Graduate Major in Earth-Life Sciences

Outline

The Earth-Life Science Course is a multidisciplinary course that straddles the Department of Earth and Planetary Sciences of the School of Science, the Department of Life Science and Technology of the School of Life Science and Technology and the Department of Chemical Science and Engineering of the School of Materials and Chemical Technology. The course provides students with an overview of the entire Earth as a system and a complex understanding of natural phenomena from multiple viewpoints, ranging from the molecular scale to observations of the Earth and planets, to foster students' ability to identify fundamental questions in natural science, such as the origin of life and to solve the global scale problems such as environment, climate, water and resources, which modern society needs over the long-term.

【Master's Degree Program】

1. Competencies Developed

Students in this program are expected to acquire following abilities in addition to specialized skills in earth and planetary science, biology, and chemistry:

1) Ability to integrate understandings of different spatial and temporal scales that are fragmented
2) Ability to initiate the solution for complex problems such as global-scale issues facing humanity, the origin of life, and extraterrestrial life
3) Ability to develop human resources who will demonstrate international leadership

2. Learning Goals

Students in this program are expected to learn to acquire the following skills to obtain the abilities mentioned above:

- Specialized academic skills necessary to understand the Earth and its planets from a molecular and biological perspective.
- The skills to tackle complex problems, identify and formulate problems, and develop research plans
- Communication skills necessary for conducting research internationally

3. Study Contents

In this course, the following contents are studied in order to acquire the "abilities to obtain" described in the "Learning Goals".

A) Cultivation of basic specialized academic skills in the field of earth and life sciences
Studying to cultivate basic specialized academic skills related to the fundamental specialized academic skills (earth and planetary science, biology, and chemistry) necessary to understand the earth and planet from a cross-sectional perspective from molecules and life

B) Applied Studies in Earth and Life Sciences
Studying of your own and other major courses from the courses related to Earth and Life Sciences among the major courses offered by the Department of Earth and Planetary Sciences of the School of Science and the Department of Life Science and Technology of the School of Life Science and Technology and the Department of Chemical Science and Engineering of the School of Materials and Chemical Technology.

C) Learning to strengthen problem identification and solution skills
Learning how to solve problems through group exercises on projects related to earth science, environment, space, life and science.

D) Communication Skills Training
Developing communication skills with scientists and the general public from a global perspective through discussions with researchers from countries around the world.

E) Academic training for cultivation of liberal arts and humanistic skills
Students take liberal arts courses and career courses to cultivate a high level of liberal arts and humanistic skills.

F) Master's thesis research
Students will learn about their master's thesis research through seminars and thesis readings.

4. IGP Completion Requirements

The following requirements must be met to complete the Master's Degree Program of this major.

1. Attain a total of 30 credits or more from 400- and 500-level courses.
2. Fulfill requirements in Table M1 below.
3. Pass the master's dissertation review and defense.

Table M1 shows course categories and the number of credits required to complete the Master's Degree Program of this major. It also shows the required minimum credits in each course category and points to be noted when selecting the required courses and electives.

The learning goals to be obtained by students through courses are listed as "associated learning goals". Prior to registering courses, students need to fully understand the course goals.

Table M1. Graduate Major in Earth- Life Sciences Completion Requirements

Course category		**<Required courses> Required credits**	**<Electives> Minimum credits required**	**Minimum credits required**	**Associated learning goals**	**Comments**
Liberal arts and basic science courses	**Humanities and social science courses**		• 2 credits from 400-level • 1 credit from 500-level	5 credits	C	
	Entrepreneurship Courses	Research Development Project for Earth-Life Science M	2 credits		C, D	All graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA)
	Other courses					
Core courses	**Research seminars**	Seminar in Earth-Life Sciences S1 Seminar in Earth-Life Sciences F1 Seminar in Earth-Life Sciences S2 Seminar in Earth-Life Sciences F2 A total of 8 credits, 2 credits each from the above courses.		25 credits from among major courses and Research-related courses outside the Graduate Major in Earth− Life Science standard curriculum	A, B, C, D. E. F	
	Research-related courses	Research Planning for Master Thesis I Research Planning for Master Thesis II Research Planning for Master Thesis III A total of 4 credits,			A, B, C, D. E. F	
	Major courses	Earth-Life Science A Earth-Life Science B Earth-Life Science C Science Communication and Society M A total of 8 credits. 2 credits each from the above courses.	5 credits		A, B, C, D. E. F	
	Major courses and Research-related courses <u>outside</u> the Graduate Major in Earth -Life Sciences standard curriculum					
Total required credits		**A minimum of 30 credits including those attained according to the above conditions**				

Note	・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level. ・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections.

5. Courses

Table M2 shows the Core Courses of the Master's Degree Program in Earth-Life Science major. Graduate Majors listed in the Comments column offer core courses that are recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table M2. Core Courses of the Graduate Major in Earth-Life Sciences

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
			Category	Sub-group	Title				
Research seminars	400 level	ELS.A401	R◎	★	Seminar in Earth-Life Science S1	0-0-2	1,2,3,4,5	A,B,D,E,F	Master's research
		ELS.A402	R◎	★	Seminar in Earth-Life Science F1	0-0-2	1,2,3,4,5	A,B,C,D,E,F	Master's research
	500 level	ELS.A501	R◎	★	Seminar in Earth-Life Science S2	0-0-2	1,2,3,4,5	A,B,C,D,E,F	Master's research
		ELS.A502	R◎	★	Seminar in Earth-Life Science F2	0-0-2	1,2,3,4,5	A,B,C,D,E,F	Master's research
Research-related	400 level	ELS.B401	R◎	★	Research Planning for Master Thesis I	0-1-0	1,2,3,5	A,B,C,D,E,F	Research Proposal
		ELS.B402	R◎	★	Research Planning for Master Thesis II	0-1-0	1,2,3,5	A,B,C,D,E,F	Mid-term survey
		ELS.B403	R◎	★	Research Planning for Master Thesis III	0-2-0	1,2,3,5	A,B,C,D,E,F	Interdisciplinary research
Major courses	400 level	ELS.C401	R◎	★	Earth-Life Science A	2-0-0	1,2,4	A	Chemistry
		ELS.C402	R◎	★	Earth-Life Science B	2-0-0	1,2,4	A	Biology
		ELS.C403	R◎	★	Earth-Life Science C	2-0-0	1,2,4	A	Earth and Planetary Science
		ELS.C431	○	★	Research Development Project for Earth-Life Science M	0-2-0	2,3,4,5	C,D,E	
		ELS.C432	○	★	Science Communication and Society M	0-2-0	2,3,4,5	C,D,E	
		ELS.C433	L elective	★	Advanced Earth and Space Sciences A	1-0-0	1,2,3,4,5	A	Earth and Planetary Science-related courses (EPS.A410)
		ELS.C434	L elective	★	Advanced Earth and Space Sciences B	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A411)
		ELS.C435	L elective	★	Advanced Earth and Space Sciences C	1-0-0	1,5	A	Earth and Planetary Science-related courses (EPS.A413)

		ELS.C436	L elective	★	Advanced Earth and Space Sciences D	1-0-0	1,2,3	A	Earth and Planetary Science-related courses (EPS.A422)
		ELS.C437	L elective	★	Advanced Earth and Space Sciences E	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A418)
		ELS.C438	L elective	★	Advanced Earth and Space Sciences F	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A420)
		ELS.C439	L elective	★	Advanced Earth and Space Sciences G	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A421)
		ELS.C440	L elective	★	Advanced Earth and Space Sciences H	1-0-0	1,5	A	Earth and Planetary Science-related courses (EPS.A424)
		ELS.C441	L elective	★	Advanced Earth and Space Sciences I	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A426)
		ELS.C442	L elective	★	Advanced Earth and Space Sciences J	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A427)
		ELS.C443	L elective	★	Advanced Earth and Space Sciences K	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A428)
		ELS.C444	L elective	★	Advanced Earth and Space Sciences L	1-0-0	1	A	Earth and Planetary Science-related courses (EPS.A429)
		ELS.C445	L elective	★	Molecular and Cellular Biology	2-0-0	1,2,4	B,D	Life Science Technology-related course (LST.A401)
		ELS.C447	L elective	★	Biophysics	2-0-0	1,2,4,5	B,D	Life Science Technology-related course (LST.A403)
		ELS.C448	L elective	★	Science of Metabolism	2-0-0	1,2,4,5	B,D	Life Science Technology-related course (LST.A407)
		ELS.C449	L elective	★	Computational Biology	2-0-0	1,2	B,D	Life Science Technology-related course (LST.A408)
		ELS.C450	L elective	★	Physical Biology of the Cell	2-0-0	1,2	B,D	Life Science Technology-related course (LST.A409)
		ELS.C451	L elective	★	Biomolecular Engineering	2-0-0	1,2,5	B,D	Life Science Technology-related course (LST.A411)
		ELS.C460	L elective	★	Advanced Molecular Design of Metal Complexes I	1-0-0	1,5	B	Chemical Science and Engineering-related course (CAP.A463)
		ELS.C461	L elective	★	Advanced Solid State Chemistry Ⅱ	1-0-0	1	B	Chemical Science and Engineering-related course (CAP.A462)
		ELS.C462	L elective	★	Advanced Organic Synthesis Ⅰ	1-0-0	1,5	B	Chemical Science and Engineering-related course (CAP.A423)
		ELS.C463	L elective	★	Advanced Organic Electrochemistry	1-0-0	1,5	B	Energy Science and Informatics-related course (ESI.H415.)
		ELS.C464	L elective	★	Advanced Polymer Assembly	1-0-0	1,4	B	Chemical Science and Engineering-related course (CAP.P414)

		ELS.C465	L elective	★	Introduction to Polymer Chemistry	2-0-0	1,4,5	A	Chemical Science and Engineering-related course (CAP.I427)
	500 level	ELS.C501	L elective	★	Molecular Simulation	1-1-0	1,5	A	Artificial Intelligence-related course (ART.T545)
		ELS.C511	L elective	★	Advanced Catalytic Reactions	1-0-0	1	B	Chemical Science and Engineering-related course (CAP.T532)

Note：
- ◎：Required course, ○：Restricted elective, ★：Classes in English
- Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)
- Comments: other) ▲▲-related course (this is the code used for Course offered by another graduate major)
- The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D400.R): A: Research seminar of Earth-Life Science Course, B: Research-related courses, C: Major courses

7. IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the master's degree program, students must attain at least two credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table M-1 of the "Entrepreneurship Courses" listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table M3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as equivalent to Entrepreneurship Courses can be counted towards the completion requirements of the master's degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.
The Graduate Attributes of the Master's Degree Program are listed in Table M1 as follows:
GA0M: You can clearly plan your own career and recognize the abilities necessary for realizing it while considering ethics and relevance to societal problems.
GA1M: You can acquire the knowledge, skills, ethics and entrepreneurship necessary for realizing your planned career and contribute to societal problem-solving while collaborating with other experts

Table M3. Courses of the Graduate Major in Earth-Life Sciences recognized as equivalent to Entrepreneurship Courses

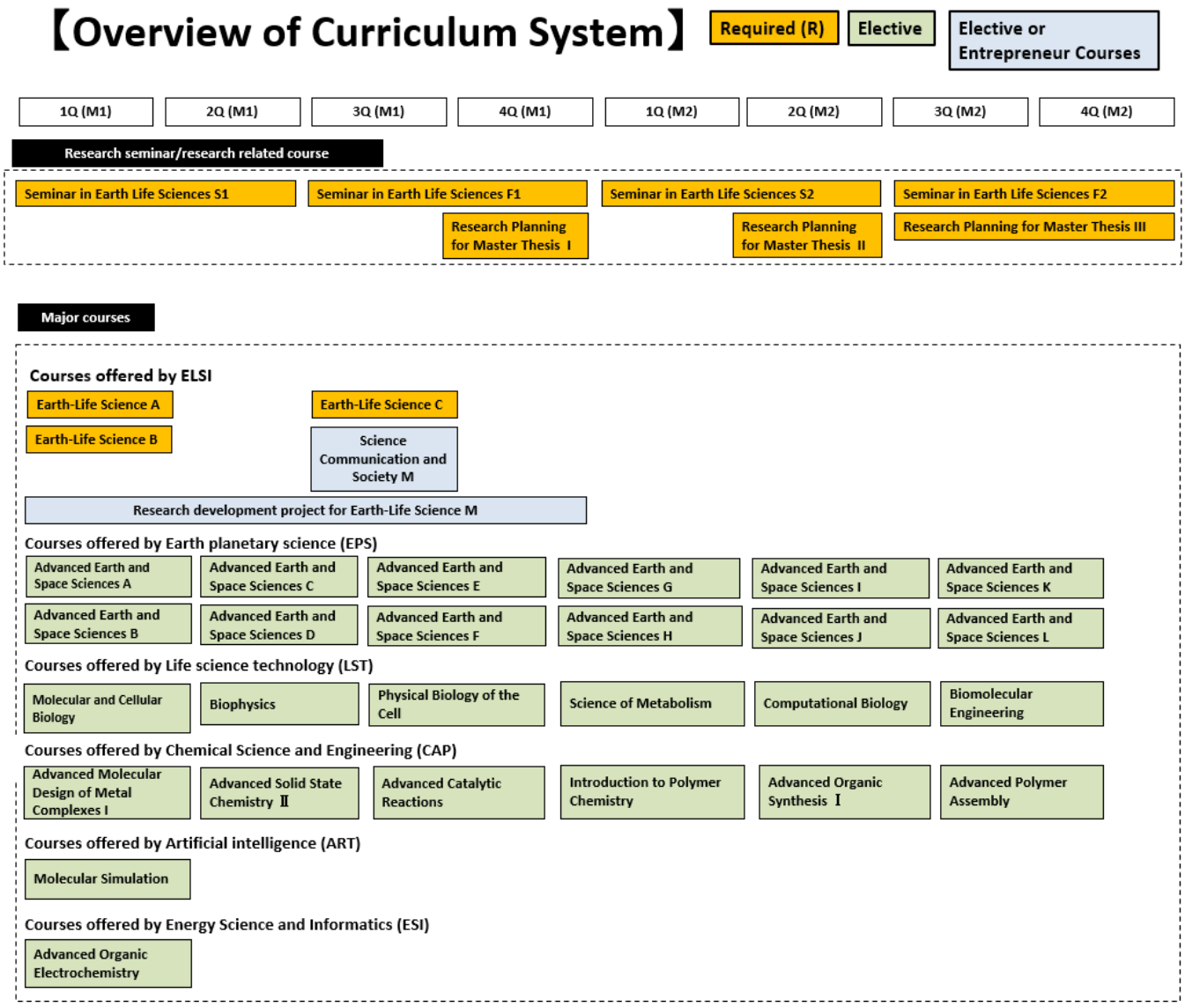
Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	ELS.C431	○	★	Research Development Project for Earth-Life Science M	0-2-0	GA1M	C,D,E	
	ELS.C432	○	★	Science Communication and Society M	0-2-0	GA0M	C,D,E	

★：Classes in English

Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.
* GA: Graduate Attributes

The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under "Liberal Arts and Basic Science Courses" in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

8. Overview of Curriculum System



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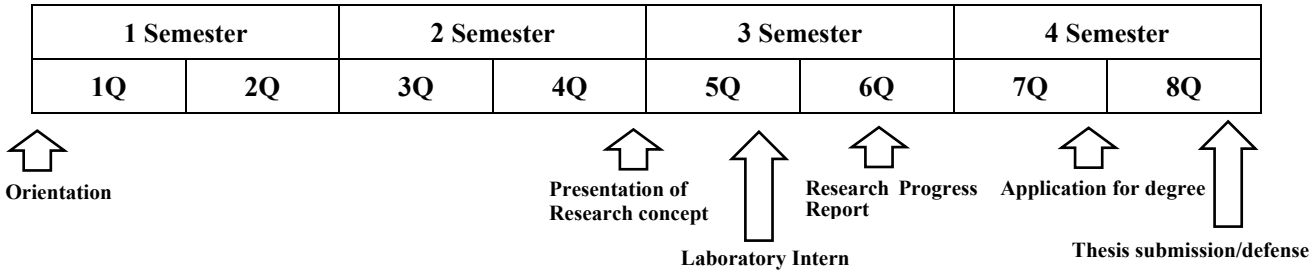
9. Example of a Standard Curriculum

Year		1st							
Subject classification		1Q		2Q		3Q		4Q	
Specialized Subjects	Major courses	Earth-Life Science A	2			Earth-Life Science C	2		
		Earth-Life Science B	2			Science Communication and Society M	2		
		Molecular and Cellular Biology	2						
		Biophysics	2						
		Research development project for Earth-Life Science M							2

	Research-related courses								Research Planning for Master Thesis I	1
	Research seminars	Seminar in Earth-Life Science S1			2	Seminar in Earth-Life Science F1				2
Year		2nd								
Subject classification		5Q		6Q		7Q		8Q		
Specialized Subjects	Major courses									
	Research-related courses			Research Planning for Master Thesis II	1	Research Planning for Master Thesis III				2
	Research seminars	Seminar in Earth-Life Science S2			2	Seminar in Earth-Life Science F2				2

10. Research Related to the Completion of Master's Theses

In the master thesis research, by experiencing a series of research processes, students will cultivate the ability to formulate and consider problems from their own unique perspectives based on previous research. The research flow of the master's thesis for this purpose is outlined as follows



• Presentation of research concept and research progress report

In order to produce research results, it is important to conduct research systematically and to check the progress regularly. In order for students to have a clear awareness of the background and purpose of their own research, a "Research Concept Presentation" (Research Planning for Master Thesis I) is held in 4Q, and a "Research Interim Presentation" (Research Planning for Master Thesis II) is held in 6Q.

After the presentation of the research plan (Research Planning for Master Thesis I), if the student is recognized as having a wide range of basic and specialized knowledge and a high level of insight and consideration in the field of earth and life sciences, he or she will be able to study the specialized courses in the 600 series. However, please note that this cannot be included in the requirements for completion of the master's course.

A master's thesis advisory committee will be formed and a research plan (at least 15 double-spaced pages, not including references) will be prepared with the faculty advisor. The prepared research plan shall be presented in the form of an oral presentation. The Thesis Advisory Committee will review the proposal together with the faculty advisor (Research Planning for Master Thesis I).

Present the progress of the master's research at the interim presentation. Specifically, the student will give an oral presentation on the content of the research project conducted, the degree of accomplishment, and future plans. Members of Earth-Life Science Institute, who specialize in earth and planetary sciences, biology, and chemistry, will attend the interim presentation and offer advice on the master's research from an interdisciplinary perspective (Research Planning for Master Thesis II).

Laboratory rotations are conducted (Seminar in Earth-Life Science S2). The student lists up to three PIs in the laboratory that are candidates for rotation. The faculty advisor will make a comprehensive decision on the match between each PI and the student and begin training in a different laboratory (one week, including a brief, simple experiment or case study). Interdisciplinary rotation is preferred but not required.

• Master's Thesis Review Criteria

The master's thesis must be a self-authored thesis that contains new knowledge in the academic field of Earth and Life Sciences or useful knowledge that contributes to the development of Earth and Life Sciences and includes an original discussion. The thesis and the thesis outline should be written in English. The thesis is unique from a journal article and should be written in the form of a thesis which summarizes research conducted during the masters period: it is not in the format typical for a journal article submission.

• Master's thesis review procedure
After preliminary peer review by the judges, oral presentations will be made for final review and evaluation. The oral presentations must be given in English.

11. Seamless Transition Between Degree Programs

The Earth-Life Science Course aims to cultivate (1) the ability to integrate the understanding of different spatial and temporal scales through research and practice of Earth and Life Science, (2) the ability to address global-scale issues facing humanity and complex problems such as the origin of life and extraterrestrial life, and (3) the ability to communicate with others to demonstrate leadership on an international level.

- The ability to identify the essence of complex phenomena in the earth and life sciences, to discover and explore new issues and to lead the way to solutions.
- Practical ability to lead fusion research with a deep understanding of the challenges and solutions of different fields of research and the commonalities with one's own specialty and methodologies.
- The ability to provide leadership internationally in related fields.

In the curriculum for the doctoral course, the following courses are offered as the 600 level courses: Seminar in Earth-Life Science S3 to S5, F3 to F5, Research Planning for Doctor Thesis I and II, Research development project for Earth-Life Science D, and Communicating Earth-Life Science to the World D. It is an organic curriculum that efficiently enhances communication and leadership skills as well as professionalism through the execution of cutting-edge research based on the curriculum from 400 level courses.

【Doctoral Degree Program】

1. Competencies Developed

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. Learning Goals

In order to achieve the above-mentioned objectives, this program sets the acquisition of the following abilities as its learning objectives with a higher standard than that of the master's program.

- Specialized academic skills necessary to understand the earth and its planets from a molecular and biological viewpoint.
- Ability to tackle complex problems, identify and formulate issues and develop research plans
- Communication skills necessary for conducting research internationally

3. Study Contents

In this course, students will learn the following contents in order to acquire the "abilities to acquire" described in "Learning Objectives".

(A) Cultivation of advanced specialized academic skills to understand the nature and universality of phenomena related to earth and life sciences
To cultivate advanced academic skills to understand the nature and universality of phenomena related to Earth and life sciences through specialized courses and studies in the Earth-Life Sciences Course.
(B) Cultivation of practical problem-solving skills utilizing a broad understanding and knowledge in the field of earth and life sciences
Strengthen practical skills to lead to solutions to set issues through internships in projects related to earth science, environment, space, life science, etc.
(C) Learning to lead the frontiers of earth and life science research and to strengthen communication skills that will enable international leadership
(D) Academic training for cultivation of cultural and human skills
Cultivate a high level of liberal arts and humanistic skills by taking liberal arts courses and career courses.

4. IGP Completion Requirements

The following requirements must be fulfilled in order to complete the doctoral program of this course.

1. 24 credits or more must be earned from graduate courses (600 series).
2. Fulfill the following requirements in the courses designated in this course.
   - The student must have earned 12 credits in research courses.
   - The student must have earned 4 credits in research-related courses.
   - The student must have earned a total of at least 6 credits, including at least 2 credits from Humanities and Social Science Courses numbered in the 600s and at least 4 credits from Entrepreneurship Courses.
3. Pass the doctoral dissertation review and final examination.

Table D1 shows the course categories and the number of credits required for completion of the doctoral program in the Earth-Life Science Course. The number of required credits is specified for each course category and for each course group, and notes are provided in the "Required Course Credits" and "Elective Course Credits" columns for course selection. The "Relation to Course Content" column indicates the content of study related to the course. When registering for a course, students should fully understand the relationship between the subject and the content of study.

Table D1. Graduate Major in Earth-Life Sciences Completion Requirements

Course category	<Required courses> Required credits	<Electives> Minimum credits required	Minimum credits required	Associated learning goals	Comments

Liberal arts and basic science courses	**Humanities and social science courses**		2 credits	6 credits	D	
	Entrepreneurship Courses		4 credits		D	All graduate Attributes (GA) should be acquired. (Refer to Section 7 for the definition of GA
	Other courses					
Core courses	**Research seminars**	Seminar in Earth-Life Science S3 Seminar in Earth-Life Science F3 Seminar in Earth-Life Science S4 Seminar in Earth-Life Science F4 Seminar in Earth-Life Science S5 Seminar in Earth-Life Science F5 A total of 12 credits, 2 credits each from above courses.		18 credits	A, B, C	
	Research-related courses and major courses	Research Planning for Doctor Thesis I Research Planning for Doctor Thesis II, A total of 4 credits, 2 credits each from above courses			A, B, C	
	Major courses and Research-related courses outside the Graduate Major in Earth-Life Sciences standard curriculum					
Total required credits		**A minimum of 24 credits including those attained according to the above conditions**				
Note		・For details of the Liberal Arts and Basic Science Courses, please refer to the relevant sections. ・Japanese Language and Culture Courses offered to international students can be recognized as equivalent to the Humanities and Social Science Courses of the corresponding course level.				

5. IGP Courses

Table D2 shows the Core Courses of the Doctoral Degree Program of this major. Graduate Majors listed in the Comments column are specialized courses of other courses designated by the Earth-Life Science Course and recognized as equivalent to the corresponding Major Courses or Research-related Courses in the standard curriculum of this major.

Table D2. Core Courses of the Doctoral Degree Program in Earth-Life Sciences

Course category		Course number	Course title			Credits	Competencies	Learning goals	Comments
Research seminars	**600 level**	ELS.A631.E	R ◎	★	Seminar in Earth-Life Science S3	0-0-2	1,2,3,4,5	A,B,C	
		ELS.A632.E	R ◎	★	Seminar in Earth-Life Science F3	0-0-2	1,2,3,4,5	A,B,C	
		ELS.A633.E	R ◎	★	Seminar in Earth-Life Science S4	0-0-2	1,2,3,4,5	A,B,C	

		ELS.A634.E	R ◎	★	Seminar in Earth-Life Science F4		0-0-2	1,2,3,4,5	A,B,C	
		ELS.A635.E	R ◎	★	Seminar in Earth-Life Science S5		0-0-2	1,2,3,4,5	A,B,C	
		ELS.A636.E	R ◎	★	Seminar in Earth-Life Science F5		0-0-2	1,2,3,4,5	A,B,C	
Research-related	600 level	ELS.B631.E	R ◎	★	Research Planning for Doctor Thesis I		0-2-0	1,2,3,4,5	A,B,C	
		ELS.B632.E	R ◎	★	Research Planning for Doctor Thesis II		0-2-0	1,2,3,4,5	A,B,C	
	600 level	ELS.C641.E	○	★	Research Development Project for Earth-Life Science D		0-2-0	2,3,4,5	A,B,C	
		ELS.C642.E	○	★	Science Communication and Society D		0-2-0	2,3,4,5	A,B,C	
	600 level	ELS.C680	○		Cooperative Education through Research Internships of Earth-Life Sciences		0-0-4	1,2,3,4,5	C	

Note：
- ◎：Required course，○：Restricted elective，★：Classes in English
- Competencies: 1 = Specialist skills, 2 = Liberal arts skills, 3 = Communication skills, 4 = Applied skills (inquisitive thinking and/or problem-finding skills), 5 = Applied skills (practical and/or problem-solving skills)
- Comments: other) ▲▲-related course (this is the code used for Course offered by another graduate major)
- The character preceding the three digits in the course number denotes the course's subdiscipline (i.e., "D" represents the subdiscipline code in the course number ABC.D400.R): A: Research seminar of Earth-Life Science Course, B: Research-related courses, C: Major courses

6. IGP Courses That Can Be Counted as Humanities and Social Science Courses

None

7. IGP Entrepreneurship Courses and IGP Courses That Can Be Counted as Entrepreneurship Courses

In order to fulfill the completion requirements for the doctoral degree program, students must attain at least four credits in Entrepreneurship Courses, and should satisfy all of the Graduate Attributes (GAs) specified in Table D-1 of the “Entrepreneurship Courses” listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program, as well as shown below. Students will be evaluated in regards to GA achievements at the time of their degree completion. For courses with two GAs, both GAs stipulated for the courses are considered to be acquired if students attain the corresponding credits for those courses.

Entrepreneurship Courses and Major Courses that enable students to acquire GAs and are recognized as equivalent to Entrepreneurship Courses, offered by the Graduate Major, are listed in Table D3 below. Students can also acquire GAs and credits by taking the Entrepreneurship Courses offered by the Center for Entrepreneurship Education (CEE) listed as “Liberal Arts and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program.

As there are some Entrepreneurship Courses without GAs, please check carefully before registering for them.

However, it must be noted that credits attained from courses that are recognized as Entrepreneurship Courses can be counted towards the completion requirements of the doctoral degree program, either for Major Courses or for Entrepreneurship Courses (not for both). Nevertheless, even in cases where credits pertaining to courses that are not considered as Entrepreneurship Courses are attained, the associated GAs may be considered by the Graduate Major to have been acquired.

For Graduate Attributes, refer to the Guide to Entrepreneurship Courses.
The Graduate Attributes of the Doctoral Degree Program are listed in Table D1 as follows:

GA0D: You can clearly design your own career and contribute to realizing scientific, technological, or social innovation through a comprehensive understanding of the knowledge, skills, social responsibilities and ethics required to become an active member of academia and/or industry.

GA1D: You can lead in realizing scientific, technological, or social innovation by acquiring advanced leadership skills, entrepreneurship, knowledge and expertise, and by developing social responsibility necessary for materializing your designed career.

The Tokyo Tech Academy for Leadership (ToTAL), WISE Programs, or Center of Data Science and Artificial Intelligence may offer courses that are recognized as equivalent to Entrepreneurship Courses in addition to those listed as such under “Liberal Arts

and Basic Science Courses” in the Guide to Graduate Education and International Graduate Program. For details about available courses or completion requirements, please refer to the study guide of the academy or center that offers the relevant program.

Table D3. Courses of the Graduate Major in Earth-Life Sciences recognized as equivalent to Entrepreneurship Courses

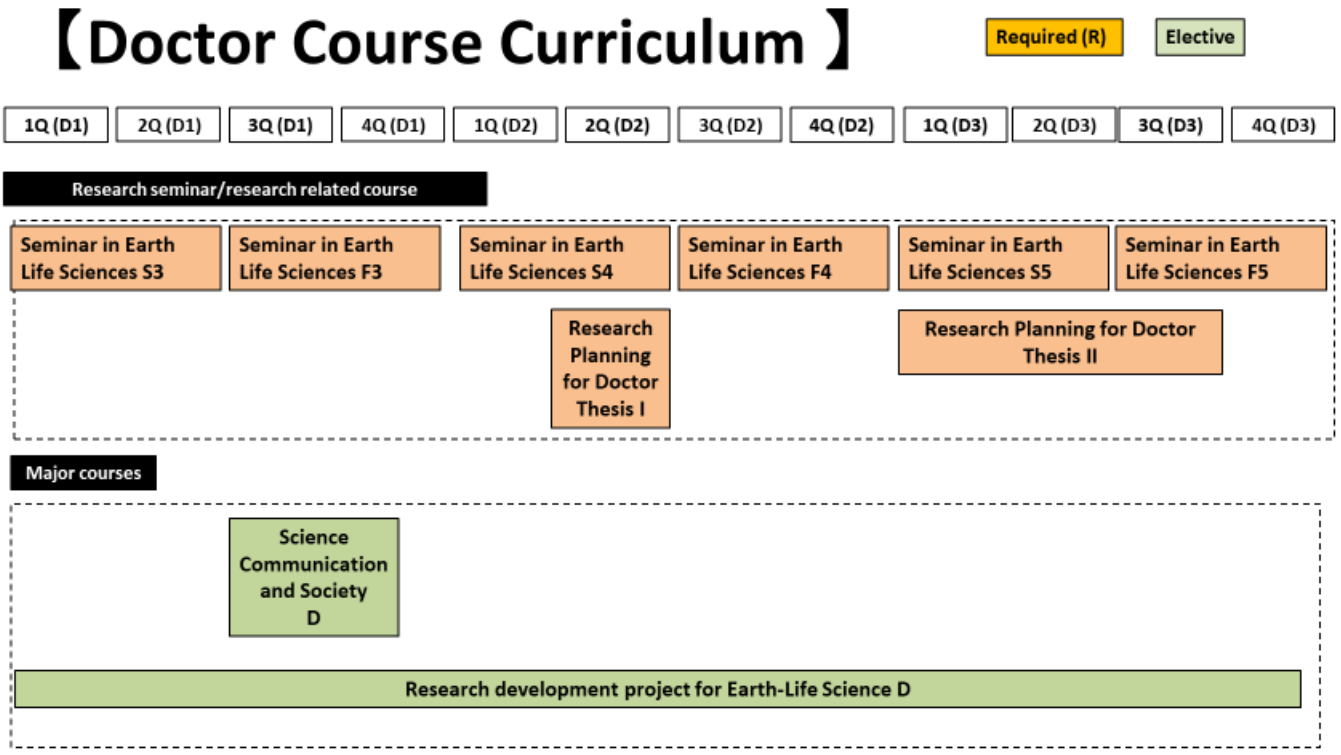
Course category	Course number	Course title			Credits	GA*	Learning goals	Comments
Courses that can be counted as Entrepreneurship Courses	ELS.C641.E	○	★	Research Development Project for Earth-Life Science D	0-2-0	GA1D	A,B,C	
	ELS.C642.E	○	★	Science Communication and Society D	0-2-0	GA0D	A,B,C	
	ELS.C680.E	○		Cooperative Education through Research Internships of Earth-Life Sciences	0-0-4	GA1D	C	

★：Classes in English

Credits in Entrepreneurship Courses must be attained from among the above-listed courses and those listed as such in the Liberal Arts and Basic Science Courses Guide.

* GA: Graduate Attributes

8. Overview of Curriculum System



9. Example of a Standard Curriculum

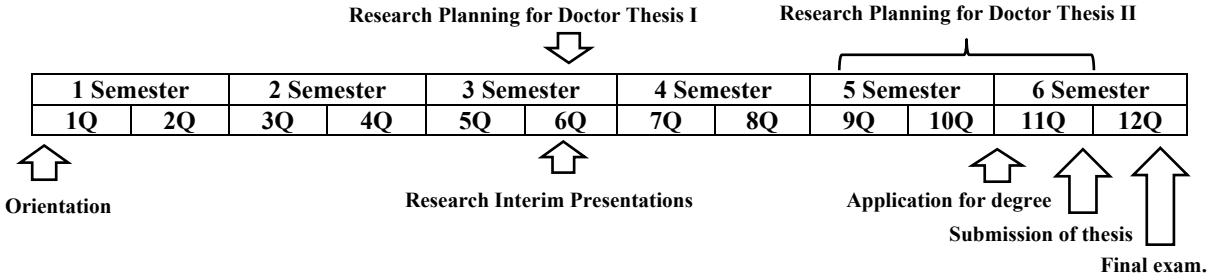
year		1st							
subject classification		1Q		2Q		3Q		4Q	
Specialized Subjects	Major courses					Science Communication and Society D	2		
	Research-related courses								
	Research seminars	Seminar in Earth-Life Science S3	2			Seminar in Earth-Life Science F3			2

year		2nd							
subject classification		5Q		6Q		7Q		8Q	
Specialized Subjects	Major courses	Research Development project for Earth-Life Science D							2
	Research-related courses			Research Planning for Doctor Thesis I	2				
	Research seminars	Seminar in Earth-Life Science S4	2			Seminar in Earth-Life Science F4			2

year		3rd							
subject classification		9Q		10Q		11Q		12Q	
Speciali	Major courses								
	Research-related courses	Research Planning for Doctor Thesis II					2		
	Research seminars	Seminar in Earth-Life Science S5	2			Seminar in Earth-Life Science F5			2

10. Research Related to the Completion of Doctoral Theses

Through the doctoral thesis research, the candidate must develop the ability to formulate a problem from an original point of view based on previous research and to construct original findings to solve the problem. The doctoral thesis research flow for this purpose is outlined below.



- Research Interim Presentations
  In order to produce research results, it is important to conduct research systematically and to check the progress regularly. For this reason, the Research Planning for Doctor Thesis I will be conducted in the 6th quarter, and the Research Planning for Doctor Thesis II in the 9th to 11th.

- Preliminary Doctoral Thesis Examination
  A preliminary review will be conducted in the Research Planning for Doctor Thesis II.

- Doctoral Dissertation Examination Criteria
  The doctoral thesis must be a self-authored thesis in the field of earth and life sciences that is novel, original, and of sufficient

academic value, and the major parts of the thesis must have been published in an international standard journal or be of a standard that will be published in an international standard journal. The doctoral thesis must be written in in English.

- The thesis review procedure
  After passing the interim review, the thesis shall be submitted for oral presentation, followed by preliminary review and evaluation by the examiners. The thesis should summarize the research performed during the degree period and is unique from a manuscript draft or drafts to be submitted to a journal, or previously submitted. In the final review, the ability to understand the relevant field (including English proficiency) will be confirmed. The oral presentation of the doctoral thesis must be given in English.