or 1-0-0)

Academic Adviser

Intensive courses on particular subjects in earth and planetary sciences

18035-18038

Cutting Edge Topics in Earth and Planetary Sciences 1-4

Each Semester (0-1-0)

Hideo TSUNAKAWA

Self-motivating activities related to English and researches in earth and planetary sciences

18122

GCOE Earths Colloquium

Autumn Semester (0-1-0)

To be assigned

GCOE Earths RA's present their research studies to one another.

18123

GCOE Earths Status Report

Autumn Semester (0-1-0)

To be assigned

GCOE Earths RA's present their research results at annual GCOE Earths workshop.

18124

GCOE Earths Internship

Autumn Semester (0-0-4)

To be assigned

GCOE Earths RA's present activity reports on their internship in other institutes and companies.

18125-18128

GCOE Earths Special Lecture 1-5

Each Semester (1-0-0)

Not opened this year

18130

GCOE Earths International Lecture 2

Autumn Semester (1-0-0)

Not opened this year

18131**GCOE Earths International**

Autumn Semester (0-1-0)

To be assigned

GCOE Earths RA's present activity reports on English debate class offered by GCOE Earths or equivalent experience.

18132**GCOE Earths Tutorial**

Autumn Semester (0-0-1)

To be assigned

GCOE Earths RA's present activity reports on their assistance in education for master course students and undergraduate students.

18133**GCOE Earths Outreach**

Autumn Semester (0-1-0)

To be assigned

GCOE Earths RA's present activity reports on their public outreach events on research results of GCOE Earths.