

Applied Marine Biology (AMB)
Course Timetable & Syllabus
2025. 10~2026. 9

(Updated on April 1, 2026)

Faculty of Agriculture
Tohoku University

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Important Notice: Information contained on this syllabus may be subject to change at the decision of the course instructor.

For any inquiries, please contact the student affairs office of the Faculty of Agriculture (email: agr-kyom@grp.tohoku.ac.jp).

Timetable 2025.10-2026.9 授業時間割表 2025.10-2026.9

General Education Subjects Specialized Subjects

		8:50~10:20	10:30~12:00	13:00~14:30	14:40~16:10	16:20~17:50
2nd Semester 後期 Fall Semester	Mon.				Basic Japanese I	
	Tues.		生命と自然 Life and Nature	物理学 A Physics A	解析学概論 Foundations of Calculus	Basic Japanese I
	Wed.	経済と社会 Economy and Society	化学A Chemistry A	(Laboratory Tour)		
	Thur.	情報とデータの基礎 Information and Data Literacy	Basic Japanese I	地球物質科学 Mineralogy, Petrology & Geochemistry	生命科学 A Biology A	
	Fri.	歴史学 History	生理・生態学概論 Introduction to Physiology and Ecology 【Kawauchi C204】	Basic Japanese I	学問論 Introduction of Academic Learning	
	Intensive course	海外短期研修(基礎 A) Study-abroad Program A				
3rd Semester 前期 Spring Semester	Mon.					生命科学 C Biology C
	Tues.	Basic Japanese II	生命科学 B Biology B		線形代数概論 Foundations of Linear Algebra	
	Wed.	化学 C Chemistry C	Basic Japanese II			
	Thur.			自然科学総合実験 Introductory Science Experiments		Basic Japanese II
	Fri.	水圏無脊椎動物学 Aquatic Invertebrate Biology 【Lecture Room 8】 1st Quarter		現代における農と農学 Modern Agriculture and Agricultural Science	陸圏・水圏環境コミュニケーション論 Introduction to Aquatic Production / Introduction to Natural and Agricultural Production	
	Intensive course	臨海実習 Practice on Marine Bio-resources Science				
4th Semester 後期 Fall Semester	Mon.			水産遺伝育種学 Fish Genetics and Breeding science 【Lecture Room 8】 3rd Quarter		
	Tues.	数理統計学 Probability & Statistics	Intermediate Japanese		日本の産業と科学技術 Science, Technology and Industry in Japan	キャリア教育特別講義 Special Lecture of Career Education
	Wed.	Intermediate Japanese	Intermediate Japanese			
	Thur.	海洋生物学 Marine Biology 【Lecture Room 8】 4th Quarter				
	Fri.		水産科学概論 Introduction to Fisheries Science 【Lecture Room 8】	スポーツ A Sports A		
	Intensive course	体と健康 Health				
5th Semester 前期 Spring Semester	Mon.	資源動物生態学 Animal Ecology and Ethology 【Lecture Room 8】 2nd Quarter		学生実験 I・基礎化学実験・基礎生物学実験 Fishery Science Practice I/Basic Chemistry, Practice/Basic Biology, Practice 【(Student Laboratory)】		
	Tues.	水圏植物生態学 Aquatic Plant Ecology 【Lecture Room 8】 1st Quarter 水産化学 Marine Biochemistry 【Lecture Room 8】 2nd Quarter				
	Wed.		科学論文講読 I Reading of Scientific Paper I 【Each Laboratory】 1st Quarter			
	Thur.	プランクトン学 Planktology 【Lecture Room 8】 2nd Quarter				
	Fri.	沿岸環境学 Marine Coastal Ecology 【Lecture Room 10】 1st Quarter 水産増殖学 Aquacultural Biology 【Lecture Room 10】 2nd Quarter				
	Intensive course	学際インターンシップ Multidisciplinary Internship 水圏植物学 Applied Aquatic Botany 生産フィールド実習 I Field Practice of Marine Production I				

		8:50~10:20	10:30~12:00	13:00~14:30	14:40~16:10	16:20~17:50
6th Semester	後期 Fall Semester	Mon.	水産資源生態学 Fisheries Biology and Ecology 【Lecture Room 8】 3rd Quarter 沿岸生物学 Applied Genetics in Aquatic Organisms 【Lecture Room 9】 4th Quarter	学生実験Ⅱ・基礎化学実験・基礎生物学実験 Fishery Science PracticeⅡ/Basic Chemistry, Practice/Basic Biology, Practice 【Student Laboratory】		
		Tues.	生物生産情報処理概論 An Introduction to Bioindustrial Information Processing 【Lecture Room 9】 3rd Quarter			
		Wed.	生物海洋学 Biological Oceanography 【Lecture Room 9】 3rd Quarter			
		Thur.	先端海洋分子生物学 / 先端海洋生物工学 Current topics of Fish Molecular Biology Current topics of Marine Biotechnology/ 【Lecture Room 8】 3rd Quarter			
		Fri.	水産利用学 Marine Product Technology 【Lecture Room 9】 3rd Quarter			
		Intensive course	実地研修 Practical Training			
7th Semester	前期 Spring Semester	Mon.				
		Tues.	先端プランクトン学 Current topics of Plankton Biology 【Lecture Room 9】 1st Quarter			
		Wed.	水産食品管理学 Seafood Management 【Lecture Room 8】 1st Quarter 先端沿岸生態学 Current topics of Coastal Ecology 【Lecture Room 9】 2nd Quarter	先端植物生命科学 Current topics of Agricultural Plant Science 【Lecture Room 9】 1st Quarter		
		Thur.	先端海洋生物生理学 Current topics of Shellfish Physiology 【Lecture Room 9】 1st Quarter 先端海洋生物生態学 Current topics of Fish Ecology 【Lecture Room 10】 2nd Quarter	食糧と化学 Food and Chemistry 【Lecture Room 9】 1st Quarter		
		Fri.		応用動物・酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 9】 1st Quarter 先端地球海洋生態学 Current Topics in Global Marine Ecology 【Lecture Room 9】 2nd Quarter		
		Intensive course	生産フィールド実習Ⅱ Field Practice of Marine ProductionⅡ 海洋応用生物化学 Marine Applied Biochemistry			
8th Semester	後期 Fall	Mon.	卒業論文 Graduation Thesis			
		Tues.				
		Wed.				
		Thur.				
		Fri.				
9th Semester	前期 Spring Semester	Mon.	卒業論文 Graduation Thesis			
		Tues.				
		Wed.	先端植物生命科学 Current topics of Agricultural Plant Science 【Lecture Room 9】 1st Quarter	卒業論文 Graduation Thesis		
		Thur.	卒業論文 Graduation Thesis		食糧と化学 Food and Chemistry 【Lecture Room 9】 1st Quarter	
		Fri.	応用動物・酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 9】 1st Quarter			
		Intensive course	海洋応用生物化学 Marine Applied Biochemistry			

The following subjects are available in 2027. 以下の科目は2027年度に開講します。

資源環境経済学概論 Introduction to Resource and Environmental Economics, 応用生物化学 Applied Biological Chemistry

AMB Course curriculum Taught in English AMB 英語コースカリキュラム

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Introduction to Academic Learning 学問論	T. Koike	1 st	Foundations Navigating Academia	2		
History 歴史学	O. Klautau	1 st	Foundations Humanities	2		
Economy and Society 経済と社会	J. Ryan	1 st	Foundations Social Sciences	2		
Foundations of Linear Algebra 線形代数学概論	Y. Chen	1 st	Foundations Natural Sciences	2		
Foundations of Calculus 解析学概論	Y. Chen	1 st	Foundations Natural Sciences	2		
Life and Nature 生命と自然	S. Katayama	1 st	Foundations Transdisciplinary Subjects	2		国費学生必修
Introductory Science Experiments 自然科学総合実験	I. Nakamura et al.	1 st	Foundations Transdisciplinary Subjects	2		
Sports A スポーツA		2 nd	Foundations Transdisciplinary Subjects Health Sciences	1		
Health 体と健康	T. Muratsubaki	2 nd	Foundations Transdisciplinary Subjects Health Sciences	2		
Information and Data Literacy 情報とデータの基礎	S. Mohammad	1 st	Advanced Subjects Information Science and Technology Education	2		
Understanding International Issues 国際事情		1 st	Advanced Subjects International Education		2	
PBL in Global Issues 国際教養PBL		1 st	Advanced Subjects International Education		2	
Special Topics on Global Issues 国際教養特定課題		1 st	Advanced Subjects International Education		2	
Understanding Culture 文化理解		1 st	Advanced Subjects International Education		2	
Exploring Culture and Society 文化と社会の探求		1 st	Advanced Subjects International Education		2	
Multicultural Communication 多文化間コミュニケーション		1 st	Advanced Subjects International Education		2	
PBL in Multicultural Environment 多文化PBL		1 st	Advanced Subjects International Education		2	
Special Topics on Multicultural Society 多文化特定課題		1 st	Advanced Subjects International Education		2	
Global Seminar グローバル学習		1 st	Advanced Subjects International Education		2	
Global Career キャリア関連学習		1 st	Advanced Subjects International Education		2	
Global Leadership Development through PBL グローバルPBL		1 st	Advanced Subjects International Education		2	
Special Topics on Global Leadership グローバル特定課題		1 st	Advanced Subjects International Education		2	
Study-abroad Semester 海外長期研修		1 st	Advanced Subjects International Education		1~6	
Study-abroad Program A 海外短期研修(基礎A)	X. Dahan et al.	1 st	Advanced Subjects International Education		1~2	
Special Lecture of Career Education キャリア教育特別講義	T. Koike et al.	2 nd	Advanced Subjects Career Education	2		国費学生必修
Current Topics カレント・トピックス		1 st	Advanced Subjects Current Topics		1~2	
Basic Japanese I	Y. Mikoda et al.	1 st	Languages Japanese	4		
Basic Japanese II	M. Hayashi et al.	1 st	Languages Japanese	3		
Intermediate Japanese	Y. Azumi et al.	2 nd	Languages Japanese	3		You may instead select 3 subjects (3 credits) from the General Education Japanese A-J classes.
Probability & Statistics 数理統計学	Y. Chen	2 nd	Basics of Discipline Basics of Mathematics	2		
Physics A 物理学A	T. Koike	1 st	Basics of Discipline Basics of Physics	2		

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Chemistry A 化学A	D.Mott	1st	Basics of Discipline Basics of Chemistry	2		
Chemistry C 化学C	D.Mott	1st	Basics of Discipline Basics of Chemistry	2		
Biology A 生命科学A		1st	Basics of Discipline Basics of Biology	2		
Biology B 生命科学B	Hsin Jun Ho	1st	Basics of Discipline Basics of Biology	2		
Biology C 生命科学C	S. Katayama	1st	Basics of Discipline Basics of Biology	2		Substitute for Modern Scholarship 現代学問論誌替
Mineralogy, Petrology & Geochemistry 地球物質科学	B. Breedlove	1st	Basics of Discipline Basics of Earth and Space Science	2		
Introduction to Aquatic Production 水圏環境コミュニケーション論	M. Ikeda	1st	Specialized Subjects Faculty Common Subjects	1		Joint class 日本人と共修
Introduction to Natural and Agricultural Production 陸圏環境コミュニケーション論	T. Sumita et al.	1st	Specialized Subjects Faculty Common Subjects	1		Joint class 日本人と共修
Modern Agriculture and Agricultural Science 現代における農と農学	The field of all Agriculture 全分野	1st	Specialized Subjects Faculty Common Subjects	2		Joint class 日本人と共修
Introduction to Physiology and Ecology 生理・生態学概論	Cheryl Ames	1st	Specialized Subjects Faculty Common Subjects	2		
An Introduction to Bioindustrial Information Processing 生物生産情報処理概論	Y. Sakai	3rd	Specialized Subjects Faculty Common Subjects		2	
Reading of Scientific Paper I 科学論文講読I	T. Nakano et al.	2nd	Specialized Subjects Faculty Common Subjects	1		Joint class 日本人と共修
Reading of Scientific Paper II 科学論文講読II	T. Nakano et al.	2nd	Specialized Subjects Faculty Common Subjects	1		Joint class 日本人と共修
Practice on Marine Bio-resources Science 臨海実習	M. Ikeda	1st	Specialized Subjects Faculty Common Subjects	1		Joint class日本人と共修 Intensive course 集中講義
Graduation Thesis 卒業論文	Instruction teacher 教授・准教授	4th	Specialized Subjects Faculty Common Subjects	10		
Physiology of Biological Resources 資源生物生理学	Cheryl Ames	2nd	Specialized Subjects Academic Common Subject	2		
Animal Ecology and Ethology 資源動物生態学	S. Katayama	2nd	Specialized Subjects Academic Common Subject		2	
Fish Genetics and Breeding science 水産遺伝育种学	M. Nakajima	2nd	Specialized Subjects Academic Common Subject		2	
Field Practice of Marine Production I 生産フィールド実習 I	M. Ikeda	2nd	Specialized Subjects Academic Common Subject	1		Joint class日本人と共修 Intensive course 集中講義
Field Practice of Marine Production II 生産フィールド実習 II	M. Ikeda	3rd	Specialized Subjects Academic Common Subject	1		Joint class日本人と共修 Intensive course 集中講義
Fishery Science Practice I 学生実験 I	T. Nakano et al.	2nd	Specialized Subjects Academic Common Subject	4		Joint class 日本人と共修
Fishery Science Practice II 学生実験 II	T. Nakano et al.	3rd	Specialized Subjects Academic Common Subject	6		Joint class 日本人と共修
Basic Chemistry, Practice 基礎化学実験	T. Nakano et al.	2nd 3rd	Specialized Subjects Academic Common Subject	1		Joint class 日本人と共修
Basic Biology, Practice 基礎生物学実験	T. Nakano et al.	2nd 3rd	Specialized Subjects Academic Common Subject	1		Joint class 日本人と共修
Aquacultural Biology 水産増殖学	T. Unuma	2nd	Specialized Subjects Academic group Common Subject	2		
Fisheries Biology and Ecology 水産資源生態学	S. Katayama	3rd	Specialized Subjects Academic group Common Subject	2		
Aquatic Plant Ecology 水圏植物生態学	A. Tanaka	2nd	Specialized Subjects Academic group Common Subject	2		
Marine Biochemistry 水産化学	T. Nakano	2nd	Specialized Subjects Academic group Common Subject	2		
Biological Oceanography 生物海洋学	W. Sato-Okoshi	3rd	Specialized Subjects Academic group Common Subject	2		
Applied Genetics in Aquatic Organisms 沿岸生物学	M. Ikeda	3rd	Specialized Subjects Academic group Common Subject	2		
Aquatic Invertebrate Biology 水圏無脊椎動物学	K. Nagasawa	1st	Specialized Subjects Technical field Subjects		2	
Applied Aquatic Botany 水圏植物学	M. Aoki	2nd	Specialized Subjects Technical field Subjects		2	Intensive course 集中講義
Marine Product Technology 水産利用学	T. Yokoyama	3rd	Specialized Subjects Technical field Subjects		2	

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Seafood Management 水産食品管理学	Cheryl Ames	3 rd	Specialized Subjects Technical field Subjects		2	
Planktology プランクトン学	G. Nishitani	2 nd	Specialized Subjects Technical field Subjects		2	
Marine Coastal Ecology 沿岸環境学	T. Fujii	2 nd	Specialized Subjects Technical field Subjects		2	
Marine Applied Biochemistry 海洋応用生物化学	M. Nishikawa	3 rd or 4 th	Specialized Subjects Technical field Subjects		1	Every other year 隔年開講 Intensive course 集中講義
Related Subjects 関連科目			Specialized Subjects Technical field Subjects		4	
Introduction to Fisheries Science 水産科学概論	T. Unuma et al	2 nd	Specialized Subjects Current subject	2		
Practical Training 実地研修	T. Unuma et al.	3 rd	Specialized Subjects Current subject	1		
Marine Biology 海洋生物学	Cheryl Ames	2 nd	Specialized Subjects Current subject	2		
Current topics of Agricultural Plant Science 先端植物生命科学	植物生命科学コース代表	3 rd or 4 th	Specialized Subjects Current subject	2		Every other year 隔年開講
Introduction to Resource and Environmental Economics 資源環境経済学概論	農業経済学コース代表	3 rd or 4 th	Specialized Subjects Current subject	2		Every other year 隔年開講
Introduction to Applied Animal and Dairy Science 応用動物・酪農科学概論	動物生命科学コース代表	3 rd or 4 th	Specialized Subjects Current subject	2		Every other year 隔年開講
Applied Biological Chemistry 応用生物化学	生物化学コース代表	3 rd or 4 th	Specialized Subjects Current subject	2		Every other year 隔年開講
Food and Chemistry 食糧と化学	生命化学コース代表	3 rd or 4 th	Specialized Subjects Current subject	2		Every other year 隔年開講
Current topics of Shellfish Physiology 先端海洋生物生理学	K. Nagasawa	3 rd	Specialized Subjects Current subject		1	
Current topics of Fish Molecular Biology 先端海洋分子生物学	H. Yokoi	3 rd	Specialized Subjects Current subject		1	
Current topics of Marine Biotechnology 先端海洋生物工学(2023.10入学者より)	H. Yokoi	3 rd	Specialized Subjects Current subject		1	Previous subject title: (Current topics of Fish Biochemistry 先端海洋生物化学)
Current topics in Global Marine Ecology 先端地球海洋生態学(2023.10入学者より)	T. Fujii	3 rd	Specialized Subjects Current subject		1	Previous subject title: (Current topics of Genetics in Aquatic Organisms 先端海洋生物遺伝学)
Current topics of Coastal Ecology 先端沿岸生態学	H. Suzuki	3 rd	Specialized Subjects Current subject		1	
Current topics of Fish Ecology 先端海洋生物生態学	H. Murakami	3 rd	Specialized Subjects Current subject		1	
Current topics of Plankton Biology 先端プランクトン学	G. Nishitani	3 rd	Specialized Subjects Current subject		1	

Free Elective Specialized Subjects (These two subjects do not count towards the 134 minimum credits for graduation.) 自由聴講科目

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Fundamentals of Interdisciplinary STEM Seminar 理工系学際基礎セミナー	X. Dahan et al.	1st	General Education Expansion Subjects		1	※国費学生は必修、私費学生 は履修を強く推奨する
Science, Technology and Industry in Japan 日本の産業と科学技術	Y. Kasukabe	2 nd	Specialized Subjects		1	国費学生必修
Multidisciplinary Internship 学際インターンシップ	S. Katayama et al	2 nd	Specialized Subjects		1	Intensive course 集中講義 国費学生必修

Graduation Requirements 卒業条件

The minimum number of credits required for graduation is 134. 134 単位以上

1. A minimum of 111 credits from obligatory subjects (Including 49 credits of general education subjects) 必修科目 111 単位以上 (全学教育科目 49 単位を含む)
2. A minimum of 23 credits from elective specialized subjects 専門選択科目 23 単位以上

Minimum credits for graduation 卒業に要する最少単位

(1) General Education Subjects 全学教育科目

Subjects		Credits
Foundations 基盤科目	Introduction to Academic Learning 学問論	2
	Humanities 人文科学	2
	Social Sciences 社会科学	2
	Natural Sciences 自然科学	4
	Transdisciplinary Subjects 学際科目	7
Subtotal		17
Advanced Subjects 先進科目	Information Science 情報教育	2
	International/Career/Current Topics 国際教育/キャリア教育/カレントトピックス	4
	Subtotal	6
Languages 言語科目	Japanese 日本語	10
Subtotal		10
Basics of Discipline 学術基礎科目	Basics of Mathematics 基礎数学	2
	Basics of Physics 基礎物理学	2
	Basics of Chemistry 基礎化学	4
	Basics of Biology 基礎生物学	6
	Basics of Earth and Space Science 基礎宇宙地球科学	2
	Subtotal	16
Total		49

Cooperative Innovation Program in Science, Engineering, and Agriculture for Leading Sustainable and Diverse Industry and Society by Digital Globalization

The FGL program has been selected by MEXT for a new program aimed at governmentsponsored students. As a result, starting in FY 2021, FGL will be able to accept 8 governmentsponsored students each year for three years. The objective of this program is to create an educational system based on cooperation between three undergraduate schools that will foster leaders in the field of global sustainable and diverse industry and society while driving innovation in university education.

Those who enter FGL as government-sponsored students will also belong to this new program. Therefore, in addition to the curricula of their undergraduate schools, the government-sponsored students will have to fulfill the requirements of this program as well. The program requirements (i.e. requirements for receiving government sponsorship) consist of nine or ten credits in the below six subjects. For details of each subject, please see the syllabus. (From 1. to 3. below are General Education subjects. In the above table, they are indicated by an asterisk (*) to the right of the subject names.)

1. Study Abroad Program A [1 credits] — General Education Subjects
2. Introduction to Academic Learning [2 credits] — General Education Subjects
3. Life and Nature (Study of Nature, Life and Technology) [2 credits] — General Education Subjects
4. Science, Technology, and Industry in Japan [1 credit] — Specialized Subjects
5. Multidisciplinary Internship [1 credit] — Specialized Subjects
6. Digital Entrepreneurship Seminar [2 credits] — General Education Subjects

(2) Specialized Subjects 専門教育科目

Subjects	Obligatory	Elective*	Total	Comments
Faculty Common Subjects 学部共通科目	19	(2)		*23 or more elective credits must be acquired from among the 30 elective credits listed in parentheses. 選択科目は、括弧の中から 23 単位以上修得すること。
Academic Common Subjects 学科共通科目	16	(4)		
Academic Group Common Subjects 学科目群共通科目	12			
Technical Field Subjects 専門領域科目	0	(17)		
Current Subjects カレント科目	15	(7)		
Total	62	23	85	

The credits acquired in each semester (example) 各セメスターの取得単位 (例)

Semester		Credits
2nd -3rd Semester	Obligatory: Including Practice on Marine Bio-resources Science 臨海実習を含む	7
	Elective	2
4th -5th Semester	Obligatory: Including Field Practice of Marine Production 生産フィールド実習を含む	21
	Elective	10
6th -7th Semester	Obligatory: Including Field Practice of Marine Production 生産フィールド実習を含む	24
	Elective	14
8th-9th Semester	Obligatory: Graduation Thesis	10
Related Subjects		
Total		88

Subject	Introduction to Aquatic Production (水圏環境コミュニケーション論)	Day/Period	Fri./4th	Object	AMB
Instructor (Post)	M. Ikeda (Prof.) T. Fujii (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	1st-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	2		
Subject Numbering	AAL-APS202B	Language Used in Course	English/Japanese		
1. Class subject Biological productivity in aquatic zone and restoration from tsunami disaster					
2. Object and summary of class Onagawa Town was one of the most prosperous fishing ports in Japan. However, the 9.0- magnitude Tohoku-Pacific Ocean Earthquake generated a tsunami as high as 15 meters in Onagawa, which caused the town to subside by 1 meter, and completely destroyed its central area. The ria coast of Onagawa and coastal region along the Pacific Ocean had been severely stricken by the tsunami. Various coastal organisms have acclimated to tsunami perturbations and survived in the area. In order to promote reconstruction of tsunami-stricken areas such as Onagawa with respect to aquatic production (fish catching, aquaculture and fishery processing), it might be a promising measure to scientifically focus on the adaptability of coastal ecosystems in the area against tsunami perturbations, and to raise public awareness of the uniqueness of the coastal ecosystems and biodiversity. This subject highlights tsunami damage and the circumstance of reconstruction in Onagawa Town including coastal ecosystems, and brings to understand the importance of constructing new relationships between natural biological productivity and human activity. Field lecture will be held in May in Onagawa Town with a one-day trip. Classroom lecture will be held in June at Aobayama Campus. More details will be announced through the Google Classroom.					
3. Keywords marine biodiversity, fisheries, aquaculture, tsunami disaster, reconstruction,					
4. Goal of study At the end of the semester, students will -understand about the tsunami disaster. -understand the importance of the relationship between natural aquatic production and human activity. -understand sustainable biological productivity and the application to reconstruction of human society.					
5. Contents and progress schedule of class <ul style="list-style-type: none"> ● Introduction to studies of marine science, biological productivity and restoration ● Field lecture about tsunami damage, the restoration of coastal ecosystems, and the circumstance of reconstruction in Onagawa Town (including Onagawa Field Center) <ul style="list-style-type: none"> ● Class room lecture ● Group discussion 					
6. Preparation For more information, note our announcement in the curriculum guidance during the first week of April.					
7. Record end evaluation method <ul style="list-style-type: none"> ● Attendance: 40% ● Activeness: 20% ● Report: 40% 					
8. Textbook and references Preparing textbook					
9. Self study None					
10. Practical business					
11. In addition Contact e-mail address: <ul style="list-style-type: none"> ● Ikeda: minoru.ikeda.a6@tohoku.ac.jp 					

Subject	Introduction to Natural and Agricultural Production (陸圏環境コミュニケーション論)	Day /Period	Fri./4th	Object	AMB
Instructor (Post)	Professors of Field Science Center etc (Prof.)	Categories	Specialized Subjects	Preferable Participants	1st-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	3		
Subject Numbering	AAL-OAG201B	Language Used in Course	English/Japanese		
1. Class subject Ecosystems including forest, grassland, farmland, paddy field and biological productivity					
2. Object and summary of class The purpose of the course is to get understanding of agronomical thinking and sustainable biological productivity through 1 day field trip, classroom lectures and discussion time. Field trip will be held in May and the destination is the Integrated Terrestrial Field Station (Kawatabi in Naruko area). Classroom lecture will be held in May and June.					
3. Keywords agronomical science, integrated terrestrial field, ecosystem, environmental issues, animal waste treatment, grasslands, farmlands, soil science, forestry					
4. Goal of study At the end of the semester, students will -experience about fundamental field science -understand agronomical thinking -understand sustainable biological productivity					
5. Contents and progress schedule of class 1-5. Introduction to Agronomical science (Profs. of Field Science Center) 6. Field lecture about forest ecosystem (Profs. of Forest Ecology) 7. Field lecture about farmlands on hilly and mountainous area (Profs. of Environmental Crop Science) 8. Field lecture about grasslands, farm animals and environmental issues (Profs. of Land Ecology) 9. Field lecture about animal waste treatment, biogas production and recycling system (Profs. of Sustainable Environmental Biology) 10. Field lecture about andosol (volcanic ash soil) and environmental issues on farmland (Profs. of Environmental Crop Science) 11. Field lecture about management of animal feeding and animal welfare (Profs. of Land Ecology) 12. Field observations for integrated terrestrial field (Profs. of Field Science Center) 13. Group discussion (Profs. of Field Science Center) 14. Class room lecture about agriculture and ecosystem (Profs. of Field Science Center) 15. Class room lecture about spatial science and agronomy (Profs. of Field Science and Technology for Society)					
6. Preparation Read books related on agronomy, soil science, animal science, forest science and environmental science before the field trip.					
7. Record end evaluation method Attendance and participation for field trip (30%) Attendance and participation for classes (20%) Reports about field trip, classes and discussion (50%)					
8. Textbook and references URL: http://www.agri.tohoku.ac.jp/kawatabi/index.html					
9. Self study Write a report after the field trip. Write down what did you see, what did you feel. We welcome your consideration based on the group discussion.					
10. Practical business					
11. In addition Field trip will be held in May (Fri.), 8:00 - 18:30. Gathering Spot is Aobayama Campus (Aobayama Commons) . Please carry rain cape, protection against cold weather, insurance card and lunch to field trip. E-mail address: tsuyoshi.sumita.e5@tohoku.ac.jp					

Subject	Modern Agriculture and Agricultural Science (現代における農と農学)	Day/Period	Fri./3 rd	Object	AMB
Instructor (Post)	**** (Prof.) et al	Categories	Specialized Subjects	Preferable Participants	1st-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	3		
Subject Numbering	AAL-OAG203B	Language Used in Course	English/Japanese		
<p>1. Class subject Grasp of problems according to water, foods, energy, biomaterials, environment and health</p>					
<p>2. Object and summary of class The purpose of the course is to let participants understand and grasp the many agricultural problems such as water, foods, energy, biomaterials, environment and health through the unique lecture with laboratory tours. Students can go to more than 30 laboratories (about 3/4 of all lab. of our faculty) in the course to know and understand the characteristics of each laboratory's state of education and research. Students will increase knowledge step by step through explanation of stuffs and discussion with each other.</p>					
<p>3. Keywords</p>					
<p>4. Goal of study At the end of the semester, students will</p> <ul style="list-style-type: none"> -have basic knowledge about the agricultural science including the academic field of plant science, animal science, fishery science, agricultural chemistry, food science at present stage in our faculty. -have deeper understanding of the strategy for survival of humans in the future by utilizing the agriculture at high levels. 					
<p>5. Contents and progress schedule of class The education and research of our Faculty of Agriculture, and the Graduate School of Agricultural Science are operating in the six different fields of plant science, material environmental economy, applied animal science, marine bioscience, biochemistry and bioscience. In the lecture, we will explain the dairy situation in each laboratory including laboratory tours style. Students will be separated into six groups and will take a lecture by stuffs of the lab. in the rotation system. Each student can visit one to four laboratories in one day.</p> <p>1. Guidance "Introduction of agricultural sciences" 2-15. Visit to six courses of Plant Science, Resource Environmental Economics, Applied Animal Science, Applied Marine Biology, Biochemistry, and Biological Chemistry 16. Examination</p>					
<p>6. Preparation</p>					
<p>7. Record end evaluation method Students must attend the laboratory tour more than 60% and take an examination (40%) of the last day.</p>					
<p>8. Textbook and references Textbook and references will be notified at the class.</p>					
<p>9. Self study</p>					
<p>10. Practical business</p>					
<p>11. In addition Students who have some questions can visit to ask to each laboratory until 18:00 after lecture time. Contact persons will be notified at the class. Contact: ****@tohoku.ac.jp</p>					

Subject	Introduction to Physiology and Ecology (生理・生態学概論)	Day/Period	Fri./2nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Prof.)	Categories	Specialized Subjects	Preferable Participants	1st-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	2
Subject Numbering	ABS-APS235E			Language Used in Course	English
1. Class subject: Introduction to Physiology and Ecology: a general introduction to physiology and marine ecology.					
2. Object and summary of class: A beginner course in the basics of writing about marine physiology and ecology. Through reading, writing and presentations, students will gain broad basic knowledge of the functional organization of animals (e.g., evolution, nervous systems) with an emphasis on the marine realm.					
3. Keywords: Nervous system, hormones, life functions, evolution, biodiversity, marine ecosystems, marine resources					
4. Goal of study: Master the basics of physiology and ecology for future application to Applied Marine Biology specialist topics and courses.					
5. Course contents and class schedule (1) Introduction. Basic principles of marine physiology, metabolism and ecology. (2) Marine animal biodiversity: bathymetric distribution of marine animals. (3-4) Phylogenetic and evolutionary adaptations of marine animals. (5-6) The nervous system. 1. Neuron structure & function. (7-8) The nervous system. 2. Sensory systems. (9) Mid-term examination. (10-11) The endocrine system. Cell signaling and hormones. (12) Harvesting Living Marine Resources (13) Final report, presentation (14) Final examination.					
6. Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.					
7. Record and evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)					
8. Textbook and references: Primary reading(s) (students can purchase or borrow a copy from campus library): Morrissey et al. (2018). Introduction to the Biology of Marine Life (Jones & Bartlett Includes Navigate 2 Advantage Access, 11th. ed.) ISBN-13: 978-1-284-09050-5. Secondary reading(s): Levinton, JS (2018). Marine Biology: Function, Biodiversity, Ecology (Oxford University Press 5th. ed.) ISBN-13: 978-0190625276; Moyes, C.D. & Schulte, P.M. (2016). Principles of Animal Physiology (Pearson, San Francisco, 3rd. ed.) ISBN-13: 978-0321838179.					
9. Self-study: There is much to learn about these topics. Students are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.					
10. Practical business					
11. In addition: This course covers a broad range of topics. Later courses will explore these topics more deeply. Questions should be addressed to the lecturer directly during or after lecture, or during office hours. ames.cheryl.lynn.al@tohoku.ac.jp					

Subject	An Introduction to Bioindustrial Information Processing (生物生産情報処理概論)	Day/Period	Thur./1st-2nd	Object	AMB
Instructor (Post)	Y. Sakai (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	6
Subject Numbering	ABS-APS336E			Language Used in Course	English
1. Class subject Introduction to fundamentals of methods for processing biological sequence data					
2. Object and summary of class The first half deals with the methods for computing the similarity between two or more biological sequences, and the remaining half introduces various methods for other types of sequence processing.					
3. Keywords biological sequence, string, similarity, alignment, phylogenetic tree, gene mapping, short read assembly					
4. Goal of study The goal is to understand the theoretical background with respect to validity or limitation of computer processing of biological sequences.					
5. Contents and progress schedule of class 1 Preliminaries 2 Similarity between sequences 3 Pairwise alignment (global alignment) 4 Pairwise alignment (local alignment and alignment with affine gap penalty) 5 Multiple alignment (star alignment) 6 Multiple alignment (progressive method) 7 Amino acid substitution matrix 8 BLAST 9 PSI-BLAST and HMM 10 Phylogenetic tree (ultra-metric tree and additive tree) 11 Phylogenetic tree (UPGMA and NJ method) 12 Gene mapping 13 Short read assembly (with reference sequence) 14 Short read assembly (de novo) 15 Suggested answers of the term paper					
6. Preparation Prepare for the next lesson by conducting a Web search on the topic words related to the lesson.					
7. Record end evaluation method Attendance: 20% Term paper: 80%					
8. Textbook and references Recommended book: Dan Gusfield, "Algorithms on Strings, Trees, and Sequences", Cambridge University Press (1997)					
9. Self study Review the previous lesson using the handout.					
10. Practical business					
11. In addition Office hours: 16:30-18:00 Mon-Wed, and Fri at Room E410 E-mail address: yoshifumi.sakai.c7@tohoku.ac.jp					

Subject	Reading of Scientific Paper I (科学論文講読 I)	Day/Period	1st Quarter Wed./2nd	Object	AMB
Instructor (Post)	T. Nakano (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	5		
Subject Numbering	AAL-APS301B	Language Used in Course	English/ Japanese		
1. Class subject Learning how to search and read scientific articles in English					
2. Object and summary of class By reading English articles in the fields of Aquaculture Biology, Fisheries Biology and Ecology, Marine Plant Ecology, Marine Biochemistry, Biological Oceanography, and Fish Genetics, students will learn the structure and specific expressions of scientific articles and acquire reading comprehension skills. In addition, students will learn search methods so that they will be able to find articles of interest.					
3. Keywords Scientific English, scientific article, literature database, literature search					
4. Goal of study Students will be able to find, read, and understand scientific articles in English necessary for their own research.					
5. Contents and progress schedule of class As Reading of Scientific Paper I and II are offered in the same week, they will be conducted and evaluated as a series of lectures with the following class contents. 1. Structure of scientific articles, How to use literature databases 2. Practice of searching literature 3-4. Group reading of articles related to Marine Biochemistry 5-6. Group reading of articles related to Fisheries Biology and Ecology 7-8. Group reading of articles related to Marine Plant Ecology 9-10. Group reading of articles related to Aquaculture Biology 11-12. Group reading of articles related to Biological Oceanography 13-14. Group reading of articles related to Fish Genetics 15. Group presentation of literature search results All students in the Applied Marine Biology Course including Japanese students will be divided into 5 groups, and the above 3-14 will be taken in a different order depending on the group.					
6. Preparation Students should read and understand the articles assigned as teaching materials by the laboratory in charge of the class in advance. Note that students will not be able to keep up with the class if they do not prepare well enough.					
7. Record end evaluation method Evaluation will be based on attendance and comprehension during group reading.					
8. Textbook and references Articles designated by each laboratory as teaching materials.					
9. Self study It is recommended that students read scientific articles in the research field you wish to pursue in the future.					
10. Practical business					
11. In addition If students have questions about a lecture, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Nakano).					

Subject	Reading of Scientific Paper II (科学論文講読Ⅱ)	Day/Period	1st Quarter Thu./4th	Object	AMB
Instructor (Post)	T. Nakano (Prof.) et al	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	5		
Subject Numbering	AAL-APS302B	Language Used in Course	English/ Japanese		
1. Class subject Learning how to search and read scientific articles in English					
2. Object and summary of class By reading English articles in the fields of Aquaculture Biology, Fisheries Biology and Ecology, Marine Plant Ecology, Marine Biochemistry, Biological Oceanography, and Fish Genetics, students will learn the structure and specific expressions of scientific articles and acquire reading comprehension skills. In addition, students will learn search methods so that they will be able to find articles of interest.					
3. Keywords Scientific English, scientific article, literature database, literature search					
4. Goal of study Students will be able to find, read, and understand scientific articles in English necessary for their own research.					
5. Contents and progress schedule of class As Reading of Scientific Paper I and II are offered in the same week, they will be conducted and evaluated as a series of lectures with the following class contents. 1. Structure of scientific articles, How to use literature databases 2. Practice of searching literature 3-4. Group reading of articles related to Marine Biochemistry 5-6. Group reading of articles related to Fisheries Biology and Ecology 7-8. Group reading of articles related to Marine Plant Ecology 9-10. Group reading of articles related to Aquaculture Biology 11-12. Group reading of articles related to Biological Oceanography 13-14. Group reading of articles related to Fish Genetics 15. Group presentation of literature search results All students in the Applied Marine Biology Course including Japanese students will be divided into 5 groups, and the above 3-14 will be taken in a different order depending on the group.					
6. Preparation Students should read and understand the articles assigned as teaching materials by the laboratory in charge of the class in advance. Note that students will not be able to keep up with the class if they do not prepare well enough.					
7. Record end evaluation method Evaluation will be based on attendance and comprehension during group reading.					
8. Textbook and references Articles designated by each laboratory as teaching materials.					
9. Self study It is recommended that students read scientific articles in the research field you wish to pursue in the future.					
10. Practical business					
11. In addition If students have questions about a lecture, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Unuma).					

Subject	Practice on Marine Bio-resources Science (臨海実習)	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	M. Ikeda (Prof.) T. Fujii (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	1st-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits		1	
		Semester		2	
Subject Numbering	AAL-APS410B	Language Used in Course		English/Japanese	
1. Class subject Observation of marine biodiversity and understanding the importance for sustainable productions.					
2. Object and summary of class To understand the importance of marine biodiversity. (1) Field trip to the rocky intertidal area and observation of the biodiversity. (2) Observation of early development of marine invertebrates					
3. Keywords marine ecosystem, biodiversity, production, aquaculture					
4. Goal of study Students will be able to understand the importance for marine biodiversity through the observation of species diversity and development of marine organisms.					
5. Contents and progress schedule of class Three days in 2nd semester (September) <ul style="list-style-type: none"> ● Days 1-2: Field trip to the rocky intertidal area and survey the biodiversity. ● Day 3: Observation of early development of marine invertebrates. 					
6. Preparation More details will be announced through the Google Classroom.					
7. Record end evaluation method <ul style="list-style-type: none"> ● Attendance: 40% ● Activeness: 20% ● Report: 40% 					
8. Textbook and references Preparing textbook					
9. Self study None					
10. Practical business					
11. In addition Contact e-mail address: <ul style="list-style-type: none"> ● Ikeda: minoru.ikeda.a6@tohoku.ac.jp 					

Subject	Physiology of Biological Resources (資源生物生理学)	Day/Period	2 nd quarter Thur./1 st ~2 nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Prof.)	Categories	Specialized Subjects	Preferable Participants	2 nd -year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5
Subject Numbering	ABS-APS338E			Language Used in Course	English
1. Class subject: Physiology of Biological Resources					
2. Object and summary of class: This course provides a fundamental overview of the physiological requirements permitting marine animals to exist and reproduce within a host of environments often differing from their internal states.					
3. Keywords: Neuroendocrinology, sensory systems, repair, sexual reproduction.					
4. Goal of study: Develop an understanding of the varied ways and means by which cells in a multicellular organism communicate to maintain the organism's integrity and ensure the production of a new generation. Develop a solid grasp of the concept of homeostasis and its application in neuroendocrine regulation, sensory perception, repair and sexual reproduction. Gain a practical understanding of the differences between phylogenetics of gene trees (amino acid sequences) in comparisons with species trees (nucleotide sequences).					
5. Course contents and class schedule (1-4) Neurophysiology. Neurophysiology and classification of chemical transmitters. Reception by target cells. Process of receptor cell receipt and information transmission. Action potentials. Origin of the nervous system. Neurons and support cells. (5-7) Neuroendocrinology. Hormones (e.g., thyroid hormone, growth hormone, and insulin), the organs and glands that secrete them, and their actions on different organ systems in the body. (8). Mid-term report and examination. (9-11). Sensory perception. Chemoreception, photoreception and mechanoreception. Comparisons between marine invertebrates and mammals. Sensory cells. (13-14). Endocrinology of reproduction. Sex hormones. Reproduction and determination of sex. Gonad structure and the development of gametes. Sex, reproduction and the environment. Control of sex and maturity, courtship, and spawning. Epigenetics. Comparisons between marine invertebrates and mammals. (15). Final report, presentations, examination.					
6. Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.					
7. Record and evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)					
8. Textbook and references: Primary reading(s) (students must purchase or borrow a copy from campus library): Moyes, C.D. & Schulte, P.M. (2015). Principles of Animal Physiology. (Pearson, San Francisco, 3rd. ed.). ISBN-13: 978-0321838179; Taiz, L et al. (2018). Fundamentals of Plant Physiology. ISBN-13: 978-1605357904. Secondary reading(s): Morrissey et al. (2016). Introduction to the Biology of Marine Life. 11th. ed. (Jones & Bartlett Includes Navigate 2 Advantage Access) ISBN-13: 978-1-284-09050-5. Ingrouille, M (2006). Plants: Diversity and Evolution. ISBN-13: 978-0521794336. Helfman, G (2009). The Diversity of Fishes: Biology, Evolution, and Ecology. ISBN-13: 978-1405124942. Brusca et al. (2016). The Invertebrates: A synthesis. 3rd Edition. (Sinauer Associates) ISBN-13: 978-1605353753.					
9. Self-study: There is much to learn about these topics. Students are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.					
10. Practical business					
11. In addition: This course covers a broad range of topics. Later courses will explore these topics more deeply. Any questions should be addressed to the lecturer directly during or after lecture, or during office hours. ames.cheryl.lynn.a1@tohoku.ac.jp					

Subject	Animal Ecology and Ethology (資源動物生態学)	Day/Period	2 nd Quarter Mon./1 st -2 nd	Object	AMB
Instructor (Post)	S. Katayama (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5
Subject Numbering	ABS-APS239E			Language Used in Course	English
1. Class subject Relationships among organisms and those between organisms and their environment as fundamental factors supporting biological production in nature.					
2. Object and summary of class More than 1500 thousand of organisms are recognized to live on the earth now. These numerous organisms maintain various interrelationships with surrounding organisms and its environmental factors, which may support biological production in nature. The present subject addresses fundamental concepts of ecology necessary to understand mechanisms of nature in each category of population, community, and ecosystem.					
3. Keywords biological production, population, biological community, marine ecosystem, environment, interspecific relations					
4. Goal of study Students can understand the structure and function of biological nature, and find an outline of the relationships between organisms and its environment.					
5. Contents and progress schedule of class 1. Species (binomial nomenclature, reproductive isolating, crossbreed) 2. Classification (five kingdoms, three domains) Biological production in each ecological category: producer, consumer, decomposer. 3. Divergent evolution, natural selection 4. Adaptation, Speciation, & Diversity 5. Niche, fitness, food selection 6. Interspecific relationships (competition, predation etc.), Gause's Law 7. Population; definition, mode of life, population growth models, r-K strategy 8. Competition, strategy and tactics, game theory, Lotka-Volterra model 9. Concept of ecological niche, relationship between niche and competition 10. Community theory, ecological succession, climax 11. Structure and function of ecosystem, 12-13. Biogeochemistry (Element ratios, Element Cycling, Energy Flow and Matter Recycling) 14. Biological and physical cycle in nature 15. Ecosystem service					
6. Preparation Many books are published on ecosystem, environment, and bio-diversity, from which it is required to obtain various information about contemporary ecological problems.					
7. Record end evaluation method Evaluation will depend on achievement of final examination.					
8. Textbook and references MJ Kaiser et al. "Marine Ecology -Processes, Systems, and Impacts-", Oxford Univ. Press (2011) M Begon et al. "Ecology: Individuals, Populations and Communities", Wiley-Blackwell (1996)					
9. Self study Students should have concern over topics on nature and organisms shown in various media and consider their biological and ecological meanings.					
10. Practical business					
11. In addition Office hour for inquiry about the course should be offered any time at the Laboratory of Fisheries Biology and Ecology (E-311). E-mail: skata@tohoku.ac.jp					

Subject	Fish Genetics and Breeding science (水産遺伝育種学)	Day/Period	3rd Quarter Mon./3rd, 4th	Object	AMB
Instructor (Post)	M. Nakajima (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	4		
Subject Numbering	ABS-APS240E	Language Used in Course	English		
1. Class subject Understand the basic theory of inheritance and the application methods for the genetic improvement in aquatic organisms.					
2. Object and summary of class In aquatic organisms, not only genetics at the individual level but also population level is important. Because, the position of conservation in genetic resources is very important in this subject. In this class, the basic theory of inheritance in individual level, population level, the basic theory of genetic improvement and the conservation of genetic resources will be explained and discussed.					
3. Keywords Genetic improvement, Genetic variation, Linkage, Genetic marker, Quantitative trait, Heritability, Breeding value, Heterosis, Recombinant DNA					
4. Goal of study 1) Understand the basic theory of genetics in both of individual and population level 2) Understand the theory of the application methods of genetics for the genetic improvement 3) Understand the basic theory of genetics for the conservation of genetic resources.					
5. Contents and progress schedule of class 1) Basic theory of inheritance 2) Variations observed in nature and livestock 3) Basic theory of genetics in populations 4) Basic theory of quantitative traits 5) Basic theory of selective breeding I 6) Basic theory of selective breeding II 7) Heritability and breeding value 8) Inbreeding and inbreeding depression 9) Linkage analysis and genome wide association study 10) Genetic improvement by heterosis and hybrid vigor 11) Genetic improvement by chromosome manipulation 12) Genetic improvement by genomic modification 13) Conservation and sustainable use of genetic resources					
6. Preparation Please read a book about conservation and genetic improvement.					
7. Record end evaluation method Total results are evaluated by the final examination, reports and the results of the problems set at a lecture at each time.					
8. Textbook and references Introduction to quantitative genetics, D. S. Falconer, Longman Scientific & Technical, New York, 1989 Genetics for fish hatchery managers, D. Tave, An AVI Books, New York, 1992 Selective Breeding in Aquaculture: An Introduction, T. Gjedrem and M. Baranski, Springer, New York, 2009 Conservation and the Genetics of Populations, F. W. Allendorf and G. Luikart, Blackwell Publishing, Oxford, 2007					
9. Self study Ask me the things which are not understood. Please do preparations for the lecture and a review of the used text book shown above.					
10. Practical business					
11. In addition The office will be opened from 10:00 AM to 05:00 PM to receive the question. The question is also received by e-mail, masamichi.nakajima.b6@tohoku.ac.jp					

Subject	Field Practice of Marine Production I・II (生産フィールド実習 I・II)	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	M. Ikeda (Prof.) T. Fujii (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	4 & 6		
Subject Numbering	ABS-APS406B Field Practice of Marine Production I・II	Language Used in Course	English/Japanese		
1. Class subject Practical field and experimental training for marine biodiversity.					
2. Object and summary of class To understand the importance of marine biodiversity. (1) Observation and analysis of marine biodiversity. (2) Analysis of genetic diversity in marine organisms. (3) Analysis of marine environments.					
3. Keywords marine ecosystem, biodiversity, genetic diversity, early development, morphogenesis					
4. Goal of study Students will be able to understand the importance for biodiversity in marine ecosystems through the observation of ecological, species, genetic diversities of marine organisms.					
5. Contents and progress schedule of class Practice I: Five days in 4th semester (August) <ul style="list-style-type: none"> ● Days 1-2: Quantitative and qualitative of marine biodiversity. ● Days 3-4: Study about adaptation of marine invertebrates to their environment. ● Day 5: Presentation Practice II: Five days in 6rd semester (June) <ul style="list-style-type: none"> ● Days 1-2: Quantitative and qualitative of genetic diversity in marine organisms. ● Days 3-4: Quantitative and qualitative of marine environments. ● Day 5: Presentation 					
6. Preparation More details will be announced through the Google Classroom.					
7. Record end evaluation method <ul style="list-style-type: none"> ● Attendance: 40% ● Activeness: 20% ● Report: 40% 					
8. Textbook and references Preparing textbook					
9. Self study None					
10. Practical business					
11. In addition Contact e-mail address: <ul style="list-style-type: none"> ● Ikeda: minoru.ikeda.a6@tohoku.ac.jp 					

Subject	Fishery Science Practice I・II (学生実験I・II)	Day/Period	Mon.- Fri./3rd & 4th	Object	AMB
Instructor (Post)	T. Nakano (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	10		
		Semester	5 & 6		
Subject Numbering	AAL-APS308E/AAL-APS309E	Language Used in Course	English		
1. Class subject Morphology, function and components of aquatic organisms, analysis of substances in environment					
2. Object and summary of class The purpose of the course is to let participants understand the taxonomy, constitution of body, function of aquatic organisms, the way to use analytical instruments and analysis of experimental data.					
3. Keywords Taxonomy, morphology, genetics, molecular biology, genetics and breeding, chemical analysis, statistics					
4. Goal of study Students will - have basic knowledge for anatomical structure and components of aquatic organisms and analysis of environment. - have deeper understanding of aquatic organisms and marine environment.					
5. Contents and progress schedule of class The course will be conducted by AMB laboratories. - Anatomy of invertebrate and teleost - Molecular biology and genetics - Taxonomy of aquatic organisms - Histology - Physiology - Analytical chemistry of environment and organisms - Microbiology - Ecology - Statistic analysis					
6. Preparation Read “Textbook of Student Experiments” and understand the purpose and outline of each experiment.					
7. Record end evaluation method Attendance is required for all experiments and absences will not be permitted. After each experiment, reports must be submitted by the due date. Evaluation will be based on the overall performance of each experiment.					
8. Textbook and references “Textbook of Student Experiments” will be provided.					
9. Self study If you are interested in the details of the experiment, check the literature to gain a deeper understanding.					
10. Practical business					
11. In addition If students have questions about an experiment, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Nakano).					

Subject	Basic Chemistry, Practice (基礎化学実験)	Day/Period	Mon.-Fri. /3rd & 4th	Object	AMB
Instructor (Post)	T. Nakano(Prof.) et al	Categories	Specialized Subjects	Preferable Participants	2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	5 & 6
Subject Numbering	AAL-APS310E			Language Used in Course	English
1. Class subject Components of aquatic organisms, analysis of substances in environment					
2. Object and summary of class The purpose of the course is for students to understand the body components of organisms and the procedures to extract and analyze chemical components in the environment.					
3. Keywords Experiments, analysis, biogenic substances, chemical components					
4. Goal of study Students will - have basic knowledge of biogenic substances from aquatic organisms and analysis of the environment. - have knowledge of experimental procedures.					
5. Contents and progress schedule of class The course will be conducted by AMB laboratories - Anatomy of fin fish - Extraction and analysis of genetic material - Analysis of components of seawater - Evaluation of taste components - Extraction and analysis of body components					
6. Preparation Read “Textbook of Student Experiments” and understand the purpose and outline of each experiment.					
7. Record end evaluation method Attendance is required for all experiments and absences will not be permitted. After each experiment, reports must be submitted by the due date. Evaluation will be based on the overall performance of each experiment.					
8. Textbook and references “Textbook of Student Experiments” will be provided.					
9. Self study If you are interested in the details of the experiment, check the literature to gain a deeper understanding.					
10. Practical business					
11. In addition If students have questions about an experiment, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Unuma).					

Subject	Basic Biology, Practice (基礎生物学実験)	Day/Period	Mon.-Fri./ 3rd & 4th	Object	AMB
Instructor (Post)	T. Nakano (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	5 & 6		
Subject Numbering	AAL-APS311E	Language Used in Course	English		
1. Class subject Body plan and function of aquatic organisms					
2. Object and summary of class The purpose of the course is to let students understand body plan and function of aquatic organisms studying on morphology, genetics, cell biology, physiology and statistic analysis.					
3. Keywords Morphology, Genetics, Taxonomy, Cellular tissue					
4. Goal of study Students will - have knowledge of basic biology - have knowledge of experimental procedure					
5. Contents and progress schedule of class The course will be conducted by AMB laboratories. - Anatomy of fin fish - Genetics and analysis of polymorphism - Cell biology of aquatic plant - Histology of marine animals					
6. Preparation Read “Textbook of Student Experiments” and understand the purpose and outline of each experiment.					
7. Record end evaluation method Attendance is required for all experiments and absences will not be permitted. After each experiment, reports must be submitted by the due date. Evaluation will be based on the overall performance of each experiment.					
8. Textbook and references “Textbook of Student Experiments” will be provided.					
9. Self study If you are interested in the details of the experiment, check the literature to gain a deeper understanding.					
10. Practical business					
11. In addition If students have questions about an experiment, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Nakano).					

Subject	Aquacultural Biology (水産増殖学)	Day/Period	2nd Quarter Fri./1st & 2nd	Object	AMB
Instructor (Post)	T. Unuma (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits		2	
		Semester		5	
Subject Numbering	ABS-APS341E	Language Used in Course		English	
1. Class subject Basic concepts of aquaculture including seed production, restocking, cultivation, and fish disease control					
2. Object and summary of class Aquaculture is playing an increasingly significant role in the fisheries industry. In this course, students will learn basic concepts of aquaculture by studying practical examples of commercially valuable species.					
3. Keywords Seed production, restocking, cultivation, pathology, fish, invertebrate					
4. Goal of study Students will - understand the importance of aquaculture in maintaining fisheries resources and increasing production of marine products. - acquire concrete knowledge of practical examples.					
5. Contents and progress schedule of class - Basic concept of aquaculture - Salmon - Red seabream - Flounder - Yellowtail - Eel - Fish pathology - Invertebrate - Term-end examination					
6. Preparation Students are encouraged to review high school biology textbooks and supplemental readings prior to the class.					
7. Record end evaluation method Term-end examination (70%) and attendance (30%).					
8. Textbook and references The following book may be helpful. Modern methods of aquaculture in Japan Vol. 24, ed. by H. Ikenoue & T. Kafuku, Elsevier, 1992					
9. Self study In order to deepen understanding, practice questions related to the lecture content will be given in each lecture. Students are expected to solve them before the next lecture.					
10. Practical business					
11. In addition Students are welcome to visit the office at any time if they have any questions about the lecture content, but should contact the office by e-mail in advance since the office is often not open. E-mail: tatsuya.unuma.b8@tohoku.ac.jp					

Subject	Fisheries Biology and Ecology (水産資源生態学)	Day/Period	3 rd quarter Mon./1 st ~2 nd	Object	AMB
Instructor (Post)	S. Katayama (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	6
Subject Numbering	ABS-APS342E			Language Used in Course	English
1. Class subject Life history of marine resources, biology, population dynamics and methodology of population analysis.					
2. Object and summary of class Characteristics of marine organisms are tempo-spacio fluctuations and reproduction. Especially marine resources are affected by not only environmental condition but also fishing pressure. In this lecture, after short review of world and Japanese fisheries production, life history traits and fluctuating patterns of populations are explained. Methodology of stock assessment and population are also mentioned for the fisheries management.					
3. Keywords Fish biology, life history strategy, Fisheries, Population analysis					
4. Goal of study To understand the biological characteristics of marine resources and to learn theoretical and technical methods for marine biology, stock assessment and fisheries management.					
5. Contents and progress schedule of class 1. Status of world and Japanese fisheries production 2. Stock identification and population structure 3. Ichthyology (External morphology and sense organs) 4. Ichthyology (Function of gill and feeding) 5. Life history (Spawning and annual cycle) 6. Life history (Migration) 7. Life history (Age and growth) 8. Life history (Early life history) 9. Life history (Maturation) 10. Population analysis (Survey method) 11. Population analysis (Delury method) 12. Population analysis (Yield per recruit model) 13. Population analysis (Cohort analysis) 14. Population analysis (MSY) 15. Fisheries management					
6. Preparation There are no particular prerequisites for this course. Basic biology capabilities will ease the learning.					
7. Record end evaluation method Score of an end-of-term exam					
8. Textbook and references Marine Fisheries Ecology, Jennings et al., 2001 Wiley-Blackwell Fishes: An Introduction to Ichthyology, Moyle and Cech, 2004 Pearson Prentice Hall Fisheries Biology, Assessment and Management, M. King, 2007 Wiley-Blackwell					
9. Self study Please do not lose teaching documents and your class note for the final exam.					
10. Practical business					
11. In addition Office hour for inquiry about the course should be offered any time at the Laboratory of Fisheries Biology and Ecology (E-311). Contact: skata@tohoku.ac.jp					

Subject	Aquatic Plant Ecology (水圏植物生態学)	Day/Period	1 st quarter Tue./1 st ~2 nd	Object	AMB
Instructor	A. Tanaka (Associate Professor)	Categories	Specialized Subjects	Preferable Participants	2nd-year
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5
Subject Numbering	ABS-APS343E			Language Used in Course	English
1. Class subject The ecology of macroalgae					
2. Object and summary of class The purpose of this class is to understand from various perspectives the life mechanisms of macroalgae (seaweeds), which are representative aquatic plants that support coastal ecosystems.					
3. Keywords Cell structure, Endosymbiosis, Cell wall, Coastal ecosystem, Blue carbon, Cultivation					
4. Goal of study This class aims to understand the roles of macroalgae in coastal ecosystems and their relationship with human society based on basic knowledge about their cellular structures and physiological characteristics.					
5. Contents and progress schedule of class (1) Introduction: A variety of aquatic plants (2) Evolution and endosymbiosis (3) Cell wall and chloroplast (4) Cell division (5) Photosynthesis 1 (6) Photosynthesis 2 (7) Blue carbon 1 (8) Blue carbon 2 (9) Life cycle of green and brown algae (10) Life cycle of red algae (11) Seaweed cultivation 1 (12) Seaweed cultivation 2 (13) Ecology of the algal bed (14) Summary (15) Final examination					
6. Preparation Review the contents of the classes "Biology A", "Biology B" and "BiologyC".					
7. Record and evaluation method Final examination will be used for evaluation.					
8. Textbook and references Reference textbooks: C. Van den Hoek, D.G. Mann and H. M. Jahns (1995) <i>Algae, An introduction to phycology</i> . Cambridge University Press. C.S. Lobban and P.J. Harrison (1994) <i>Seaweed ecology and physiology</i> . Cambridge University Press.					
9. Self study Extend your curiosity with the reference textbooks and scientific papers.					
10. Practical business					
11. In addition Please contact me by email first when you need more information about this class or its contents. Mail address: atsuko.tanaka.d1@tohoku.ac.jp					

Subject	Marine Biochemistry (水産化学)	Day/Period	2 nd Quarter Tue./1 st -2 nd	Object	AMB
Instructor (Post)	T. Nakano (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5
Subject Numbering	ABS-APS244E			Language Used in Course	English
1. Class subject Biochemical characterization of aquatic organisms and seafood					
2. Object and summary of class The organisms that inhabit water have unique characteristics that enable them to adapt to and survive in their environment. To understand their ways of life, it is essential to understand the chemical components of fish and other marine organisms. While marine organisms exhibit beneficial effects on human health, some of them contain toxic substances, and certain microorganisms and parasites are responsible for foodborne illnesses, including food poisoning. The class explores the biochemical, nutritional, and functional properties of the components in organisms, as well as the mechanisms of development and adaptation to the habitat environment. The other related topics will also be introduced.					
3. Keywords Aquatic organisms, chemical components, catabolic pathways, regulatory systems					
4. Goal of study To get sufficient knowledge about the characteristics of marine organisms from a biochemical viewpoint. To understand the mechanisms for surviving in water.					
5. Contents and progress schedule of class 1: Biochemical characteristics of marine organisms 2: Proteins 1 3: Proteins 2 4: Lipids 1 5: Lipids 2 6: Carbohydrates 1 7: Carbohydrates 2 8: Minerals 1 9: Minerals 2 7: Vitamins 8: Pigments 9: Carotenoids 10: Bioactive compounds 11: Natural toxins 1 12: Natural toxins 2 13: Food poisoning 14: Final presentations 15: Final exam					
6. Preparation Collect the related information in the library and through the web					
7. Record end evaluation method Based on the final exam, class attendance, and lecture notes.					
8. Textbook and references Nelson & Cox: Lehninger Principles of Biochemistry 8 th edition (2021)					
9. Self study Read related papers published in recent years.					
10. Practical business					
11. In addition Contact email: nakanot@tohoku.ac.jp					

Subject	Biological Oceanography (生物海洋学)	Day/Period	3 rd quarter Wed./1 st ~2 nd	Object	AMB
Instructor (Post)	A. Yamaguchi (Professor)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	6
Subject Numbering	ABS-APS345E			Language Used in Course	English
1. Class subject Review marine environment and adaptive ecology of pelagic and benthic organisms that evolved in the oceans.					
2. Object and summary of class Deepen understanding of plankton, nekton, and benthos that live in vast and deep ocean environments based on physical and chemical characteristics of the ocean.					
3. Keywords Marine environment, Ecosystem, Biology, Ecology, Productivity, Plankton, Nekton, Benthos					
4. Goal of study Understand pelagic and benthic environments of the oceans and adaptation of their inhabitants, regional differences, and biological oceanographic basis that support fish and other upper-level production					
5. Contents and progress schedule of class 1-2: History of Biological Oceanography 3-4: Physical environment 5-6: Chemical environment 7-9: Marine plankton 10: Nekton 11-13: Marine benthos 14: Marine ecosystems 15: Current topics on Biological Oceanography					
6. Preparation Acquire basic knowledge on oceans and organisms living in them.					
7. Record end evaluation method Term-end test					
8. Textbook and references Biological Oceanography: An Introduction, 2nd ed., Lalli and Parsons, 1997 Butterworth-Heinemann					
9. Self study Understand cause and effect of phenomena taught in class.					
10. Practical business					
11. In addition mail address: atsushi.yamaguchi.d6@tohoku.ac.jp					

Subject	Applied Genetics in Aquatic Organisms (沿岸生物学)	Day/Period	4th Quarter Mon./1st-2nd	Object	AMB
Instructor (Post)	M. Ikeda (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	6		
Subject Numbering	ABS-APS347E	Language Used in Course	English		
1. Class subject Conservation and sustainable yield of marine bio-resources					
2. Object and summary of class A variety of marine bio-resources have inhabited the coastal areas. These are important food resources and also reproductive resources. Considering a conservation and sustainable yield of them, though ecological and physiological studies are important, genetic studies should be quite important for the future. In the present lecture, I will explain the importance of applied genetics for future management of marine bio-resources by using actual scientific research in my laboratory.					
3. Keywords marine organisms, genetics and breeding science, population structure, conservation, aquaculture					
4. Goal of study Understanding the present condition of marine production in coastal area of Japan. Also, through the lecture, ability of consideration and problem solving are required.					
5. Contents and progress schedule of class 1. Introduction 2. Extinction 3. Quantification of Genetic Diversity (I) 4. Quantification of Genetic Diversity (II) 5. Quantification of Genetic Diversity (III) 6. Quantification of Genetic Diversity (IV) 7. Inbreeding & Outbreeding Depressions (I) 8. Inbreeding & Outbreeding Depressions (I) 9. Molecular Identification (VI) 10. Conservation Units (I) 11. Conservation Units (II) 12. Conservation Units (III) 13. Genetic Rescue 14. Translocations 15. Captive Breeding Program					
6. Preparation No need but you should survey the technical terms in the lecture and write in your notebook. More details will be announced through the Google Classroom.					
7. Record end evaluation method Examination and Reports					
8. Textbook and references Directing on the lecture					
9. Self study					
10. Practical business					
11. In addition When you have a question, please contact me by e-mail. e-mail address: minoru.ikeda.a6@tohoku.ac.jp					

Subject	Aquatic Invertebrate Biology (水圏無脊椎動物学)	Day/Period	1 st quarter Fri./1 st ~2 nd	Object	AMB
Instructor (Post)	K. Nagasawa (Associate prof)	Categories	Specialized Subjects	Preferable Participants	1 st year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	3
Subject Numbering	ABS-APS348E			Language Used in Course	English
<p>1. Class subject To trigger understanding and scientific interest in aquatic invertebrates, students will learn about each phylum of aquatic invertebrates in evolution, morphology, embryology, physiology, ecology, and fisheries in these animals.</p>					
<p>2. Object and summary of class Much of the biology we have studied consists of knowledge of vertebrates such as mammals and fish. However, these vertebrates represent only 4% of all animal species, and our knowledge of them is too limited to be considered a general understanding of animals. On the other hand, we have too few opportunities to learn about the biology of invertebrates, which represent the remaining 96%. In particular, although many marine invertebrates are known as commercial species as seafood, their biological information is poorly understood. In this lecture, we will focus on the aquatic invertebrates that inhabit the sea, where life was born, and learn about their diverse lifestyles and the characteristics of each animal phylum to understand the aquatic invertebrates systematically.</p>					
<p>3. Keywords Aquatic invertebrates, biodiversity, morphological evolution, development and physiology</p>					
<p>4. Goal of study Students are expected to achieve the following learning objectives. To acquire a basic knowledge of the morphology and ecology of each phylum of aquatic invertebrates. To acquire a systematic understanding of the mechanisms that are common system to all animals and those that are unique to each phylum, and to understand what is essential and what is specialized components in each animal.</p>					
<p>5. Contents and progress schedule of class 1st: Orientation and introduction 2nd: The Evolutional history the invertebrates 3rd: Invertebrate phyla-1.1: Protozoa, sponges, flatworms, worms 4th: Invertebrate phyla-1.2: Protozoa, sponges, flatworms, worms 5th: Invertebrate phyla-2.1: Molluscs 6th: Invertebrate phyla-2.2: Molluscs 7th: Invertebrate phyla-3.1: Lophophorates, arthropods, deuterostomes 8th: Invertebrate phyla-3.2: Lophophorates, arthropods, deuterostomes 9th: Phylogenic trees and biodiversity 1 10th: Phylogenic trees and biodiversity 2 11th: Feeding 1 12th: Feeding 2 13th: Respiration 1 14th: Respiration 2 15th: Review and supporting explanation of all lectures 16th: Final examination</p>					
<p>6. Preparation None</p>					
<p>7. Record end evaluation method The final examination is graded on a 100-point scale, with 60 points or more as passing as a “C”, 70 points or more as a “B”, 80 points or more as an “A”, and 90 points or more as an “AA” grade.</p>					
<p>8. Textbook and references The Invertebrates: A Synthesis (R. S. K. Barnes, 2001, Wiley-Blackwell) ISBN 978-0632047611</p>					
<p>9. Self study Review lecture handouts and answer questions in each lecture.</p>					
<p>10. Practical business</p>					
<p>11. In addition Questions about the lecture content may be submitted by e-mail at any time. E-mail: kazue.nagasawa.d6*tohoku.ac.jp (replace * to @)</p>					

Subject	Applied Aquatic Botany (水圏植物学)	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	M. Aoki (Professor)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5
Subject Numbering	ABS-APS349E			Language Used in Course	English
1. Class subject Concepts and methods for the study of marine plant life					
2. Object and summary of class Marine algae are the major primary producers at the marine coastal areas, but most of us know little about them. Object of the class is to understand the concepts and methods for the study of marine plants such as algae and seagrasses. In this series of lectures, firstly, we will try to understand the basic characteristics of marine plants. Second, the patterns in the geographical and vertical distributions of marine algae will be discussed. Next, we will overview the studies on the population and community aspects of marine plants. Analytical methods of population dynamics and the details of plant-animal interactions will also be discussed. In addition, some topics in seaweed mariculture and marine pollution will be shown. Finally, monitoring methods of marine plant communities and the actual application of them will be introduced.					
3. Keywords seaweed, kelp, <i>Sargassum</i> , plant-animal interactions, grazers, herbivores					
4. Goal of study For students to be able to understand the basic ideas and methods for the study of marine plants.					
5. Contents and progress schedule of class (1) At the beginning: all about WAKAME: <i>Undaria pinnatifida</i> (2) Geographical distribution of marine algae (3) Vertical distribution of marine algae: intertidal zone (4) Vertical distribution of marine algae: subtidal zone (5) Primary production of coastal marine plants (6) Population analysis of marine plants (7) Monitoring survey of marine plant communities (8) Dispersal ability of marine plants (9) Plant-animal interactions in benthic algae communities (10) Epiphytic animals and tsunami impacts (11) Grazing snails (12) Field experiments (13) Mariculture (14) Pollution (15) Session review					
6. Preparation					
7. Record and evaluation method Attendance rates and test scores will be recorded and evaluated.					
8. Textbook and references Handouts will be available at the beginning of each lecture.					
9. Self study Review is required.					
10. Practical business					
11. In addition Mail address: masakazu.aoki.e6@tohoku.ac.jp					

Subject	Marine Product Technology (水産利用学)	Day/Period	3 rd Quarter Fri./1 st -2 nd	Object	AMB
Instructor (Post)	T. Yokoyama (Assoc. Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	6
Subject Numbering	ABS-APS350E			Language Used in Course	English
1. Class subject The biochemical characteristics and effective utilization of marine bioresources					
2. Object and summary of class The biochemical characteristics of marine organisms as foodstuffs will be explained. The attendees are expected to understand the principles of seafood production and the associated processing methods. Accurate knowledge of the hygienic control of fish and shellfish will also be addressed to understand the roles of marine organisms as a resource for food. The functions of seafood for human health and the characteristics of seafood for medicinal and industrial purposes will also be discussed.					
3. Keywords Food preservation, Freezing and thawing techniques, Postmortem changes of fish and shellfish					
4. Goal of study To be able to understand the principles and methods of food processing, preservation, and the control of seafood qualities, and to gain knowledge for the effective utilization of marine resources.					
5. Contents and progress schedule of class 1 Marine resources for food 2 Characteristics and variation of seafood 3 Nutritional aspects of seafood 4 Processing principles of typical seafood 5 Food poisonings related to seafood 6 Seafood allergy 7 Health-promoting functions of the substances from aquatic organisms 8 Biochemical substances from marine organisms for medicinal and industrial materials 9 Control of muscle protein quality 10 Report writing 11 Term-end exam					
6. Preparation Review the contents of the lectures on Marine Biochemistry					
7. Record end evaluation method Based on the final exam , class attendance, and lecture notes.					
8. Textbook and references Handbook of Marine Natural Products vol.1, vol.2 (Fattorusso, E. et al., ed.) Springer (2012) Seafood Processing Technology, Quality and Safety (Bosiaris, I.S. ed) Wiley Blackwell (2014) Food Physics Physical Properties-Measurement and Applications (Figura, L.O. and Teixeira, A.A. ed.) Springer (2007) Assessment and management of seafood safety and quality Current practices and emerging issues ((Ryder, J., Iddya, K. and Ababouch, L. ed.) FAP Fisheries and Aquaculture Technical Paper 574 (2014)					
9. Self study Refer to the websites related to the topics and the relevant papers.					
10. Practical business					
11. In addition Contact email: takehiko.yokoyama.c7@tohoku.ac.jp					

Subject	Seafood management (水産食品管理学)	Day/Period	1st quarter Wed./1 st ~2 nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	7		
Subject Numbering	ABS-APS351E	Language Used in Course	English		
1. Class subject: Seafood Management.					
2. Object and summary of class: This dynamic course, the contents of which keep changing with fluctuating fisheries resources, instructs on the features of seafood quality and its management with regards to maintaining the safety of seafood.					
3. Keywords: Hygiene, HACCP, diseases, food safety, pandemic, disasters, aquaculture, legal and international issues, traceability, sustainability Blue Economy					
4. Goal of study: Develop a solid understanding of methods for ensuring quality and hygiene management of seafood at each step, from harvest to the consumer's table. Describe the features of seafood quality. State the methods of maintaining quality in terms of safety. State relevant regulations and public laws for maintaining seafood quality and safety. Describe the essential points of quality management under the HACCP system, and necessity of the FERAT system.					
5. Course contents and class schedule. (1-2). Introduction. Seafood traceability, sustainability, Blue Economy. Seafood production and processing. FERAT: Fisheries Emergency Rapid Assessment Tool. Fisheries in light of natural disasters and pandemics. (3-4). Chemistry: Components of seafood affecting color, taste and smell. Harmful chemicals (e.g., histamine, etc.) and physical substances (foreign objects) affecting food safety. (5-6). Harmful biological substances (1) Parasites. Bacterial & fungal infections, listeriosis, etc. Preservation of seafood products: Principles and methods. Fundamentals of hygienic practices. (7-8). Ecology of Wild-caught and Aquaculture Fisheries. Students produce an outline of his/her selected target seafood species for final project (9-10). Seafood management (1): Seafood handling regulations, legislation and public laws on seafood hygiene. Basic seafood handling: visit to Ishinomaki Fish Landing and Market* or Sendai City Fish Market. * (11-12). Seafood management (2): Prerequisites to HACCP (Hazard Analysis and Critical Control Point). Seafood management (3): The HACCP system. Visit to a food processing company. * (13-14). Class debate on sustainable options to replace vital but unsustainable fisheries (15). Final Presentations. Final Report Examination. *In person or virtual.					
6. Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.					
7. Record end evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)					
8. Textbook and references: Primary reading(s) (students can access all main material online): Secondary Readings: FAO, Fisheries and Aquaculture Department (various publications) http://www.fao.org/fishery/publications/en ; Food and Agriculture Organization of the United Nations (2020) http://www.fao.org/3/a-i5555e.pdf ; US FDA HACCP Principles & Application Guidelines https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines Seafood Health Facts by Seagrant Delaware: https://www.seafoodhealthfacts.org/ ; Fish and Fishery Products Hazards and Controls Guidance: https://www.fda.gov/media/80288/download ; Reference texts: Venugopal, V. (2006). Seafood processing. (Taylor & Francis). Hemminger (2000). Food safety: a guide to what you really need to know. (Blackwell). ISBN 978-0-8138-2482-6. McElhatton, A. & Marsall, R.J. (2007). Food safety. A practical and case study approach. (Springer). Boziaris, IS. (2014). Seafood Processing: Technology, Quality and Safety (IFST Advances in Food Science). ISBN-13: 978-1118346211.					
9. Self-study: Weekly reports must be written by students in their own words. Reports will be assessed for their completeness, accuracy and unique writing style. Students will write in the context of demonstrating clearly what they have learned during lectures and readings assignments.					
10. Practical business					
11. In addition: Any questions should be addressed to the lecturer directly during or after lectures, or during office hours. ames.cheryl.lynn.a1@tohoku.ac.jp *The class will participate in one off-campus practical excursion as time and schedules permit.					

Subject	Planktology (プランクトン学)	Day/Period	2 nd Quarter Wed./1 st ~2 nd	Object	AMB
Instructor (Post)	G. Nishitani (Associate Professor)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	5		
Subject Numbering	ABS-APS252E	Language Used in Course	English		
1. Class subject Systematics and biology of marine plankton					
2. Object and summary of class An introduction to systematics, physiology, and ecology of marine plankton					
3. Keywords Diatom, dinoflagellate, ciliate, copepod, krill, food chain, microbial food web, vertical migration					
4. Goal of study Understanding structure and role of plankton community in marine ecosystem					
5. Contents and progress schedule of class Marine ecological division (1) Classification of marine plankton (1) Characteristics of phytoplankton and zooplankton (2) Food chain and food web in marine plankton (1) Primary production by marine phytoplankton (1) Material circulation (carbon and nitrogen cycles) (2) Ecology and application of useful phytoplankton (2) Ecology and biology of harmful phytoplankton (2) Current topics in marine plankton (2) Examination					
6. Preparation Basic knowledge of biology and ecology, basic understanding of marine ecosystem					
7. Record and evaluation method Presence/absence evaluation & examination					
8. Textbook and references					
9. Self study					
10. Practical business					
11. In addition Contact email address: ni5@tohoku.ac.jp					

Subject	Marine Coastal Ecology (沿岸環境学)	Day/Period	1 st quarter Fri./1 st 、2 nd	Object	AMB
Instructor (Post)	Toyonobu Fujii (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	5		
Subject Numbering	ABS-APS353E	Language Used in Course	English		
1. Class subject The structure and functioning of marine coastal ecosystems and the impacts of human activities on them.					
2. Object and summary of class This class introduces the fundamentals of marine biology by examining the vibrant life in the oceans with particular reference to the coastal ecosystems. Students will study a range of coastal habitats including shelf seas, coral reefs, mangroves, estuaries and various shore types. This class covers a diverse set of topics ranging from structure and functioning of different coastal ecosystems, through adaptations of organisms for their particular living conditions, to issues relating to the sustainable management of marine coastal resources.					
3. Keywords marine coastal ecosystems, community ecology, biogeography, conservation, anthropogenic influences, sustainable resource management					
4. Goal of study Students are expected to enhance their skills in marine ecological research methods, reading scientific articles, critical thinking, communication and scientific writing.					
5. Contents and progress schedule of class: 1. Introduction 2. An Introduction to Marine and Coastal Ecosystems: A Global Perspective 3. Estuaries and Muddy, Sandy & Rocky Shores 4. Seagrass Meadows and Kelp Forests 5. Mangroves and Coral reefs 6. Coastal Fisheries and Aquaculture 7. Issues Surrounding Anthropogenic Impacts and Marine Coastal Management 8. Essay Writing Skills Session 9. Case Studies in the Onagawa Bay Coastal Ecosystem: (I) Physical Components 10. Case Studies in the Onagawa Bay Coastal Ecosystem: (II) Biological Components 11. Case Studies in the Onagawa Bay Coastal Ecosystem: (III) Anthropogenic Components 12. Case Studies in the Onagawa Bay Coastal Ecosystem: (IV) Socio-Ecological System Dynamics 13. Revision Session 14. Final Exam 15. Final Exam					
6. Preparation None					
7. Record end evaluation method Attendance: 10 % Essay writing: 30 % (Review essay on contemporary topic relating to marine and coastal management (~1500 words)) Final Exam: 60 % (The exam will consist of essay style questions. You will be asked to attempt 2 questions from a choice of 5 questions (2 hours duration))					
8. Textbook and references There is no dedicated textbook for this class. A list of key references will be provided in each lecture.					
9. Self study None					
10. In addition Contact e-mail address: toyonobu.fujii.a8@tohoku.ac.jp					

Subject	Marine Applied Biochemistry (海洋応用生物化学)	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	M. Nishikawa	Categories	Specialized Subjects	Preferable Participants	3 rd and 4 th year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	7&9		
Subject Numbering	ABS-APS354E	Language Used in Course	English		
1. Class subject Development of nutritional and functional substances from marine bioresources					
2. Object and summary of class It has been established that the habit of eating fish is beneficial for maintaining and promoting human health. In this class, students are supposed to learn the developmental strategies, function evaluation methods, and marketing of the nutritional and functional substances from marine organisms. They are also requested to understand the developmental steps for food for specified health use (FoSHU) by referring to the commercially available goods.					
3. Keywords Marine bioresource, functional substances, healthy food, FoSHU, pharmaceuticals					
4. Goal of study To understand the chemical structures, pharmaceutical effects, and preparation methods of the nutritional and functional substances in marine organisms, and the strategies for industrial applications.					
5. Contents and progress schedule of class 1 Development of nutritional and functional substances from marine bioresource (overview) 2 Development of EHA preparation (including development of FoSHU and pharmaceuticals) 3 Development of DHA preparation (including development of FoSHU) 4 Squalene and squalane 5 Chondroitin sulfate 6 Chitin, chitosan, and glucosamine 7 Other substances: fish collagen, ether lipids, astaxanthin, zinc, DNA, etc. Further details of this subject will be announced later.					
6. Preparation Not necessary					
7. Record end evaluation method Based on the evaluation of reports					
8. Textbook and references None					
9. Self study Collection of the latest information from newspapers, the internet, etc. Checking commercially available goods					
10. In addition Contact address: nakanot@tohoku.ac.jp (Prof. T. Nakano, Marine Biochem. Lab.)					

Subject	Introduction to Fisheries Science (水産科学概論)	Day/Period	Fri./2nd	Object	AMB/JYPE
Instructor (Post)	T. Nakano (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	2nd-year & JYPE students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	4		
Subject Numbering	ABS-APS255E	Language Used in Course	English		
1. Class subject Introduction to Fisheries Science					
2. Object and summary of class This course provides an overview of fisheries science. Students will learn the fundamentals of fisheries science as it relates broadly to marine biology, from molecules to ecosystems.					
3. Keywords Fisheries science, fundamentals, overview					
4. Goal of study The goal is to understand the fundamentals of fisheries science from ecology, physiology, genetics, molecular biology and evolution, and to appreciate fisheries science as it relates to applied marine biology.					
5. Contents and progress schedule of class The following lectures will be given, but the order is yet to be determined. 1. "Reproductive physiology of bivalves" (K. Nagasawa) 2. "How to know the fish age" (S. Katayama) 3. "How to know the fish migration" (S. Katayama) 4. "Think about the marine ecosystem" (A. Tanaka) 5. "The meanings of 'primary producer' in the ocean" (A. Tanaka) 6. "Food chemistry of fish and shellfish" (T. Nakano) 7. "Plankton in the ocean 1" (A. Yamaguchi) 8. "Biochemistry of seaweed" (T. Yokoyama) 9. "How to cultivate quality sea urchins" (T. Unuma) 10. "Plankton in the ocean 2" (G. Nishitani) 11. "Flatfish metamorphosis and aquaculture" (H. Yokoi) 12. "Biological sequence comparison methods" (Y. Sakai) 13. "Evolution and fisheries resources" (M. Ikeda) 14. "Coastal ecosystem dynamics and fisheries resources" (T. Fujii) 15. "Molecular phylogenetics: Tools and applications" (C. Ames)					
6. Preparation None in particular.					
7. Record end evaluation method Evaluation will be based on class attendance (70%) and report scores (30%).					
8. Textbook and references None in particular.					
9. Self-study Students should review the lecture contents thoroughly using the handouts.					
10. Practical business					
11. In addition If students have questions about a lecture, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Nakano).					

Subject	Practical Training (実地研修)	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	T. Nakano (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	6
Subject Numbering	ABS-APS456E			Language Used in Course	English
1. Class subject Practical training at the points of fishery production and research					
2. Object and summary of class This course provides the tours at the point of fishery production and research. Students will learn fisheries science practically.					
3. Keywords Field trip, investigative tour					
4. Goal of study The goal is to increase awareness of students to learn fisheries science.					
5. Contents and progress schedule of class This course provides the practical tours as below: 1. Fish market 2. Tidal flat 3. Aquarium 4. Salmon hatchery 5. Nature exhibition hall					
6. Preparation Collect information before starting each tour.					
7. Record and evaluation method Attendance and report. The reports must be submitted by the due date.					
8. Textbook and references No textbook. Reference books will be introduced by each professor.					
9. Self study Refer to related books in the library after each tour.					
10. Practical business					
11. In addition If students have questions about tours, they can ask the instructor by e-mail or visit his/her office after asking for his/her availability in advance. E-mail: nakanot@tohoku.ac.jp (T. Nakano).					

Subject	Marine Biology (海洋生物学)	Day/Period	4 th quarter Thu./1 st ~2 nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	4		
Subject Numbering	ABS-APS257E	Language Used in Course	English		
1. Class subject: Marine Biology: Systematics, biodiversity, phylogenetics, habitats and ecological niches of marine organisms.					
2. Object and summary of class: Survey the different types of organisms in the sea in order to develop a fundamental understanding of marine biodiversity. Assess the effects of natural and anthropogenic disturbances on marine ecosystems and their inhabitants. Develop an understanding of Metazoa evolution and molecular phylogenetics.					
3. Keywords: Marine Biodiversity, Plankton, Evolution, Phylogenetics, Systematics, Ecology					
4. Goal of study: Develop an understanding of the main categories of marine animals (Metazoa), become familiar with the basic body plans and distinguishing features against the background of evolution, ecology and systematics.					
5. Contents and progress schedule of class Each lecture will provide an overview of the fundamentals of different groups of marine organisms. Students will gain an understanding of the field of systematics and dynamics of molecular phylogenetics. Practical components may be incorporated through “virtual” class excursions to public museums and aquariums. (1-2). Introduction. Marine organisms and the food web; producers, consumers, detritivores; the major groups & their spatial and bathymetric distributions; solar-dependent and solar-independent (hydrothermal) systems. (3-4). Marine animal (Metazoa) taxonomy, systematics and phylogenetics. Basic body plans (diploblasts versus triploblasts) and evo-devo (evolution of development). Evolution of the nervous system. (5-6). Marine Invertebrates (non-bilaterians). Zooplanktonic forms. (7-8). Bilateria. Deuterostomia and Protostomia. Chordata. Chaetognath, Urochordata, Cephalochordate. Hemichordate. (9-10). Mid-term report and exam. Basics of fish systematics. Gnathostomes. Agnatha. (11-12). Basics of fish systematics. Chondrichthyes. Osteichthyes. (13-14). Marine mammals. Systematics. Comparison with closest relatives (15). Final report, presentations and exam.					
6. Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.					
7. Record and evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)					
8. Textbook and references: Primary reading(s) (students can purchase or borrow a copy from campus library): Morrissey et al. (2018). Introduction to the Biology of Marine Life (Jones & Bartlett Includes Navigate 2 Advantage Access, 11th. ed.) ISBN-13: 978-1-284-09050-5. Secondary reading(s): Levinton, JS (2018). Marine Biology: Function, Biodiversity, Ecology (Oxford University Press 5th. ed.) ISBN-13: 978-0190625276; Helfman, G et al. (2009). The Diversity of Fishes: Biology, Evolution, and Ecology (Wiley-Blackwell, 2nd. ed) ISBN-13: 978-1405124942. Brusca et al. (2016). The Invertebrates: A Synthesis (Sinauer Associates, 3rd. ed) ISBN-13: 978-1605353753.					
9. Self-study: There is much to learn about these topics. Students are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.					
10. Practical business: Student projects will contribute to the Tree of Life project.					
11. In addition: Questions should be addressed to the lecturer directly during or after lecture, or during office hours. ames.cheryl.lynn.a1@tohoku.ac.jp *Taxa not covered during this course will be addressed in the courses <i>Life & Nature</i> , <i>Planktonology</i> and in <i>Basic Seminars</i> .					

Subject	Current topics of Agricultural Plant Science (先端植物生命科学)	Day/Period	1 st quarter Wed./3 rd ~4 th	Object	AMB/JYPE
Instructor (Post)	T. Makino (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	3rd & 4th-year & AMB students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	7 and 9
Subject Numbering	ABS-PLA358E			Language Used in Course	English
<p>1. Class subject Professors and associate professors in Course of Plant Science introduce current topics of agricultural plant science.</p>					
<p>2. Object and summary of class The purpose of this class is to enhance students' interests on crop science, horticultural science, soil science, plant pathology, plant breeding and genetics, insect science and bioregulation, environmental plant biotechnology, environmental crop science and forest ecology.</p>					
<p>3. Keywords Crop, Plant, Soil, Insect, Microorganisms.</p>					
<p>4. Goal of study The goal of this course is for students to understand and broaden the knowledge of agricultural plant science, and to have great interests in our studies on plant production science, environmental plant biotechnology, and applied plant science. Students will want to study in our course of Graduate School of Agricultural Science.</p>					
<p>5. Contents and progress schedule of class Each week there will be lectures and discussions of the following topics:</p> <ol style="list-style-type: none"> 1) Introduction (Prof. Makino) Soil science: Soil science on the risk alleviation methods for heavy metal contamination in soil and rice (Prof. Makino) 2) Crop science-1: Climate change impact on crop production (Prof. Homma) 3) Crop science-2: Crop physiology and production (Assoc. Prof. Kameoka) 4) Horticultural science-1: Fruit production and research (Prof. Kanayama) 5) Horticultural science-2: Functional properties of fruit and vegetable crops (Assoc. Prof. Kato) 6) Plant breeding and genetics-1: Nanohana-Project (Prof. Kitashiba) 7) Plant breeding and genetics-2: Molecular mechanism of self-incompatibility (Assoc. Prof. Yamamoto) 8) Plant pathology: Plant virus evolution and evolution of plant antiviral resistance (Prof. Miyashita) 9) Applied Entomology-1: Insect-plant interaction (Prof. Hori) 10) Applied Entomology-2: Insect phototaxis and its applied use (Assoc. Prof. Endo) 11) Environmental plant biotechnology: Genetics and genetic engineering of plants (Prof. Ito) 12) Environmental crop science-1: Soil management and productivity (Prof. Nishida) 13) Environmental crop science-2: Role of plant roots in crop production and environmental impacts (Assoc. Prof. Tajima) 14) Forest ecology-1: Forest molecular ecology (Prof. Suyama) 15) Forest ecology-2: Forest microbial ecology (Assoc. Prof. Fukasawa) 					
<p>6. Preparation Briefly understand each field on the website below.</p>					
<p>7. Record end evaluation method Attendance (30%), class participation (30%), and report (40%).</p>					
<p>8. Textbook and references http://www.agri.tohoku.ac.jp/en/about/organization/faculty/index.html</p>					
<p>9. Self study Study the above website in detail and understand the contents of research in each field. If you want to study in more detail, ask each faculty for reference books.</p>					
<p>10. In addition Contact: Prof. Tomoyuki Makino E-mail: tomoyuki.makino.d6@tohoku.ac.jp Office: Room E308</p>					

Subject	Advanced Lecture on Animal Science (応用動物・酪農科学概論)	Day/Period	1 st quarter Fri./3 rd ~4 th	Object	AMB/JYPE
Instructor (Post)	Tetsuya Tanaka, Sanggun Roh et al.	Categories	Specialized Subjects	Preferable Participants	3rd&4th-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	7 and 9		
Subject Numbering	ABS-ANS360E	Language Used in Course	English		
1. Class subject Advanced Lecture on Animal Science					
2. Object and summary of class To understand the scientific and technological advances in animal life science related with the efficient production and advanced utilization of higher quality products such as milk, meat, clothing, and medicines from animals, which are mainly livestock and poultry.					
3. Keywords Animal Reproduction and Development, Animal Nutrition, Animal Breeding and Genetics, Animal Physiology, Animal Functional Morphology, Animal Microbiology, Animal Food Function, Land Ecology and Sustainable Animal Environment					
4. Goal of study Students will understand the advanced animal science and learn different techniques for research.					
5. Contents and progress schedule of class: 1) Guidance and Ruminant Physiology in Beef cattle (Sanggun ROH) 2) Molecular nutrition: Interaction of nutrients, gene regulations and performance (Kan SATO) 3) Sperm stem cell behaviors in mammalian testis (Kenshiro HARA) 4) Functional morphology in mucosal immune tissues (Tomonori NOCHI) 5) Machine Learning Applications in Livestock Disease Management (Jahidul ISLAM) 6) Zoonoses (Kentaro KATO) 7) Introduction of hard tick, <i>Haemaphysalis longicornis</i> (Tetsuya TANAKA) 8) Role of the gut microbiota in health and disease (Keita NISHIYAMA) 9) Forage production and livestock grazing systems in Japan (Shin-ichiro OGURA) 10) Selenium in Agriculture (Ryuta TOBE) 11) Energy production from organic wastes using the small methane fermentation system (Chika TADA) 12) Introduction to quantitative genetics (Yoshinobu UEMOTO) 13) Functions of Phytobiotics in animals (Motoi KIKUSATO) 14) General Discussion (Sanggun ROH) 15) General Discussion (Sanggun ROH)					
6. Preparation: N/A					
7. Record end evaluation method: Attendance to the lectures 50%, reports 50%. Evaluation will be based on the quality of the reports submitted for each teacher's lecture.					
8. Textbook and references: There are no textbooks. Reference books or materials will be introduced within each lecture.					
9. Self study: Students are required to review using references, and to prepare the reports on the selected lectures.					
10. Practical business: N/A					
11. In addition Questions will be taken directly after each class or anytime through e-mail. Contact: Prof. Sanggun ROH E-mail: sanggun.roh@tohoku.ac.jp					

Subject	Food and Chemistry (食糧と化学)	Day/Period	1 st quarter Thur./3 rd ~4 th	Object	AMB/JYPE
Instructor (Post)	M. Ishikawa (Prof.) et al.	Categories	Specialized Subjects	Preferable Participants	3rd&4th-year & JYPE students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	2		
		Semester	7 and 9		
Subject Numbering	ABS-AGC362E	Language Used in Course	English		
1. Class subject: Biochemistry and chemistry of food and bioactive natural products					
2. Object and summary of class: This class object is to study the basic concepts of biochemistry and chemistry of food and related bioactive natural products. More than ten Professors and Associate Professors will give the lectures weekly to introduce their specific research fields.					
3. Keywords:					
4. Goal of study: The goal of this class is to obtain the background knowledge concerning biochemistry and chemistry as well as the basic principles of food science and natural products chemistry.					
5. Contents and progress schedule of class:					
1. Food allergens: why certain types of proteins contained in foods act as allergens? (Prof. Masako TODA) Biochemical and immunological properties of food allergens that induce food allergies will be introduced.					
2. Novel functions of dietary vitamins and its contribution to our health. (Prof. Hitoshi SHIRAKAWA) This lecture will focus on physiological roles of vitamins in food and also will mention about the recent knowledge of their functions for health maintenance.					
3. Food and bioactive natural products for human health (Prof. Kiyotaka NAKAGAWA) This lecture will give you basic understanding of the roles of food and bioactive natural products to prevent against ageing and oxidative damages (e.g., dementia, cancers, atherosclerosis). This lecture will also address the development of food for human health.					
4. Beneficial health effects of dietary lipids (Assoc. Prof. Takahiro EITSUKA) Lipids play important roles in the function of our body in both health and disease. This lecture will provide basic knowledge of health functions of dietary lipids and their mechanisms of action.					
5. Chemistry and biochemistry of marine toxins I (Prof. Mari YAMASHITA) Some of the marine animals contain highly toxic compounds which could cause food intoxication. Isolation, structural determination, analytical methods and pharmacology of these compounds will be presented.					
6. Chemistry and biochemistry of marine toxins II (Assoc. Prof. Keiichi KONOKI) Isolation, structural determination, analytical methods and pharmacology of marine toxins will be presented. (This lecture is the second part of lecture about the marine toxins.)					
7. Application of high pressure to food processing. (Prof. Tomoyuki FUJII) High pressure technique is one of non-thermal processing of food. In this lecture, the quality of the pressurized food will be discussed from the viewpoint of the high pressure effect on food structure.					
8. Protein chemistry (Prof. Yoshikazu TANAKA) To understand function of protein, determining its 3D structure is of significance. In this lecture, basic principle of 3D structure determination is introduced. The practical experiment will be carried out as well.					
9. Bioactive molecules and their application for drug discovery (Prof. Minoru ISHIKAWA) There are many biologically active compounds in natural products. This lecture will focus on bioactive compounds in human health, their target molecules, and applications for drug discovery and medicinal chemistry.					
10. Medicinal chemistry of antibacterial and antiviral agents (Prof. Hirokazu ARIMOTO) Selected topics in anti-infective agents will be discussed with an emphasis on how organic chemistry is used in the drug development process.					
11. Synthetic and medicinal chemistry of marine natural products (Prof. Hirofumi UEDA) Marine natural products that display important biological activities with remarkable potency and specificity are known to be useful for understanding/regulating biological events. This lecture will give an overview of the synthetic and medicinal chemistry of some important marine natural products.					
12. Nutrient-inspired biomaterials and its applications for the health purpose (Assoc. Prof. Taiki MIYAZAWA) There are different types of nutrients in nature, which have a variety of different biological activities and physical properties. The challenge of biomaterials, composed primarily of these properties, is one of the important topics for human health. The basic outline and application of this research area are introduced in this lecture.					
13. Mechanisms of salt and fluid homeostasis: Insights from renal physiology (Assoc. Prof. Yusuke OHSAKI) The kidney produces urine and regulates blood pressure by controlling plasma volume. This lecture introduces how kidney manages fluid and electrolyte balance in response to sodium intake.					
14. Harmful natural products: Cases from food poisoning and tooth decay (Assoc. Prof. Yuta KUDO) This lecture introduces natural products harmful to human health, derived from terrestrial plants and oral bacteria responsible for dental cavities, focusing on their chemistry, biosynthesis, and bioactivity.					
6. Preparation:					
7. Record and evaluation method: Attendance to the lectures 50%, reports 50%					
8. Textbook and references: Textbook and references will be introduced by each professor.					
9. Self study: Read textbooks and references to advance knowledge about related topics					
10. In addition: For inquiry, please contact Prof. Minoru Ishikawa: minoru.ishikawa.e4@tohoku.ac.jp					

Subject	Current topics of Aquatic animal Physiology (先端海洋生物生理学)	Day/Period	1 st quarter Thu./1 st ~2 nd	Object	AMB
Instructor (Post)	Kazue Nagasawa (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	7		
Subject Numbering	ABS-APS363E	Language Used in Course	English		
1. Class subject Introduction to Recent Research in Aquatic Animal Physiology					
2. Object and summary of class Basic research in aquatic animal physiology has contributed much to basic biology as well as aquaculture production. In this course, I will introduce some of the recent findings in aquatic animals, focusing on research in germ cell biology and neuroendocrinology. Students will gain an understanding of research trends in the field of aquatic animal physiology and how these have been accumulated through direct exposure to original papers.					
3. Keywords Germline stem cells, Reproductive physiology, Neuropeptides, Fish, Shellfish					
4. Goal of study Students will gain an understanding of the scientific interest and importance of recent findings in aquatic animal physiology. Students will also learn about applied research using these findings.					
5. Contents and progress schedule of class Face-to-face classes will be held in the lecture hall. Progress will be made in one session on one of the following topics. 1. Germ cell biology in aquatic animals 1 (germ cell classification) 2. Germ cell biology in aquatic animals 2 (germline stem cell) 3. Germ cell biology in aquatic animals 3 (germ cell transplantation 1) 4. Germ cell biology in aquatic animals 4 (germ cell transplantation 2) 5. Neuroendocrinology in aquatic animals 1 6. Neuroendocrinology in aquatic animals 2 7. Discussion and follow up					
6. Preparation Not required					
7. Record end evaluation method Grades are based on attendance and quiz scores in each class.					
8. Textbook and references Handouts and original research papers will be provided.					
9. Self study Review with provided handouts.					
10. Practical business					
11. In addition Questions about the lecture content may be submitted by e-mail at any time. E-mail: kazue.nagasawa.d6*tohoku.ac.jp (replace * to @)					

Subject	Current Topics of Fish Molecular Biology (先端海洋分子生物学)	Day/Period	3 rd quarter Thur./1 st ~2 nd	Object	AMB
Instructor (Post)	H. Yokoi (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	6		
Subject Numbering	ABS-APS368E	Language Used in Course	English		
1. Class subject Fish Molecular Biology -- Fish as a Model System					
2. Object and summary of class In recent decades, fish became more and more popular as an excellent model system to investigate fundamental questions not only in aquaculture, but also in basic biology, medicine, and environmental science. This class will discuss why they are favored and how the model system developed, by showing examples of fish and other animals used as experimental model systems.					
3. Keywords Experimental model animal, genetics, developmental biology, non-conventional model animal					
4. Goal of study Students will understand the potential of fish and the reason why fish are used as an excellent experimental model in various fields. Some of the learned strategies would be helpful for students to design their own research projects in any field.					
5. Contents and progress schedule of class 1. Introduction: Molecular biology as a tool for the research in biology and medicine 2. Advantage of nematode and fly as model system: development, genetics and mutagenesis 3. Advantage of fish as a model system: developmental genetics, genomics and mutagenesis 4. Advantage of frog and chicken as model system: development and micro-surgery 5. Advantage of mouse as a model system: development and stem cell technology 6. Advantage of using multiple model system: comparative approach and evolutionary biology 7. Experimental model system: past, present and future 8. Summary and final exam					
6. Preparation Review the previous classes. Please feel free to ask during the class, if you have any ambiguous points.					
7. Record end evaluation method Attendance, participation, quiz and final exam.					
8. Textbook and references Developmental biology (Scott F Gilbert) Others will be introduced in the class.					
9. Self study Take a look at the Nature or Science magazine to see how model organisms are used in the latest biological research, and read some of the articles if you find them interesting.					
10. Practical business					
11. In addition Office hours, 10:00 to 18:00, Monday to Friday, please make an appointment beforehand. Contact, hayokoi@tohoku.ac.jp					

Subject	Current Topics of Marine Biotechnology (先端海洋生物工学)	Day/Period	3 rd quarter Thur./1 st ~2 nd	Object	AMB
Instructor (Post)	H. Yokoi (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1		
		Semester	6		
Subject Numbering	ABS-APS365E	Language Used in Course	English		
1. Class subject Techniques of molecular biology and marine biotechnology, genome editing					
2. Object and summary of class Students will learn about developmental biology of fish, molecular engineering in fish, and web-based bioinformatics resources.					
3. Keywords Fish development, genome, genome editing, positional cloning, bioinformatics					
4. Goal of study Students will understand the basic mechanisms and strategies of genetic engineering and genomics in fish, and bioinformatics necessary for future research in the fields of marine biotechnology.					
5. Contents and progress schedule of class 1: Reverse genetics (Knockout fish, CRISPR/Cas9) 2: Forward genetics (Mutant library, Positional cloning) 3: Other basic techniques essential for fish biotechnology 4: Fish genomes 5: Practical training using computer (BLAST search, Multiple alignment, Phylogenetic tree, Ensembl, PubMed) 6: Larval and metamorphic development 7: Transgenic fish					
6. Preparation TBA (will be announced in the class)					
7. Record end evaluation method Attendance, participation and test/report					
8. Textbook and references Reference Books: Gene Cloning & DNA Analysis; An Introduction. By Brown TA. Willey-Blackwell Recombinant DNA; Genes and Genomics – A Short Course. By Watson JD. W. H. Freeman and Company Developmental Biology. By Gilbert SF. Sinauer Associates					
9. Self-study Students are recommended to read above textbooks.					
10. Practical business No					
11. In addition This lecture will be held consecutively after "Current Topics of Fish Molecular Biology." Therefore, please be sure to enroll in the "Current Topics of Fish Molecular Biology" first. Office hour: Questions are accepted after class, or by e-mail. E-mail address: hayato.yokoi.a4@tohoku.ac.jp					

Subject	Current Topics in Global Marine Ecology (先端地球海洋生態学)	Day/Period	2 nd quarter Fri./3 rd ~4 th	Object	AMB
Instructor (Post)	Toyonobu Fujii (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	3 rd -year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	7
Subject Numbering	ABS-APS366E			Language Used in Course	English
1. Class subject The structure and functioning of large marine ecosystems and the impacts of global environmental change on them.					
2. Object and summary of class This class synthesizes the core concepts of marine ecosystem dynamics in relation to global environmental change and human impact. Students will go over a range of large marine habitats including coastal waters, polar regions, open oceans, and deep-sea environments. This class covers a diverse set of topics ranging from structure and functioning of different large marine ecosystems, through adaptations of organisms for their particular living conditions, to issues relating to the sustainable environmental management.					
3. Keywords Marine ecosystems, coastal waters, polar regions, deep-sea environments, community ecology, biogeography, adaptation, conservation, anthropogenic influences, environmental management					
4. Goal of study Students are expected to enhance their skills in marine ecological research methods, reading scientific articles, critical thinking, communication and scientific writing.					
5. Contents and progress schedule of class 1 An Introduction to Large Marine Ecosystems: A Global Perspective 2 Coastal Waters 3 Deep Sea Environments I 4 Deep Sea Environments II 5 Hydrothermal Vents and Polar Regions 6 Issues Surrounding Global Environmental Change and Human Impact on Marine Ecosystems 7 Oral Presentation Session					
6. Preparation None					
7. Record end evaluation method Attendance: 10 % Oral presentation: 30 % (10-minute oral presentations will take place during the final lecture session) Essay writing: 60 % (Review essay on contemporary topic relating to marine conservation (~1500 words))					
8. Textbook and references There is no dedicated textbook for this class. A list of key references will be provided in each lecture.					
9. Self study None					
10. In addition Contact e-mail address: toyonobu.fujii.a8@tohoku.ac.jp					

Subject	Current topics of Coastal Ecology (先端沿岸生態学)	Day/Period	2 nd quarter Wed./1 st ~2 nd	Object	AMB
Instructor (Post)	H. Suzuki (Assistant Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	7
Subject Numbering	ABS-APS367E			Language Used in Course	English
1. Class subject Ecology of temperate reef communities.					
2. Object and summary of class Some current topics in ecology of temperate reef communities will be introduced.					
3. Keywords seaweed, kelp bed, canopy-forming algae, turf algae, herbivore, sea urchin					
4. Goal of study To learn the factors affecting the complex networks in temperate reef communities.					
5. Contents and progress schedule of class 1) Introduction 2) Introduction of recently published papers-1 3) Introduction of recently published papers-2 4) Introduction of recently published papers-3 5) Introduction of recently published papers-4 6) Introduction of recently published papers-5 7) Review					
6. Preparation Study relevant papers in advance.					
7. Record end evaluation method Report and attendance					
8. Textbook and references Recent papers are given within class.					
9. Self study Review is required.					
10. Practical business					
11. In addition Office phone number: 022-757-4151 Mail address: haruka.suzuki.a6@tohoku.ac.jp					

Subject	Current topics of Fish Ecology (先端海洋生物生態学)	Day/Period	2nd quarter Thur. 1st ~2nd	Object	AMB
Instructor (Post)	H. Murakami (Assistant Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)	Credits	1	Semester	7
		Language Used in Course	English		
Subject Numbering	ABS-APS364E				
1. Class subject Current topics of Fish Ecology					
2. Object and summary of class This course covers the fish ecology and fish biodiversity in the marine ecosystem, using environmental DNA.					
3. Keywords Environmental DNA, Fish Ecology, Climate change, Marine ecosystem					
4. Goal of study Through this course, students will be able to understand fish ecology and the methods for ecological study, environmental DNA in particular.					
5. Contents and progress schedule of class 1 Overview of fish ecology 2 The methods for ecological study 3 What is environmental DNA (eDNA)? 4 eDNA metabarcoding for biodiversity monitoring 5 Species-specific methods of eDNA for biomass estimation 6 Application of eDNA for ecosystem conservation 7 Application of eDNA for fisheries management					
6. Preparation No need.					
7. Record and evaluation method Attendance and participation during lectures (10%), assignments (30%), and reports (60%)					
8. Textbook and references Miya, M. (2022). Environmental DNA metabarcoding: a novel method for biodiversity monitoring of marine fish communities. Annual review of marine science, 14, 161-185.					
9. Self study No need.					
10. Practical business No need.					
11. In addition If you have any questions, contact Assistant Prof. Hiroaki Murakami by E-mail (hiroaki.murakami.d2@tohoku.ac.jp) or Prof. Satoshi Katayama by E-mail (satoshi.katayama.c5@tohoku.ac.jp).					

Subject	Current topics of Plankton Biology (先端プランクトン学)	Day/Period	1 st quarter Tue./1 st ~2 nd	Object	AMB
Instructor (Post)	G. Nishitani (Asso. Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	7
Subject Numbering	ABS-APS369E			Language Used in Course	English
1. Class subject Molecular Ecology and utilization of plankton					
2. Object and summary of class Plankton is a very small organism and its morphology cannot be observed without using a microscope. However, plankton is one of the most important components and significantly contributes to the marine ecosystem. In this class, several researches on utilization of plankton and its ecology using the latest molecular techniques will be introduced.					
3. Keywords Phytoplankton, Useful and harmful species, Molecular ecology					
4. Goal of study Students will learn that molecular methods are effective and are important tools for plankton research. Moreover, students will also understand the utilization of plankton for industry and human health.					
5. Contents and progress schedule of class Useful microalgae (phytoplankton) (2) Harmful microalgae (2) Research introduction (2) Report					
6. Preparation Understand an outline of each topic in advance					
7. Record end evaluation method Attendance and examination					
8. Textbook and references All handouts will be given within class					
9. Self study					
10. In addition E-mail: ni5@tohoku.ac.jp					

Subject	Multidisciplinary Internship (学際インターンシップ)	Day/Period	Intensive course	Target	FGL students
Instructor	Katayama S. (Professor)	Categories	Specialized Subjects	Credits	1
				Semester	5th Semester
Position	Faculty of Agriculture				
1. Class subject					
Introduction of Japanese fisheries and aquaculture productions and seafood processing.					
2. Object and summary of class					
Japan is well-known for fisheries and aquaculture production. The objective of the class is for international students to gain an understanding of fisheries production systems. Students taking this course will take interests in the traditional and recent art and technologies of fisheries, aquaculture, distributing, processing and eating fish and shellfish in Japan.					
3. Goal of study					
Students will:					
1. learn about the distribution system for raw marine organisms landed at the fish market.					
2. understand operations of the seafood processing industry.					
3. discover Japanese excellent techniques of fish aquaculture and its seedling production.					
4. Contents and progress schedule of class					
This class will consist of two site visits. Each half-day visit will take place at a fishery site in Miyagi Prefecture. (Two field trips on Saturdays of June)					
5. Record end evaluation method					
Attendance, participation, and a report					
6. Preparation					
Detailed schedule will be provided in May.					
7. Contact					
skata@tohoku.ac.jp (Prof. Satoshi KATAYAMA)					

Syllabus of “Science, Technology, and Industry in Japan” in Fall 2023 (SB4792, TB14141, ABG3041)

Time & Classroom: Tuesday 4th period (14:40-16:10), **in A204***

Most of the classes will be conducted in person in the classroom above.

Google Classroom: “2023 Science, Technology, and Industry in Japan (**for 3 FGL undergraduate courses**)”

URL: <https://classroom.google.com/c/NTIzODAwMDQ4OTQx>

Class Code: 5b74ehh

Meet Link: <https://meet.google.com/arn-pxpj-wws>

Zoom Link: <https://zoom.us/j/98044498012?pwd=QTRMZm4rQjBYcHBxSHRYblhRT0gyZz09>

Meeting ID: 980 4449 8012

Passcode: 492448

Course coordinator: Yumiko Watanabe (yumiko.watanabe.a5@tohoku.ac.jp) at Global Learning Center.

Office: “GLC6” in the International Exchange Building (A12 on the Kawauchi campus map)

Course Title: Science, Technology, and Industry in Japan

Course Subject: The past, present, and future of industry, science, and technology and their relationships and integration in Japan

Language: English

Aim and outline:

This specialized subject course (**one credit**) is a multidisciplinary course that has been organized by the faculties of science, engineering, and agriculture since 2016. Except for the first class, each class will feature a lecture by a specialist in his field. The topic of each lecture will be related to the science, technology, and industry, and their relationships in Japan and the globe”. The topics also include issues and efforts in specific fields of industry to implement the 17 SDGs (Sustainable Development Goals) announced by the United Nations in 2016.

Students will learn how science, technology, and industry in different fields were integrated and developed, and how they contributed, contribute, and will contribute to our society with different cultures, and in diverse circumstances.

MEXT scholarship students in FGL courses are expected to apply what they learn from this course in another course titled “Multidisciplinary Internship” which will be offered in the spring/summer of 2024.

Goal: The goal of this course is to give students a multidisciplinary perspective and open-minded attitude in a diverse group of people with different cultural and academic backgrounds.

Schedule of the course

#1 Guidance will be given by Y. Watanabe at GLC on October 3, 2023.

#2-8 lectures by guest speakers will be given as listed in the table below.

#3 lecture by Dr. Ebina on **October 31 starts at 16: 20.**

Oct. 3	渡邊由美子 (Yumiko WATANABE)	東北大学・GLC
Oct. 10	山田 幹也氏 (Mikiya YAMADA)	(株) みずほ証券 (Mizuho Securities)
Oct. 17	佐藤 實氏 (Minoru SATO)	東北大学名誉教授・(株) スマートハンドレッド Emeritus Professor at Tohoku University ・ COE of Smar100
Oct. 24	野田 智之氏 (Tomoyuki NODA)	(株) 国際電気通信基礎技術研究所 (ATR: Advanced Telecommunications Research Institute International)
Oct. 31 (16:20)	蛸名 武雄氏 (Takeo EBINA)	(国研) 産業技術総合研究所 (AIST: Advanced Industrial Science & Tech.)
Nov. 7	藤森 俊郎氏 (Toshiro FUJIMORI)	(株) IHI (IHI, Corp.)
Nov. 14	富田二三彦氏 (Fumihiko TOMITA)	(国研) 情報通信研究機構 (NICT: Info. & Comm. Tech.)
Nov. 21	佐藤 陽一氏 (Yoichi SATO)	(株) 理研食品 (Riken Food)

Evaluation method:

- ❖ Attendance, active participation during the class including the submission of a short essay on each lecture **(70%)**

The length of the short essay is expected to be approximately one A4 page (~500 words) using 12-point "Times New Roman" font. You may want to write what you learned from the lectures and the situation of the lecture topic in your home country.

Please save your file with a name including your **student ID** and the **date** of the class in **"docx"** or **"doc"** format. This rule applies to the final report as well.

C2SBxxxxDATE (e.g., 1010 for DATE of October 10)

C2TBxxxxDATE

C2ABxxxxDATE

The deadline for submitting an essay to the classroom is **noon (JST) every next Monday after the class.**

- ❖ Submit an essay (~1,000 – 1,200 words) about the most important matter in achieving sustainable development in your home country or any specific region in the globe you **learned from this series of lectures. (30%)**

The deadline for this report is **noon (JST) on Wednesday, December 20, 2023.**

Note: Late submission of an essay and a summary may result in a lower score on your work. A long delay (more than 1 week) without a reasonable reason will be considered to be a failure of the submission, and no scores will be given.

Misc.: If you cannot attend a class for any reason, please email the coordinator of this course (yumiko.watanabe.a5@tohoku.ac.jp) as soon as you know you will be absent.