AMB Course Syllabus

- 2019～2020 -

Faculty of Agriculture

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Please Note : Anything contained on this syllabus may be subject to change at the discretion of the instructor.

Timetable for AMB Course　AMB コース授業時間割表

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.	情報基礎B An Introduction to Information Science B	地球物質科学 Mineralogy, Petrology & Geochemistry	線形代数学概要 Foundations of Linear Algebra	生命と自然 Life and Nature	Basic Japanese 1
		Tues.	経済学 Economics	生命科学 A Biology A	スポーツA Sports A	物理学A(未修者クラス) Physics A (Beginner)	Basic Japanese 1
		Wed.	歴史と人間社会 History and Human Society	化学A Chemistry A	(Labo. Tour)		
		Thur.	(If applicable) Supplementary lessons of Calculus	芸術の世界 World of Fine Arts	化学B Chemistry B	体と健康 Health	Basic Japanese 1
		Fri.		生理・生態学概論 Introduction to Physiology and Ecology	解析学概要 Foundations of Calculus	物理学A(既修者クラス) Physics A (Advanced)	Basic Japanese 1
3rd Semester	前期 Spring Semester	Mon.					
		Tues.		生命科学 B Biology B			Basic Japanese 2
		Wed.	物理学 C Physics C	Basic Japanese 2	化学 C Chemistry C	生命科学 C Biology C	歴史学 History
		Thur.		物理学 B Physics B	~~自然科学総合実験~~ ~~Introductory Science Experiments~~		Basic Japanese 2
		Fri.	水圏無脊椎動物学 Aquatic Invertebrate Biology 【Lecture Room 8】 ***First Half Semester***		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		基礎ゼミ Introductory Seminar		
4th Semester	後期 Fall Semester	Mon.			水産遺伝育種学 Fish Genetics and Breeding science 【Lecture Room 9】		
		Tues.		Intermediate Japanese	Intermediate Japanese	日本の産業と科学技術 Science, Technology and Industry in Japan	
		Wed.	Intermediate Japanese	数理統計学 Probability & Statistics			
		Thur.		海洋生物学 Marine Biology 【Lecture Room 10】	自然科学総合実験 Introductory Science Experiments		
		Fri.		水産科学概論 Introduction to Fisheries Science 【Lecture Room 9】			
5th Semester	前期 Spring Semester	Mon.	資源動物生態学 Animal Ecology and Ethology 【Lecture Room 9】 ***First Half Semester***		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.					
		Wed.	プランクトン学 Planktology 【Lecture Room 9】	水産化学 Marine Biochemistry 【Lecture Room 9】			
		Thur.			科学論文講読 I Reading of Scientific Paper I 【Each Laboratory】		
		Fri.	水圏無脊椎動物学 Aquatic Invertebrate Biology 【Lecture Room 8】***First Half Semester*** 水族生理生態遺伝学 Integrate Aquatic Biology 【Lecture Room 8】***Second Half Semester***		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】		
		Intensive course	生産フィールド実習 I Field Practice of Marine Production I ／ 学際インターンシップ Multidisciplinary Internship				

			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.		水産利用学 Marine Product Technology 【Lecture Room 10】	学生実験 II･基礎化学実験･基礎生物学実験 Fishery Science Practice II/Basic Chemistry, Practice/Basic Biology, Practice 【Student Laboratory】		
		Tues.	水産資源生態学 Fisheries Biology and Ecology 【Lecture Room 9】	水圏植物生態学 Aquatic Plant Ecology 【Lecture Room 9】			
		Wed.	生物海洋学 Biological Oceanography 【Lecture Room 9】	海洋生物工学 Marine Biotechnology 【Lecture Room 10】			
		Thur.	資源生物生理学 Physiology of Biological Resources 【Lecture Room 10】	水圏植物学 Applied Aquatic Botany 【Lecture Room 9】	科学論文講読 II Reading of Scientific Paper II 【Each Laboratory】	生物生産情報処理概論 An Introduction to Bioindustrial Information Processing 【Lecture Room 10】	
		Fri.	沿岸生物学 Applied Genetics in Aquatic Organisms 【Lecture Room 10】 ***Second Half Semester***		学生実験 II･基礎化学実験･基礎生物学実験 Fishery Science Practice II/Basic Chemistry, Practice/Basic Biology, Practice 【Student Laboratory】		
7th Semester	前期 Spring Semester	Mon.			実地研修 Practical Training		
		Tues.	水産食品管理学 Seafood Management 【Lecture Room 9】	水産増殖学 Aquacultural Biology 【Lecture Room 9】			
		Wed.	~~水圏無脊椎動物学~~ ~~Aquatic Invertebrate Biology~~ ~~【Lecture Room 10】~~	先端植物生命科学 Current topics of Agricultural Plant Science 【Lecture Room 10】	先端海洋生物生態学 Current topics of Fish Ecology 【Lecture Room 10】	先端海洋生物化学 Current topics of Fish Biochemistry 【Lecture Room 10】	
		Thur.	先端海洋生物生理学 Current topics of Shellfish Physiology 【Lecture Room 10】	食糧と化学 Food and Chemistry 【Lecture Room 10】	先端沿岸生態学 Current topics of Coastal Ecology 【Lecture Room 10】	~~先端海洋生物遺伝学~~ ~~Current topics of Genetics in Aquatic organisms~~ ~~【Lecture Room 10】~~	
		Fri.	水圏無脊椎動物学 Aquatic Invertebrate Biology 【Lecture Room 8】 ***First Half Semester***		応用動物･酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 10】 ***First Half Semester***	先端海洋分子生物学 Current topics of Fish Molecular Biology 【Lecture Room 10】	
				応用動物･酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 10】 ***Second Half Semester***	先端プランクトン学 Current topics of Plankton Biology 【Lecture Room 10】 ***Second Half Semester***		
		Intensive course	生産フィールド実習 II Field Practice of Marine Production II ／ 海洋応用生物化学 Marine Applied Biochemistry				
8th Semester	後期 Fall Semester	Mon. to Fri.	卒業論文 Graduation Thesis				
9th Semester	前期 Spring Semester	Mon.					
		Tues.					
		Wed.	卒業論文 Graduation Thesis	先端植物生命科学 Current topics of Agricultural Plant Science 【Lecture Room 10】	卒業論文 Graduation Thesis		
		Thur.		食糧と化学 Food and Chemistry 【Lecture Room 10】			
		Fri.		応用動物･酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 10】 ***Second Half Semester***	応用動物･酪農科学概論 Introduction to Applied Animal and Dairy Science 【Lecture Room 10】 ***First Half Semester***		
		Intensive course	海洋応用生物化学 Marine Applied Biochemistry				

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	
World of Fine Arts 芸術の世界	M. Haga	1st	General Education Core Subjects Human Studies	2		
History and Human Society 歴史と人間社会	M. Nakagawa	1st	General Education Core Subjects Social Studies	2		
Life and Nature 生命と自然	M. Robert	1st	General Education Core Subjects Science Studies	2		
History 歴史学	M. Haga	1st	General Education Expansion Subjects Human Sciences	2		
Linguistics 言語学		1st	General Education Expansion Subjects Human Sciences		2	2020年度開講なし
Economics 経済学	D. Qin	1st	General Education Expansion Subjects Social Sciences	2		
Foundations of Calculus 解析学概要	F. Hansen	1st	General Education Expansion Subjects Natural Sciences/Mathematics	2		
Foundations of Linear Algebra 線形代数学概要	F. Hansen	1st	General Education Expansion Subjects Natural Sciences/Mathematics	2		
Probability & Statistics 数理統計学	F. Hansen	2nd	General Education Expansion Subjects Natural Sciences/Mathematics	2		
Physics A 物理学A	T. Koike	1st	General Education Expansion Subjects Natural Sciences/Physics	2		
Physics B 物理学B	T. Koike	1st	General Education Expansion Subjects Natural Sciences/Physics		2	
Physics C 物理学C	T. Koike	1st	General Education Expansion Subjects Natural Sciences/Physics		2	
Chemistry A 化学A	N. U. Zhanpeisov	1st	General Education Expansion Subjects Natural Sciences/Chemistry	2		
Chemistry B 化学B	N. U. Zhanpeisov	1st	General Education Expansion Subjects Natural Sciences/Chemistry		2	
Chemistry C 化学C	N. U. Zhanpeisov	1st	General Education Expansion Subjects Natural Sciences/Chemistry	2		
Biology A 生命科学A	M. Robert	1st	General Education Expansion Subjects Natural Sciences/Biology	2		
Biology B 生命科学B	M. Robert	1st	General Education Expansion Subjects Natural Sciences/Biology	2		
Biology C 生命科学C	M. Robert	1st	General Education Expansion Subjects Natural Sciences/Biology	2		Substitute for Modern Scholarship 現代学問論読替
Mineralogy, Petrology & Geochemistry 地球物質科学	N. U. Zhanpeisov	1st	General Education Expansion Subjects Natural Sciences/Earth and Space Science	2		
Introductory Science Experiments 自然科学総合実験	N. Nakamura et al.	1st	General Education Expansion Subjects Natural Sciences/Scientific Experiments	2		
Introductory Seminar 基礎ゼミ	IIE Teacher	1st	General Education Common Subjects Small-Group Freshmen Seminars	2		Intensive course 集中講義
Basic Japanese 1	N. Sugaya et al.	1st	General Education Common Subjects Subjects for International Students	4		
Basic Japanese 2	N. Sugaya et al.	1st	General Education Common Subjects Subjects for International Students	3		
Intermediate Japanese	A. Uchiyama et al.	2nd	General Education Common Subjects Subjects for International Students	3		You may instead select 3 subjects (3 credits) from the General Education Japanese A-J classes.
An Introduction to Information Science B 情報基礎B	S. Isobe et al.	1st	General Education Common Subjects Information Sciences	2		Substitute for Intro Info Sci A 情報基礎A読替
Sports A スポーツA	T. Fujimoto et al.	1st	General Education Common Subjects Health Sciences	1		
Health 体と健康	R. Nagatomi	1st	General Education Common Subjects Health Sciences	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	C. Yonezawa et sl.	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	The field of all App Mar Biol　全分野	2nd	Specialized Subjects Faculty Common Subjects	1		Joint class 日本人と共修

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Reading of Scientific Paper II 科学論文講読II	The field of all App Mar Biol 全分野	3rd	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 & T. Yorisue	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	3rd	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 水産遺伝育種学	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	The field of all App Mar Biol 全分野	2rd	Specialized Subjects Academic Common Subject	4		Joint class 日本人と共修
Fishery Science Practice II 学生実験 II	The field of all App Mar Biol 全分野	3rd	Specialized Subjects Academic Common Subject	6		Joint class 日本人と共修
Basic Chemistry, Practice 基礎化学実験	The field of all App Mar Biol 全分野	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	The field of all App Mar Biol 全分野	2nd 3rd	Specialized Subjects Academic Common Subject	1		Joint class 日本人と共修
Aquacultural Biology 水産増殖学	M. Osada	3rd	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	Y. Agatsuma	3rd	Specialized Subjects Academic group Common Subject	2		
Marine Biochemistry 水産化学	Y. Ochiai	2nd	Specialized Subjects Academic group Common Subject	2		
Biological Oceanography 生物海洋学	Y. Endo	3rd	Specialized Subjects Academic group Common Subject	2		
Marine Biotechnology 海洋生物工学	T. Suzuki	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. Takahashi	1st	Specialized Subjects Technical field Subjects		2	
Applied Aquatic Botany 水圏植物学	M. Aoki	3rd	Specialized Subjects Technical field Subjects		2	
Marine Product Technology 水産利用学	T. Yamaguchi	3rd	Specialized Subjects Technical field Subjects		2	
Seafood Management 水産食品管理学	Cheryl Ames	3rd	Specialized Subjects Technical field Subjects		2	
Planktology プランクトン学	W. Sato-Okoshi	2nd	Specialized Subjects Technical field Subjects		2	
Integrate Aquatic Biology 水族生理生態遺伝学	M. Ikeda	2nd	Specialized Subjects Technical field Subjects		2	
Marine Applied Biochemistry 海洋応用生物化学	M. Nishikawa	3rd or 4th	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	Y. Ochiai et al	2nd	Specialized Subjects Current subject	2		
Practical Training 実地研修	W. Sato-Okoshi	3rd	Specialized Subjects Current subject	1		
Marine Biology 海洋生物学	Cheryl Ames	2nd	Specialized Subjects Current subject	2		
Current topics of Agricultural Plant Science 先端植物生命科学	Y. Kitashiba et al.	3rd or 4th	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	T. Sumita et al.	3rd or 4th	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	H. Yoneyama et al.	3rd or 4th	Specialized Subjects Current subject	2		Every other year 隔年開講
Applied Biological Chemistry 応用生物化学	S. Kuwahara et al.	3rd or 4th	Specialized Subjects Current subject	2		Every other year 隔年開講
Food and Chemistry 食糧と化学	Y. Tanaka et al.	3rd or 4th	Specialized Subjects Current subject	2		Every other year 隔年開講

Subjects	Instructors	year	Categories	Credits		Reference
				Obligatory	Elective	
Current topics of Shellfish Physiology 先端海洋生物生理学	K. Nagasawa		Specialized Subjects Current subject		1	
Current topics of Fish Ecology 先端海洋生物生態学	K. Kinoshita	3rd	Specialized Subjects Current subject		1	
Current topics of Fish Biochemistry 先端海洋生物化学	T. Nakano	3rd	Specialized Subjects Current subject		1	
Current topics of Genetics in Aquatic organisms 先端海洋生物遺伝学	T. Yorisue	3rd	Specialized Subjects Current subject		1	
Current topics of Coastal Ecology 先端沿岸生態学	E. Inomata	3rd	Specialized Subjects Current subject		1	
Current topics of Fish Molecular Biology 先端海洋分子生物学	H. Yokoi	3rd	Specialized Subjects Current subject		1	
Current topics of Plankton Biology 先端プランクトン学	G. Nishitani	3rd	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	
Science, Technology and Industry in Japan 日本の産業と科学技術	Y. Watanabe	2nd	Specialized Subjects		1	
Multidisciplinary Internship 学際インターンシップ	S. Katayama et al.	2nd	Specialized Subjects		1	Intensive course 集中講義

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 113 credits from obligatory subjects 必修科目 113 単位以上
2. A minimum of 21 credits from elective specialized subjects 専門選択科目21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
Core Subjects 基幹科目	Human Studies 人間論 Social Studies 社会論 Science Studies 自然論	2 2 2
	Subtotal	6
Expansion Subjects 展開科目	Human Sciences 人文科学 Social Sciences 社会科学 Natural Sciences 自然科学	2 2 22
	Subtotal	26
Common Subjects 共通科目	Japanese 日本語 Introductory Seminar 基礎ゼミ Information Sciences 情報科目 Sports スポーツ Health Care 体と健康	10 2 2 1 2
	Subtotal	17
Total		**49**

Cooperative Innovation Program in Science, Engineering, and Agriculture for Leading Sustainable Industry and Society

（持続可能で多様な産業・社会を先導する理・工・農学協働イノベーションプログラム）

Those who enter FGL as government-sponsored students will also belong to this program.
In addition to the AMB curriculum, the government-sponsored students will be required to take four subjects below in order to fulfill the program requirements (i.e. requirements for receiving government sponsorship).

1. Introductory Seminar (Interdisciplinary Seminar) [2 credits]
   — General Education Subjects
2. Life and Nature (Study of Nature, Life and Technology) [2 credits]
   — General Education Subjects
3. Science, Technology and Industry in Japan [1 credit]
   — Specialized Subjects
4. Multidisciplinary Internship [1 credit]
   — Specialized 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)		*21 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 21 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	14			
Technical Field Subjects 専門領域科目	0	(17)		
Current Subjects カレント科目	15	(7)		
Total	**64**	**21**	**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
4th Semester	Obligatory Elective	4 2
5th Semester	Obligatory: Including Field Practice of Marine Production 生産フィールド実習を含む Elective	16 6
6th -7th Semester	Obligatory: Including Field Practice of Marine Production 生産フィールド実習を含む Elective	16 29
8th-9th Semester	Obligatory: Graduation Thesis	10
Related Subjects		
Total		**90**

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)	Ikeda M. (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-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 costal 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 relationship between natural biological productivity and human activity. Field lecture will be held on April in Onagawa Town with a two-day trip. Classroom lecture will be held on May or June at Aobayama Campus.

3. Keywords

marine biodiversity, fisheries, aquaculture, tsunami disaster, reconstruction,

4. Goal of study

At the end of the semester, students will
-understand about tsunami disaster.
-understand the importance of 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

- 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)
- 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

- Attendance: 40%
- Activeness: 20%
- Report: 40%

8. Textbook and references

Preparing textbook

9. Self study

None

10. In addition

Contact e-mail address:

- 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 filed 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 (40%)
Attendance and participation for classes (30%)
Report about field trip (30%)

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. In addition

Field trip will be held in May (Fri.), 8:00 - 18:30. Gathering Spot is Aobayama Campus (Faculty of Agriculture Building).
Please carry rain cape, protection against cold weather, insurance card and lunch to field trip.
E-mail address: chinatsu@m.tohoku.ac.jp

Subject	Modern Agriculture and Agricultural Science（現代における農と農学）	Day/Period	Fri./3rd	Object	AMB
Instructor (Post)	Professors, Associated Prof. and Assistant Prof.	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

1. Class subject

Grasp of problems according to water, foods, energy, biomaterials, environment and health

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 20 laboratories (about the half numbers 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 others.

3. Keywords

4. Goal of study

At the end of the semester, students will

-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.

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.

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

6. Preparation

7. Record end evaluation method

Students must be attend the laboratory tour more than 60% and take an examination (40%) of the last day.

8. Textbook and references

Textbook and references will be notified at the class.

9. Self study

10. 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: skata@tohoku.ac.jp

Subject	Introduction to Physiology and Ecology（生理・生態学概論）	Day/Period	Fri./2nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Assoc. 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 animal and plant physiology.**

2. Object and summary of class: A beginner course in the basics of physiology. Students will gain a broad basic knowledge of Animal life, including nervous and neuroendocrine systems and their functional organization within broad ecological settings. Students will also gain an understanding of aspects of plant life, including functional organization, nutrition, movement, and growth.

3. Keywords: Nervous system, life functions, hormones, plant biodiversity, photosynthesis, immune systems

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. Methods used in this lecture course. Basic principles of animal physiology. Cell function, metabolism and management.
(2). The nervous system. 1. Neuron structure & function.
(3). The nervous system. 2. Sensory systems.
(4). The nervous system. 3. Functional organization.
(5). The endocrine system. 1. Cell signaling and endocrine regulation.
(6). The endocrine system. 2. Oogenesis, spermatogenesis & fertilization.
(7). The endocrine system. 3. Reproductive hormones.
(8). The immune system.
(9). Mid-term review and examination.
(10). Plant Biodiversity. The algae and development of plant life from anaerobic organisms to oxygen-utilizing plants. Seaweed ecology: zonation and succession. Geographical distribution.
(11). Plant physiology. 1. Plant morphogenesis, growth & specialization.
(12). Plant physiology. 2. Plant nutrition & metabolism. Photosynthesis.
(13). Plant physiology. 3. Plant body. Plant material production. Uses and usage of marine plants.
(14). Plant body defenses, environmental responses & information transmission.
(15). End-of-term 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):
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; Levinton, JS (2017). Marine Biology: Function, Biodiversity, Ecology. ISBN-13: 978-0190625276. 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. Student 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. 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.

Subject	An Introduction to Bioindustrial Information Processing （生物生産情報処理概論）	Day/Period	Thur./4th	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. 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	Thur./3rd	Object	AMB
Instructor (Post)	Professors from all the fields of AMB (Prof. & Assoc. Prof.)	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

Reading scientific papers in English

2. Object and summary of class

The purpose of the course is to let students understand the composition and critical reading of scientific paper.

3. Keywords

Critical reading, discussion

4. Goal of study

Students will
- have practical capability to read scientific paper in marine biology.
- have knowledge of technical terms on studying field of marine biology.

5. Contents and progress schedule of class

The course will be conducted by AMB laboratories.
- Students will take a class in each laboratory three to four times
- Scientific paper to read will be provided from each laboratory
- The format of a class follows an instruction of instructor of each laboratory

6. Preparation

Read the parts to be dealt in each class in advance.

7. Record end evaluation method

The academic achievement will be evaluated by attendance and understanding of class subject of each laboratory.

8. Textbook and references

Scientific paper to read will be provided by each laboratory in advance and students may be recommended to prepare well.

9. Self study

Read the related scientific articles in each field.

10. In addition

Students may visit the instructor of each class anytime.

Subject	Reading of Scientific Paper II （科学論文講読 II）	Day/Period	Thur./3rd	Object	AMB
Instructor (Post)	Professors from all the fields of AMB (Prof. & Assoc. Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	6
Subject Numbering	AAL-APS302B			Language Used in Course	English/Japanese

1. Class subject

Reading scientific papers in English

2. Object and summary of class

The purpose of the course is to let students understand the composition and critical reading of scientific paper.

3. Keywords

Critical reading, discussion

4. Goal of study

Students will
- have practical capability to read scientific paper in marine biology.
- have knowledge of technical terms on studying field of marine biology.

5. Contents and progress schedule of class

The course will be conducted by AMB laboratories.
- Students will take a class in each laboratory three to four times
- Scientific paper to read will be provided from each laboratory
- The format of a class follows an instruction of instructor of each laboratory

6. Preparation

Read the parts to be dealt in each class in advance.

7. Record end evaluation method

The academic achievement will be evaluated by attendance and understanding of class subject of each laboratory.

8. Textbook and references

Scientific paper to read will be provided by each laboratory in advance and students may be recommended to prepare well.

9. Self study

Read the related scientific articles in each field.

10. In addition

Students may visit the instructor of each class anytime.

Subject	Practice on Marine Bio-resources Science（臨海実習）	Day/Period	Intensive Course	Object	AMB
Instructor (Post)	Ikeda M. (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-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 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

Four days in 2nd semester (August)

- Days 1-2:Field trip to the rocky intertidal area and survey the biodiversity.
- Days 3-4: Observation of early development of marine invertebrates.

6. Preparation

For more information, note our announcement on June or July.

7. Record end evaluation method

- Attendance: 40%
- Activeness: 20%
- Report: 40%

8. Textbook and references

Preparing textbook

9. Self study

None

10. In addition

Contact e-mail address:

- Ikeda: minoru.ikeda.a6@tohoku.ac.jp

Subject	Physiology of Biological Resources （資源生物生理学）	Day/Period	Thur./1st	Object	AMB
Instructor (Post)	Cheryl L Ames (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-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 organisms to stay alive and reproduce within a host of environments that often differ significantly from their internal states.

3. Keywords: Neuroendocrinology, reproduction, osmoregulation, immunology.

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, osmoregulation and immunology.

5. Course contents and class schedule
(1-4) Neuroendocrinology.
Definition of neuroendocrinology and classification of chemical transmitters. Reception by target cells. Process of receptor cell receipt and information transmission. Neuroendocrine organs and the hormones they secrete.
(5-9) Endocrinology of reproduction.
Reproduction and determination of sex. Gonad structure and the development of gametes. Mutual and quantitative relationships of the sex hormones. Sex, reproduction and the environment. Control of sex and maturity, control of spawning.
(10). Mid-term review.
(11-12). Osmoregulation.
Significance of the control of osmotic pressure and the function of the regulatory cells. Mechanisms of the hormonal control of osmoregulation.
(13-14). Immunology.
Natural immunity and the recognition and removal of foreign material from the body. Vertebrate and invertebrate immune systems.
(15). End-of-term report/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. Student 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. 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.

Subject	Animal Ecology and Ethology (資源動物生態学)	Day/Period	Mon./2nd	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. Clasification (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
6. Interspecific relationships (competition, predation etc.), Gause's Law
7. Population; definition, mode of life, population growth models, r-K strategy
8. Category of interspecific relationships (competition, predation etc.), Gause's Law
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. Furthermore, submissions of short term papers are required several times in the course.

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. In addition

Office hour for inquiry about the course should be offered any time at the Laboratory of Fisheries Biology and Ecology.
E-mail: skata@tohoku.ac.jp

Subject	Fish Genetics and Breeding science （水産遺伝育種学）	Day/Period	Mon./3rd	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 the aquatic organisms, not only genetics in individual level but also population level is important. Because, the position of conservation in genetic resources has 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

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

Basic theory of inheritance

1) Basic theory and various mode of inheritance
2) Genetic variations
3) Linkage and recombination
4) Basic theory of genetics in population
5) Genetic drift and inbreeding
6) Natural selection
7) Population structure and genetic diversity of population
8) Genetic markers for the analysis of populations and quantitative traits

Basic theory of genetic improvement

9) Basic theory of inheritance in quantitative traits
10) Heritability and breeding value
11) Basic theory of selection
12) Heterosis and hybrid vigor
13) Genetic improvement by recombinant DNA

6. Preparation

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
Principles of population genetics, D. L. Hartl and A. G. Clark, Sinauer Associates, Inc., Massachusetts
Conservation and the Genetics of Populations, F. W. Allendorf and G. Luikart, Blackwell Publishing, Oxford, 2007

9. Self study

10. 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)	Ikeda M. (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	5&7
Subject Numbering	ABS-APS406B			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 importance of marine biodiversity.

(1) Observation and analysis of marine biodiversity.
(2) Analysis of genetic diversity in marine organisms.
(3) Comparative observation of early development and morphogenesis of marine invertebrates.

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 species/genetic diversity and development of marine organisms.

5. Contents and progress schedule of class

Five days in 4th semester (August)

- Days 1-2: Quantitative and qualitative of marine biodiversity.
- Days 3-4: Observation of early development of marine invertebrates.
- Day 5: Presentation

Five days in 6rd semester (August)

- Days 1-2: Quantitative and qualitative of genetic diversity in marine organisms.
- Days 3-4: Observation of morphogenesis of marine invertebrates.
- Days 5: Presentation

6. Preparation

For more information, note our announcement on June or July.

7. Record end evaluation method

- Attendance: 40%
- Activeness: 20%
- Report: 40%

8. Textbook and references

Preparing textbook

9. Self study

None

10. In addition

Contact e-mail address:

- Ikeda: minoru.ikeda.a6@tohoku.ac.jp

Subject	Fishery Science Practice I･II （学生実験Ⅰ・Ⅱ）	Day/Period	Mon.-Wed. & Fri./3rd & 4th	Object	AMB
Instructor (Post)	Professors from all the fields of AMB (Prof. & Assoc. Prof.)	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-APS308J/AAL-APS309J			Language Used in Course	Japanese

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

Experiments, anatomy, microscopy, 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

Understand the materials and methods to be used in each class in advance.

7. Record end evaluation method

Students should attend every experiments and absence is not acceptable for any reason. Students should submit report of each by the deadline suggested in each experiment. The academic achievement will be evaluated by attendance and submitted report through entire period.

8. Textbook and references

Text for the course will be provided and students may be recommended to prepare well.

9. Self study

Refer to related books in the library for writing reports.

10. In addition

Students may visit the instructor of each experiment anytime.

Subject	Basic Chemistry, Practice （基礎化学実験）	Day/Period	Mon.-Wed. & Fri./3rd & 4th	Object	AMB
Instructor (Post)	Y. Ochiai et al. (Prof., Assoc. Prof., Assistant Prof.)	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-APS310J			Language Used in Course	Japanese

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

Understand the materials and methods to be used in each class in advance.

7. Record end evaluation method

Students should attend every experiment and absence is not acceptable for any reason. Students should submit a report on each theme by the required deadline. Academic achievement will be evaluated by attendance and grading of all reports submitted .

8. Textbook and references

Texts for the course will be provided.

9. Self study

Refer to related books in the library for writing reports. Prepare well before attending each practical.

10. In addition

Students may visit the instructor of each experiment any time.

Subject	Basic Biology, Practice （基礎生物学実験）	Day/Period	Mon.-Wed. & Fri./3rd & 4th	Object	AMB
Instructor (Post)	Y. Ochiai et al. (Prof., Assoc. Prof., Assistant Prof.)	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-APS311J			Language Used in Course	Japanese

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 before the class and understand an outline of experimental procedure in advance.

7. Record end evaluation method

Students should attend every experiments and absence is not acceptable for any reason. Students should submit report of each by the deadline suggested in each experiment. The academic achievement will be evaluated by attendance and submitted report through entire period.

8. Textbook and references

Text for the course will be provided and students may be recommended to prepare well.

9. Self study

Review the results of the experiment and summarize it in the report.

10. In addition

Students may visit the instructor of each experiment anytime.

Subject	Aquacultural Biology（水産増殖学）	Day/Period	Tues./2nd	Object	AMB
Instructor (Post)	M. Osada (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-APS341E			Language Used in Course	English

1. Class subject

Underlying concept of aquaculture and overview of projects of representative aquaculture

2. Object and summary of class

Restoration of natural fishery resources and growth of fish products is an urgent issue to be resolved in aquaculture. The purpose of this class is to let students understand the concept of aquaculture and specific aquaculture projects.

3. Keywords

Teleost, Crustacea, Bivalve, Natural seed, Artificial seed

4. Goal of study

Students will

- cognize the importance of aquaculture for restoration and growth of fishery product.
- have knowledge of specific issues on aquaculture.

5. Contents and progress schedule of class

- Concept of aquaculture 1
- Concept of aquaculture 2
- Salmon 1 (life cycle)
- Salmon 2 (artificial seed production and release)
- Yellowtail 1 (life cycle)
- Yellowtail 2 (natural seed collection and farming)
- Flounder 1 (life cycle)
- Flounder 2 (artificial seed production and release)
- Kuruma Prawn 1 (life cycle)
- Kuruma Prawn 2 (artificial seed production and farming)
- Scallop 1 (life cycle)
- Scallop 2 (natural seed collection and farming)
- Oyster (natural seed collection and farming)
- Others (Pearl oyster and Bluefin tuna cultivation)
- Chromosome manipulation and sex manipulation

6. Preparation

Read textbook before the class and understand an outline of life cycle and aquaculture process of each animal in advance.

7. Record end evaluation method

The academic achievement will be evaluated by report assigned in each lecture.

8. Textbook and references

Modern methods of aquaculture in Japan Vol. 24, ed. by H. Ikenoue & T. Kafuku, Elsevier, 1992

9. Self study

Read again textbook based on the information learned at the class and review the knowledge of aquaculture.

10. In addition

Students may visit the office or contact via Email (makoto.osada.a8@tohoku.ac.jp) anytime.
URL of the lab “Aquacultural Biology’’; http://www.agri.tohoku.ac.jp/zoshoku/english.html

Subject	Fisheries Biology and Ecology （水産資源生態学）	Day/Period	Tues./1st-2nd	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
3-4. Ichthyology (External and internal morphology)
5-8. Life history (Age and growth, life cycle, migration, maturing and spawning, early life history, mortality and survival)
9. Patterns of population dynamics
10-11. Data analysis and stock assessment
12-13. Surplus yield model and yield per recruit model
14. Cohort analysis
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 and attendance

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. In addition

Contact: skata@tohoku.ac.jp

Subject	Aquatic Plant Ecology （水圏植物生態学）	Day/Period	Tues./2nd	Object	AMB/JYPE
Instructor	Y. Agatsuma (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd-year & JYPE students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	6
Subject Numbering	ABS-APS343E			Language Used in Course	English

1. Class subject

Interaction between herbivores and marine plants in coastal rocky bottoms

2. Object and summary of class

This course provides reproduction, grazing activity, population dynamics of herbivores associated with Kelp beds (forests). Students will learn marine forestation technology, and management and enhancement means of sea urchin and abalone stocks associated with their ecological characteristics.

3. Keywords

Kelp forest, Sea urchin, Barren, Grazing, Population dynamics, Production, Rocky subtidal ecosystem, Phase shift Global warming

4. Goal of study

The goal is to understand how sea urchin and abalone maintain their population associated with seaweeds beds and how enhancement means of seaweed, sea urchin and abalone were developed on the basis of biology and ecology.

5. Contents and progress schedule of class

1. Structure and function of marine forest（Oct. 2, 9）
2. Reproduction of herbivore (Oct.16)
3. Growth and gonad production of herbivore (Oct. 23)
4. Grazing activity (Oct. 30, Nov. 6)
5. Chemical defense of seaweeds (Nov. 13)
6. Mechanisms of population maintenance and fluctuation (Nov. 20)
7. Effects of sea urchin grazing on rocky subtidal communities (Nov. 27, Dec. 4)
8. Restoration of “barren” (Dec. 11)
9. Effect of ocean warming and acidification on rocky subtidal communities (Dec. 18, 25)
10. Development of enhancement means of sea urchin and abalone (Jan. 8, 15)

6. Preparation

7. Record end evaluation method

Examination, report and attendance

8. Textbook and references

Reference texts:

Lawrence JM (2013) Sea urchins: biology and ecology. Elsevier.

Schiel DR and Foster MS (2015) The biology and ecology of giant kelp forests. University of California Press

9. Self study

Review is required.

10. In addition

Questions, comments, and requests are accepted. Send them to Professor Agatsuma: yukio.agatsuma.c7@tohoku.ac.jp

Office hour: Tuesday 16:00~18:00 in Professor room of Laboratory of Marine Plant Ecology

Subject	Marine Biochemistry（水産化学）	Day/Period	Wed./2nd	Object	AMB
Instructor (Post)	Yoshihiro OCHIAI (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 inhabiting in the ocean have unique components to adapt to and survive in the environment. To utilize effectively the limited bioresources, it is essential to understand the chemical components of fish and other marine organisms and their postmortem changes. While marine organisms show beneficial effects on human health, some of them possess toxic substances and some microorganisms and parasites are responsible for food poisoning. To maximize the benefits of seafood, marine organisms should be thoroughly understood.

The class deals with the biochemical, nutritional and functional properties of the components in the organisms and the mechanisms of postharvest deterioration and health improvement. The other related topics will also be introduced.

3. Keywords

Seafood, chemical components, nutrients, physiological functions, food processing, effective utilization

4. Goal of study

To get the sufficient knowledge about the characteristics of marine organisms for biochemical viewpoint.
To understand the beneficial effects and hazardous aspects of seafood as well as the theories for preservation

5. Contents and progress schedule of class

1: Biochemical characteristics of marine organisms
2: Proximate composition of seafood
3: Proteins
4: Lipids
5: Carbohydrates
6: Vitamins
7: Minerals
8: Extractives
9: Color and flavor
10: Physical properties
11: Functional substances
12: Natural toxins and food poisoning
13: Freshness and shelf life of fish and shellfish
14: Postmortem changes in muscle
15: Report writing

6. Preparation

Collect the related information in the library and through the web

7. Record end evaluation method

Based on the final report (50%), homework (20%) and class attendance (30%).

8. Textbook and references

M. Sakaguchi: More efficient utilization of fish and fisheries products. Elsevier, 2004
I. Hamed et al.: Marine bioactive compounds and their health benefits: a review. Comp. Rev. Food Sci. Food Safety, 14, 446 (2015)

9. Self study

Read related papers published in recent years.

10. In addition

Handouts will be provided for each class.
Questions are welcome. Please feel free to step in during the office hours (after each class).

Subject	Biological Oceanography （生物海洋学）	Day/Period	Wed./1st	Object	AMB
Instructor (Post)	Y. Endo （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-APS345E			Language Used in Course	English

1. Class subject

Review marine environment and adaptive ecology of pelagic organisms that evolved in the oceans.

2. Object and summary of class

Deepen understanding of the production of plankton that live in vast and deep ocean environment based on physical and chemical characteristics of the ocean.

3. Keywords

physics, chemistry, biology, ecology, productivity, global warming

4. Goal of study

Understand pelagic environment of the oceans and adaptation of its inhabitants, regional differences, and biological oceanographic basis that support fish production

5. Contents and progress schedule of class

1, 2: History of Biological Oceanography

3-5: Physical environment

6-8: Chemical environment

9: Primary production in the oceans

10: Secondary production in the oceans

11: Relationship between phytoplankton and zooplankton

12-14: Marine plankton and global environment

15: Current topics on Biological Oceanography

6. Preparation

Acquire basic knowledge on oceans and organisms living in them.

7. Record end evaluation method

short tests and 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. In addition

mail address: yoshinari.endo.e2@tohoku.ac.jp

Subject	Marine Biotechnology（海洋生物工学）	Day/Period	Wed./2nd	Object	AMB
Instructor (Post)	T. Suzuki (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-APS346E			Language Used in Course	English

1. Class subject

1. Techniques of molecular biology
2. Developmental engineering in fish
3. Marine biotechnology for aquaculture
4. Computer practice

2. Object and summary of class

In this class, students will learn about developmental biology of fish, molecular engineering in fish, and bioinformatics using computer and web sites.

3. Keywords

Fish development, genome, genome editing, positional cloning, bioinformatics

4. Goal of study

Students will understand the fundamental issues of genetic engineering and genomics in fish, and bioinformatics necessary for future researches in the fields of marine biotechnology.

5. Contents and progress schedule of class

1-2：Embryonic development in fish
3-4: Reverse genetics (Knockout fish, CRISPR/Cas9)
5-6: Forward genetics (Mutant library, Positional cloning)
7: Other basic techniques essential for fish biotechnology
8: Fish genomes
9-12: Practical training using computer (BLAST search, Multiple alignment, Phylogenetic tree, Ensembl, PubMed)
13-14: Larval and metamorphic development
15: Transgenic fish

6. Preparation

Since texts for next week are passed, students should read them before class.

7. Record end evaluation method

Attendance and test

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. Watson JD. W. H. Freeman and Company
Developmental Biology. Gilbert SF. Sinauer Associates

9. Self study

Students are recommended to read above textbooks.

10. In addition

1. Office hour: Questions are accepted after class, or by e-mail. Students can also visit my office for questions and discussion.
2. Home Page: http://www.agri.tohoku.ac.jp/bioinfor/index-j.html
3. E-mail address: toru.suzuki.a8@tohoku.ac.jp

Subject	Applied Genetics in Aquatic Organisms（沿岸生物学）	Day/Period	Fri./1st-2nd	Object	AMB
Instructor (Post)	Minoru IKEDA (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-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 in 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 future.

In the present lecture, I will explain the importance of applied genetics for future managements 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 on your note book.

7. Record end evaluation method

Examination and Reports

8. Textbook and references

Directing on the lecture

9. Self study

10. 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	Fri./1st-2nd	Object	AMB
Instructor (Post)	Keisuke Takahashi (Associate Prof.)	Categories	Specialized Subjects	Preferable Participants	1st & 2nd & 3rd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	3&5&7
Subject Numbering	ABS-APS348E			Language Used in Course	English

1. Class subject

On the invertebrate animals distributed in aquatic environments, basic physiology, especially immunology and feeding behavior, digestive and circulatory systems and life history will be outlined.

2. Object and summary of class

To learn the innate immune systems in marine invertebrates involved in basic innate immune systems, molecular and cellular host defense and apoptosis of immune cells.
To learn trained immunity of aquatic invertebrates based on host-parasite coevolution.
To understand structures of digestive organs, and feeding and digestive mechanisms of bivalve mollusks.
To understand structures of heart and vessels, and circulatory system of bivalve mollusks.

3. Keywords

Aquatic invertebrates, Innate immunity, Host defense, Apoptosis, Digestive organs, Circulatory systems

4. Goal of study

Understanding the basic sciences in relation to immunology, feeding behavior and life history of aquatic invertebrates.

5. Contents and progress schedule of class

1st: Guidance and overview of aquatic invertebrates
2nd: Innate Immunity in Invertebrates 1: general theory of innate immunity
3rd: Innate Immunity in Invertebrates 2: general theory of innate immunity 2
4th: Innate Immunity in Invertebrates 3: cellular defense mechanisms: morphology and functions
5th: Innate Immunity in Invertebrates 4: humoral defense mechanisms: molecule types and their functions
6th: Innate Immunity in Invertebrates 5: pathogen recognition receptors (PRRs) and PAMPs
7th: Innate Immunity in Invertebrates 6: trained immunity of invertebrates: model for host-parasite coevolution
8th: A thorough review and first examination (Exam 1) of the class in the first half
9th: Feeding mechanisms of bivalve mollusks 1
10th: Feeding mechanisms of bivalve mollusks 2
11th: Feeding mechanisms of bivalve mollusks 3
12th: Digestion and nutrition in bivalve mollusks 1
13th: Digestion and nutrition in bivalve mollusks 2
14th: Circulatory system of bivalve mollusks 1
15th: Circulatory system of bivalve mollusks 2
16th: A thorough review and second examination (Exam 2) of the class in the second half

6. Preparation

You should study basic biology, especially immunology and molluscan biology, prior to class studying.

7. Record end evaluation method

Attendance point: 300 points (20 points per one lecture time; 15 times)
Examination point: 200 points (100 points per one exam)
AA=90-100%; A=80-89%; B=70-79%; C=60-69%; D=below 60%

8. Textbook and references

Brusca, R.C., 2016. Invertebrates, 1st Edition, Sinauer, Sunderland, MA.
Ruppert, E.E., , J.A. 2003. Invertebrate Zoology. A functional evolutionary approach. Brook/Cole, CA.
Murphy, K. 2016. Janeway's Immunobiology, 9th Edition. Garland Science, New York.

9. Self study

You can study yourself to use textbooks (shown as above) getting for general knowledge of this class. These textbooks are owned by the library of Tohoku University. You can use these one.

10. In addition

E-mail: waradica@tohoku.ac.jp
Office hour: 13:00-15:00 of Tuesday and Wednesday.

Subject	Applied Aquatic Botany （水圏植物学）	Day/Period	Thur./2nd	Object	AMB
Instructor (Post)	M. Aoki (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-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, *Sargassum*, 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: *Undaria pinnatifida*
(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-1
(6) Primary production of coastal marine plants-2
(7) Population analysis of marine plants-1
(8) Population analysis of marine plants-2
(9) Dispersal ability of marine plants
(10) Plant-animal interactions in benthic algae communities
(11) Mariculture
(12) Pollution
(13) Monitoring survey of marine plant communities
(14) Final examination

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

10. In addition

Office phone number: 022-757-4152
Mail address: masakazu.aoki.e6@tohoku.ac.jp

Subject	Marine Product Technology （水産利用学）	Day/Period	Mon./2nd	Object	AMB
Instructor (Post)	T. Yamaguchi (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-APS350E			Language Used in Course	English

1. Class subject

The biochemical characteristics of marine resources and the methods for their effective utilization

2. Object and summary of class

We will learn the biochemical characteristics of marine organisms as foodstuffs. We will understand the principle of production of seafood, and their processing methods.

We will have an accurate knowledge of the quality control of marine foodstuffs and seafood. So we will understand the role of marine organisms as resources for food.

And we will also learn the function of seafood for human health and the characteristics of seafood for medicinal and industrial materials.

3. Keywords

Food preservation technique, Freezing and thawing technique, Postmortem change of fish,

4. Goal of study

We will understand the principals and the methods of food processing, and the controls of food qualities. We will obtain the knowledge for the effective utilization of marine resources.

5. Contents and progress schedule of class

1 Marine resources for food
2 Characteristics marine processing foods
3 Processing principals of typical seafood
4 Food poisonings related to seafood
5 Function of marine lipids
6 Biochemical substances from marine organisms for medicinal and industrial materials

6. Preparation

It is desirable that you take a lecture on Marine Biochemistry

7. Record end evaluation method

Our final grade will be calculated according to the following process: Mid-term reports and examination (40%), term-end examination (60%), and a fraction of
in-class contribution.

8. Textbook and references

Handbook of Seafood and Seafood Products Analysis (Noliet,L.M.L., and Teldra,F, ed.) CRC Press (2010)
Handbook of Marine Natural Products vol.1, vol.2 (Fattorusso,E., Gewick,W.H. and T-Scafati,O. ed.) Springer (2012)
Seafood Processing Technology, Quality and Safety (Bosiaris,I.S. ed) Wiley Blackwell (2014)
Food Analysis (Nielsen, S.S. ed.) Springer (2010)
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.) FAPFisheries and Aquaculture Technical Paper 574 (2014)

9. Self study

10. In addition

Subject	Seafood management （水産食品管理学）	Day/Period	Tues./1st	Object	AMB
Instructor (Post)	Cheryl L Ames (Assoc. 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, problems with seafood, legal and international issues

4. Goal of study: Develop a solid understanding of methods for 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.

5. Course contents and class schedule
(1). Introduction. Seafood and seafood processing.
(2). Chemistry: Components of seafood affecting color, taste and smell.
(3). Harmful chemical (e.g., histamine, etc.) and physical substances (foreign objects) affecting food safety.
(4). Harmful biological substances (1) Parasites.
(5). Harmful biological substances (2) Bacterial & fungal infections, listeriosis, etc.
(6). Preservation of seafood products: Principles and methods.
(7). Fundamentals of hygienic practices.
(8). Review of issues related to global seafood management.
(9). Seafood management (1): Seafood handling regulations, legislation and public laws on seafood hygiene.
(10). Basic seafood handling: visit to Ishinomaki Fish Landing and Market*.
(11). Seafood management (2): Prerequisites to HACCP (Hazard Analysis and Critical Control Point).
(12). Practice of seafood management: visit to Sendai City Fish Market. *
(13). Seafood management (3): The HACCP system.
(14). Practice of HACCP: visit to a food processing company*. [Final Report].

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 must purchase or borrow a copy from campus library):
Boziaris, IS. (2014). Seafood Processing: Technology, Quality and Safety (IFST Advances in Food Science). ISBN-13: 978-1118346211. Secondary Readings: FAO, Fisheries and Aquaculture Department (various publications) http://www.fao.org/fishery/publications/en ; Food and Agriculture Organization of the United Nations (2016) 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).

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. In addition: Any questions should be addressed to the lecturer directly during or after lectures, or during office hours.
*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	Wed./1st	Object	AMB
Instructor (Post)	W. Sato-Okoshi (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, flagellate, ciliate, jelly fish, 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

Definition of plankton (1)
Historical development of planktology (1)
Marine environmental characteristics (2)
Systematics and biology of marine phytoplankton (3)
Systematics and biology of marine zooplankton (4)
Characteristics of primary production in the ocean (1)
Characteristics of secondary production in the ocean (1)
Vertical migration in zooplankton and its ecological role (1)
Current topics in marine plankton (1)

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

Biological Oceanography: An Introduction, second edition
Lalli and Parsons, 1997, ELSEVIER Butterworth-Heinemann

9. Self study

Fisheries Science

10. In addition

Contact email address: wsokoshi@tohoku.ac.jp

Subject	Integrate Aquatic Biology （水族生理生態遺伝学）	Day/Period	Fri./1st-2nd	Object	AMB
Instructor (Post)	Ikeda M. (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-APS353B			Language Used in Course	English

1. Class subject

Elementary knowledge for diversity of aquatic organisms based on genetics, evolutionary biology, ecology.

2. Object and summary of class

This course is intended to provide a framework for the study of aquatic organisms, the foundation upon which all other courses in AMB will build. Using evolution as central organizing principle, we will examine the material and processes of inheritance, the forces that drive biological diversification, and the patterns and phenomena that result from these processes.

3. Keywords

genetics, evolution, ecology, marine biodiversity, diversification, conservation

4. Goal of study

Students will be able to gain the synthetic concept for conservation and utilization of aquatic organisms based on genetics, evolutionary biology, ecology.

5. Contents and progress schedule of class

1. Introduction
2. Molecular Genetic Markers (I)
3. Molecular Genetic Markers (II)
4. Molecular Genetic Markers (III)
5. Molecular Genetic Markers (VI)
6. Molecular Identification (I)
7. Molecular Identification (II)
8. Molecular Identification (III)
9. Molecular Identification (VI)
10. DNA Barcoding (I)
11. DNA Barcoding (II)
12. DNA Barcoding (III)
13. DNA Barcoding (IV)
14. Guidance of Molecular Ecological Softwares (I)
15. Guidance of Molecular Ecological Softwares (II)

6. Preparation

None

7. Record end evaluation method

Attendance: 10%
Activeness: 10%
Final Exam: 80%

8. Textbook and references

Preparing textbook

9. Self study

None

10. In addition

Contact e-mail address:
Ikeda: minoru.ikeda.a6@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	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

2. Object and summary of class

3. Keywords

4. Goal of study

5. Contents and progress schedule of class

Further details of this subject will be announced later.

6. Preparation

7. Record end evaluation method

8. Textbook and references

9. Self study

10. In addition

Subject	Introduction to Fisheries Science （水産科学概論）	Day/Period	Fri./2nd	Object	AMB/JYPE
Instructor (Post)	Y. Ochiai, et al. (Prof.)	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 the fishery science. Students will learn the fishery science on the basis of marine biology in a broad sense from molecules to ecosystems.

3. Keywords

Fisheries science, basics & outlines

4. Goal of study

The goal is to understand the fishery science basically from ecology, physiology, genetics, molecular biology and evolution, and to appreciate the fishery science as the applied marine biology.

5. Contents and progress schedule of class

Topics on marine ecology and oceanography

Lab Marine Plant Ecology

Oct. 4 ---- “Introduction to rocky subtidal communities” (Y. Agatsuma)

Nov. 8 --- “The ecology of floating seaweeds” (M. Aoki)

Lab Fisheries Biology & Ecology

Oct. 18 --- “How to know the fish age” (S. Katayama)

Nov. 1 ---- “How to know the fish migration” (S. Katayama)

Lab Biological Oceanography

Oct.11 -----“Marine environment for marine organisms” (W. Sato-Okoshi)

Oct. 25 ---- “Plankton and benthos in the ocean” (W. Sato-Okoshi)

Topics on biology and biochemistry of aquatic organisms

Lab Aquacultural Biology

Nov. 15 ---- “Immunity in marine invertebrates” (K. Takahashi)

Nov. 29 ---- “Manipulation of reproduction in bivalve mollusks” (M. Osada)

Lab Marine Biochemistry

Nov. 22 ----- “Food chemistry of fish and shellfish” (Y. Ochiai)

Dec. 6 ----- ““Function of marine lipids” (T. Yamaguchi)

Topics on fish genetics and biotechnology

Lab Marine Life Science & Genetics

Dec. 13 ----- ““Fish development and biotechnology“ (T. Suzuki)

Dec. 20------- “Genetic conservation and sustainable use of resources in aquatic organisms“ (M. Nakajima)

Lab Integrative Aquatic Biology

Jan. 10 ----- “Conservation genetics for fishery resources -1” (M. Ikeda)

Jan. 24 ----- “Conservation genetics for fishery resources -2” (M. Ikeda)

6. Preparation

Refer to the recent topics in each field.

7. Record end evaluation method

Attendance and report. The report should be directly submitted to the instructor of each lecture by the next lecture.

8. Textbook and references

No textbook. Reference books will be introduced.

9. Self study

Summarize the content of each class promptly.

10. In addition

Questions, comments, and requests accepted.

Send them to the representative instructor, Prof. Ochiai: yochiai@tohoku.ac.jp

Subject	Practical Training (実地研修)	Day/Period	Mon./3rd	Object	AMB
Instructor (Post)	Y. Ochiai et al. (Prof. & Assoc. 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-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. Research institute of fishery
2. Seafood company
3. Fish market
4. Aquarium etc.

6. Preparation

Collect information before starting each tour.

7. Record and evaluation method

Attendance and report.
The report should be submitted by the designated deadlines.

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. In addition

Questions, comments, and requests are welcome.

Send them to the representative instructor, Prof. Ochiai: yochiai@tohoku.ac.jp

Subject	Marine Biology（海洋生物学）	Day/Period	Thur./2nd	Object	AMB
Instructor (Post)	Cheryl L Ames (Assoc. 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: Taxonomy, biodiversity, and habitats and ecological niches of marine organisms (plants and animals).

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.

3. Keywords: Marine biodiversity, Plankton, Ecdysozoa, Lophotrochozoa, Phylogenetics, Fisheries species, Identification

4. Goal of study: Develop an understanding of the main categories of marine life (plants and animals), become familiar with the basic body plans and distinguishing features of marine organisms and, in particular, assess those exploited for fisheries and aquaculture.

5. Contents and progress schedule of class
Each lecture will provide an overview of the fundamentals of different groups of marine organisms*, relating form and function. Students are expected to build up a file of comprehensive notes on the special features of each group and the characteristics of specific organisms, that will be submitted as a final report at the end of the course. Practical components will be incorporated through class excursions to local museums and aquariums.
(1). 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.
(2). Plants. Phytoplankton: major groups & their characteristics. Macrophytic seaweeds.
(3). Animals. Basic body plans. Segmentation. Annelida, particularly Polychaeta.
(4). Crustacea (1) Major groups. Zooplanktonic forms.
(5). Crustacea (2) Malacostraca. Major fisheries species.
(6). Crustacea (3) Parasitic forms.
(7). Review & discussion. Submission of notes file.
(8). Mollusca (1) Monoplacophora, Polyplacophora, Scaphopoda, Bivalvia.
(9). Mollusca (2) Cephalopoda.
(10). Echinodermata.
(11). Chaetognatha, Hemichordata, Urochordata, Cephalochordata.
(12). Basics of fish taxonomy. Chondrichthyes & Osteichthyes.
(13). Amphibia, Reptilia, Aves. Seabirds.
(14). Marine mammals. Comparison with closest terrestrial relatives.
(15). Review and discussion. Final submission of reports and notes file.

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): 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. Secondary reading(s): Levinton, JS (2017). Marine Biology: Function, Biodiversity, Ecology. ISBN-13: 978-0190625276; 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. Student 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. In addition: Any questions should be addressed to the lecturer directly during or after lectures, or during office
*Groups not covered during this course will be dealt in the courses *Life & Nature, Planktonology* and in *Basic Seminars.*

Subject	Current topics of Agricultural Plant Science (先端植物生命科学)	Day/Period	Wed./2nd	Object	AMB
Instructor (Post)	H. Kitashiba, et al. (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd&4th-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	7&9
Subject Numbering	ABS-PLA358E			Language Used in Course	English

1. Class subject

Professors and associate professors in Course of Plant Science introduce current topics of agricultural plant science.

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.

3. Keywords

Crop, Plant, Soil, Insect.

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.

5. Contents and progress schedule of class

Each week there will be lectures and discussions of the following topics:

1) Introduction (Prof. Kitashiba)
2) Plant breeding and genetics (Prof. Kitashiba)
3) Crop science (Prof. Homma)
4) Horticultural science-1 (Prof. Kanayama)
5) Horticultural science-2 (Assoc. Prof. Kato)
6) Soil science-1 (Prof. Makino)
7) Soil science-2 (Assoc. Prof. Kanno)
8) Plant pathology-1 (Prof. Takahashi)
9) Plant pathology-2 (Assoc. Prof. Ando)
10) Basic entomology (Prof. Konno)
11) Insect science and bioregulation (Assoc. Prof. Hori)
12) Environmental plant biotechnology-1 (Prof. Toriyama)
13) Environmental plant biotechnology-2 (Assoc. Prof. Ito)
14) Environmental crop science (Prof. Nishida)
15) Forest ecology (Assoc. Prof. Suyama)

6. Preparation

Briefly understand each field on the website below.

7. Record end evaluation method

Attendance (30%), class participation (30%), and report (40%).

8. Textbook and references

http://www.agri.tohoku.ac.jp/en/about/organization/faculty/index.html

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.

10. In addition

Contact: Prof. Hiroyasu Kitashiba
E-mail: hiroyasu.kitashiba.c7@tohoku.ac.jp
Office: Room S405

Subject	Introduction to Applied Animal and Dairy Science (応用動物・酪農科学概論)	Day/Period	First Half Semester Fri./3rd Second Half Semester Fri./2nd	Object	AMB/JYPE
Instructor (Post)	Yoneyama 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&9
Subject Numbering	ABS-ANS360E			Language Used in Course	English

1. Class subject: **Introduction to Applied Animal and Dairy Science**

2. Object and summary of class:
This class object is to study the basic concepts of applied animal and dairy science. 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 about animal and dairy science including comparative physiology, anatomy, nutrition, genetics, reproduction, animal product, immunology, microbiology, environment biology, and animal behavior.

5. Contents and progress schedule of class:
1) Overview of Animal Reproduction (Prof. Kentaro Tanemura, Assoc. Prof. Kenshiro Hara)
Major interest is to elucidate the physiological mechanism controlling reproduction and development in mammals and to develop biotechnology in reproduction of domestic, laboratory and endangered animals.
2) Overview of Animal Nutrition (Assoc. Prof. Motoi Kikusato)
Introduction to metabolism of protein, fat and carbohydrate; energy metabolism with emphasis on mitochondrial ATP production; metabolic regulation in response to environmental stress in farm animals.
3) Overview of Animal Breeding and Genetics (Assoc. Prof. Yoshinobu Uemoto)
For the genetic improvement of economically important traits in livestock population, the concepts of animal breeding theory with quantitative genetics and genomic information are studied.
4) Overview of Animal Physiology (Assoc. Prof. Sanggun Roh)
Our research area offers the new information about the basic principles of animal physiology and their applications, in order to investigate the molecular mechanism of the endocrine and metabolic systems in the ruminant.
5) Overview of Animal Cell Biology (Assoc. Prof. Tomonori Nochi)
Our research is focused on mutual relationship of the structures and functions of cells and tissues during myogenesis, development and growth of farm animals to utilize animal production.
6) Overview of Animal Microbiology (Prof. Hiroshi Yoneyama)
Life of all organisms depends on microorganisms, especially bacteria. Our laboratory is interested in bacterial genetic engineering, bacterial flora and zoonotic diseases. Our goal of research and education is the production of healthy animals including human.
7) Overview of Animal Food Science (Prof. Haruki Kitazawa)
Basic and application studies on probiotic/immunobiotic lactic acid bacteria to produce physiologically functional foods and feeds will be introduced, and their future prospects will also be discussed.
8) Overview of Grazing Management (Prof. Shin-ichiro Ogura, Assoc. Prof. Michiru Fukasawa)
Grazing systems have various functions on animal production and ecological conservation. We introduce the outline of herbivore grazing and refer to its effects on animal welfare and bio-diversity.
9) Overview of Animal Health and Management (Prof. Kentaro Kato, Assoc. Prof. Chika Tada)
Zoonotic microorganisms and pathogenic microorganisms in the environment of the animal production as well as functional microorganisms in animal waste treatment systems are studied.

6. Preparation:

7. Record end 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:

10. In addition:

Subject	Food and Chemistry (食糧と化学)	Day/Period	Thur./2nd	Object	AMB/JYPE
Instructor (Post)	Yoshikazu TANAKA, et al. (Prof.)	Categories	Specialized Subjects	Preferable Participants	3rd&4th-year & JYPE students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	2
				Semester	7&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, Assoc. Prof. Takahiro EITSUKA)
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. Chemistry and biochemistry of marine toxins (Prof. Mari YAMASHITA, Assoc. Prof. Keiichi KONOKI)
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.

5. Nutrition biochemistry (Assoc. Prof. Nao INOUE)
Some bioactive food components related to human health are outlined.

6. Application of high pressure to food processing and terahertz spectroscopy in biological systems
(Prof. Tomoyuki FUJII, Assoc. Prof. Masae TAKAHASHI)
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.
Terahertz (THz) spectroscopy has attracted significant interest in biological systems. This lecture will give some recent examples of THz spectroscopy related to biomolecules, biomedicine, and pharmaceuticals.

7. 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.

8. 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.

9. 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.

10. Synthetic and medicinal chemistry of marine natural products
(Prof. Makoto SASAKI)
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.

11. Obesity and dietary factors: why we get fat? (Assoc. Prof. Akira ASAI)
The increasing prevalence of obesity has become a global health problem. An overview of obesity and metabolic syndrome will be introduced, including dietary factors that have been discussed to be involved in the obesity epidemic.

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.

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:

10. In addition

Subject	Current topics of Shellfish Physiology (先端海洋生物生理学)	Day/Period	Thur./1st	Object	AMB
Instructor (Post)	Kazue Nagasawa (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-APS363E			Language Used in Course	English

1. Class subject

Recent research topics of aquatic animal physiology

2. Object and summary of class

Studies on aquatic animal physiology have contributed to not only fishery and food production, but also basic science including material and medical sciences. In this course, recent findings on aquatic animal physiology (mainly germ cell biology and neuroendocrinology) will be introduced

3. Keywords

Germ cells, Reproduction, Neuropeptides, Fish, Shellfish

4. Goal of study

Learning recent research activities, scientific interests with impacts, and further application.

5. Contents and progress schedule of class

1. Introduction: What is "shellfish" and what is "physiology"?
2. Germ cell biology in aquatic animals 1 (germ cell classification/identification)
3. Germ cell biology in aquatic animals 2 (germ cell development)
4. Germ cell biology in aquatic animals 3 (germ cell transplantation)
5. Neuroendocrinology in aquatic animals 1 (Teleosts)
6. Neuroendocrinology in aquatic animals 2 (Marine invertebrates)
7. Examination

*Contents of the class may be changed without prior notification.

6. Preparation

No need.

7. Record end evaluation method

Evaluation is based on class attendance and the final examination.

8. Textbook and references

Handouts are used.

9. Self study

Read again handouts based on the information learned at the class and review the knowledge of physiological topics.

10. In addition

Students may visit the office or contact by Emailing (kazue.magasawa.d6@tohoku.ac.jp) anytime.

Subject	Current topics of Fish Ecology (先端海洋生物生態学)	Day/Period	Wed./3rd	Object	AMB
Instructor (Post)	Kyoko Kinoshita (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-APS364E			Language Used in Course	English

1. Class subject

Current topics of Fish Ecology

2. Object and summary of class

This course covers the functions of benthic invertebrates in the marine ecosystem and their contribution to fishery resources.

3. Keywords

Benthos, Climate change, Invasive species, Marine ecosystem, Stable Isotopes

4. Goal of study

Through the course, students will be able to understand environmental conditions surrounding marine biological resources.

5. Contents and progress schedule of class

1 Overview of the marine environment
2 Benthic life habits
3 Coastal environments: soft-substratum shores and estuaries
4 Stable isotope ecology
5 Mariculture
6 Biological invasion and climate change
7 Examination

6. Preparation

No need.

7. Record end evaluation method

Attendance and participation during lectures (12%), assignments (28%) and final examination (60%).

8. Textbook and references

Levinton, J. S. (2017) *Marine Biology: Function, Biodiversity, Ecology*, 5th Edition.
Oxford University Press, New York.
Fry, B. (2006) *Stable Isotope Ecology*, Springer-Verlag, New York.
Handouts are given within class.

9. Self study

Thinking about current topics on Marine Ecology through the textbook, handouts and recent papers.

10. In addition

If you have any questions, contact me by email.
My email address is as follows: kyoko.kinoshita.c7@tohoku.ac.jp

Subject	Current topics of Fish Biochemistry （先端海洋生物化学）	Day/Period	Wed./4th	Object	AMB
Instructor (Post)	T. Nakano (Assist. 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-APS365E			Language Used in Course	English

1. Class subject

Marine Biochemistry & Seafood Science

2. Object and summary of class

This course will provide students with an understanding of the importance of biochemistry, physiology and food science in the field of fisheries sciences.

3. Keywords

Lipid; Protein; Bioactive Substance; Freshness; Quality Assessment; Stress; Transgenic Fish

4. Goal of study

To understand biochemical and physiological phenomena in fish and functional substances for our health from marine natural products and seafood.

5. Contents and progress schedule of class

1. Introduction “Current research topics in our lab at a glance”
2. Functional substances from marine products 1
3. Functional substances from marine products 2
4. Quality of seafood 1
5. Quality of seafood 2
6. Stress, growth, and nutrition in fish
7. Examination

6. Preparation

TBA (Preparation will be notified at the class)

7. Record end evaluation method

Class attendance, presentation, and examination

8. Textbook and references

References will be notified at the class.

(tentative) Dietary Supplements for the Health and Quality of Cultured Fish by Nakagawa, Sato and Gatlin, CABI, 2007.

The Physiology of Fishes 3rd ed. by Evans and Claiborne, Taylor and Francis, 2006.

9. Self-study

TBA (Self-study will be notified at the class)

10. In addition

Questions, comments, and requests will be accepted during office hours.

Subject	Current topics of Genetics in Aquatic organisms（先端海洋生物遺伝学）	Day/Period		Object	AMB
Instructor (Post)		Categories	Specialized Subjects	Preferable Participants	3rd-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

Recent studies of genetics in aquatic organisms.

2. Object and summary of class

Learning recent topics of genetics in relation to larval evolutionary ecology to discuss the future area of active research.

3. Keywords

Larvae, Development, Evolutionary ecology, Climate change

4. Goal of study

Touching the current topics in the genetics of aquatic organisms with a focus on evolutionary ecology of marine invertebrate larvae.

5. Contents and progress schedule of class

・General introduction of this class
・Evolutionary origins and transitions in developmental mode
・Functional morphology and ecology of larval forms
・Larval transport, settlement, and metamorphosis
・Larval ecology at the extremes
・Larval ecology in the face of changing climate
・An -omics perspective on marine invertebrate larvae; summary

6. Preparation

No need.

7. Record end evaluation method

Class attendance, presentation, and reports

8. Textbook and references

Carrier, T. J., Reitzel, A. M., & Heyland, A. (Eds.). (2018). *Evolutionary ecology of marine invertebrate larvae*. Oxford University Press.

9. Self study

Search recent topics on what learned in previous class

10. In addition

Subject	Current topics of Coastal Ecology (先端沿岸生態学)	Day/Period	Thur./3rd	Object	AMB
Instructor (Post)	E. Inomata (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 marine temperate reef communities.

2. Object and summary of class

Some current topics in ecology of marine temperate reef communities will be introduced.

3. Keywords

seaweed, kelp bed, herbivore, grazer, sea urchin, gastropod, plant-animal interactions, benthos, parasite, symbiosis,

4. Goal of study

To learn the factors affecting the complex networks in marine temperate reef communities.

5. Contents and progress schedule of class

1) Plant-animal interactions in marine benthos
2) Biology and ecology of sea urchins
3) Phase shift in rocky subtidal ecosystem
4) Biology and ecology of marine crustaceans
5) Parasitic and symbiotic relationships
6) Marine mesograzers
7) Examination

6. Preparation

7. Record end evaluation method

Attendance (50%) and examination (50%)

8. Textbook and references

Recent papers are given within class.

9. Self study

10. In addition

yukio.agatsuma.c7@tohoku.ac.jp
masakazu.aoki.e6@tohoku.ac.jp

Subject	Current topics of Fish Molecular Biology（先端海洋分子生物学）	Day/Period	Fri./4th	Object	AMB
Instructor (Post)	H. Yokoi (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-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 used as 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 system.

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 learned strategies would be helpful for students to design their own research projects in any fields.

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

Have a look at the Nature or Science magazine to see how model organisms are used in the latest biological research, and read some articles if you find them interesting.

10. 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 Plankton Biology (先端プランクトン学)	Day/Period	Fri./3rd	Object	AMB
Instructor (Post)	G. Nishitani (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-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

Plankton, Harmful and useful 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

1) Classification and biology of useful plankton
2) Applications of useful plankton for human health
3) Molecular Ecology of useful plankton
4) Classification and biology of harmful and toxic plankton
5) Molecular Ecology of harmful and toxic plankton
6) Food analysis in the gut contents of invertebrate larvae
7) Examination

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

Read handouts again and review the molecular topics in plankton. If you are interested in some plankton species, learn more in details from the literature and using Internet, etc.

10. In addition

E-mail: ni5@tohoku.ac.jp

Subject	Science, Technology and Industry in Japan（日本の産業と科学技術）	Day/Period	Tue./4th	Object	AMB
Instructor (Post)	Yumiko Watanabe (Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Agriculture (Graduate School of Agricultural Science)			Credits	1
				Semester	4
Subject Numbering	ABS-OAR970E			Language Used in Course	English

1. Class subject

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

2. Object and summary of class

This specialized subject course (one credit) is a multidisciplinary course that has been organized by the faculties of science, engineering, and agriculture since 2016. This year a new series of lectures starts.

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 "past, present, and future of industry, science, and technology, and their relationships and integration in Japan". 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 obtain fundamental problem-solving abilities, pro-activeness, understanding of different cultures, and a multidisciplinary perspective in diverse circumstances.

Registered students are expected to apply what they learn from this course in another course titled "Multidisciplinary Internship" which will be given in summer 2020.

3. Keywords

4. Goal of study

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.

5. Contents and progress schedule of class

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

#2-8 Lectures by guest speakers will be given on the 7 dates listed in the table below. Please note that this schedule is a tentative one and the final schedule will be announced in a timely manner.

Oct. 8	谷口　旭氏 (Akira TANIGUCHI)	（株）三洋テクノマリン (SANYO TECHNO MARINE)
Oct. 15	蛯名　武雄氏 (Takeo EBINA)	（国研）産業技術総合研究所 (AIST: Advanced Industrial Science & Tech.)
Oct-29	野元　克彦氏 (Katsuhiko NOMOTO)	アクロスケール社 (ACROSCALE)
Nov. 5	富田二三彦氏 (Fumihiko TOMITA)	（国研）情報通信研究機構 (NICT: Info. & Comm. Tech.)
Nov-12	熊田　幸生氏 (Sachio KUMADA) 山口　喬　(Takashi YAMAGUCHI)	（株）住友重機械工業 (Sumitomo Heavy Industries)
Nov-19	井出　秀一氏 (Hidekazu IDE)	（株）原子力燃料工業 (Nuclear Fuel Industries)
Nov-26	佐藤　陽一氏 (Yoichi SATO)	（株）理研食品 (Riken Food)

6. Preparation

7. Record end evaluation method

❖ Attendance, active participation, including the submission of a short essay on each lecture **(50%)**
The length of the short essay is expected to be approximately one A4 page using 12 point 'Times New Roman' font. You may want to write what you learn from the lectures, and also the situation of a specific area of your home country.

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

B8SBxxxxDATE (e.g., 1008 for October 8)
B8TBxxxxDATE
B8ABxxxxDATE

The deadline for submitting the essay as an email attachment to Yumiko Watanabe (yumiko.watanabe.a5@tohoku.ac.jp) is **9 am of every Monday after the class**.

❖ A proposal (1,200~1,500 words) on your idea to contribute to the growth and/or innovation of an industry in your country while maintaining sustainable development in that country or elsewhere in the globe.
You are expected to apply your specialty and integrated knowledge beyond the conventional academic field that you learned about from this course (50%)

The deadline of this report is **9 am on Monday, January 6, 2020** (negotiable).

Note: Late submission of essays and reports may result in a lower score on your work. A long delay (more than 1 week) or failure to submit may cause further serious penalties.

8. Textbook and references

9. Self study

10. In addition
The guest speakers and topics will be announced in timely manner. This course is opened to Japanese students, too.

Subject	Multidisciplinary Internship （学際インターンシップ）	Day/Period	Intensive course	Object	AMB
Instructor (Post)	Fukazawa H. (Assist. Prof) Breedlove B. (Assoc. Prof.)	Categories	Specialized Subjects	Preferable Participants	2nd-year students
Position	Faculty of Engineering			Credits	1
				Semester	5
Subject Numbering	ABS-OAR970E			Language Used in Course	English

1. Class subject

Introduction to the Research Center for Electron Photon Science (ELPH) of Tohoku University

2. Object and summary of class

In 1966, the Research Center for Electron Photon Science (ELPH) of Tohoku University was established, and a year later, 300 MeV electron linear accelerator (linac) became operational. Until the Great East Japan Earthquake of 2011, the linac provided high energy beams at a high repetition rate to nuclear physics and other fields of study. After the removal of the original linac, repairs and renovation, the center reopened in 2013 with new and important technology. A variety of fields, such as non-linear beam dynamics, quark nuclear physics, the structure of unstable radioisotopes, radiochemistry, and condensed matter nuclear reactions (CNMR), are currently being studied at ELPH. The object of this internship to introduce students to the ELPH center and how experiments in nuclear physics, nuclear and radiochemistry, and condensed matter nuclear reactions are conducted.

3. Keywords

4. Goal of study

Students will
- learn about the center and its research.
- learn about the technology currently available at ELPH.
- understand how research is conducted in the areas of nuclear physics, nuclear and radiochemistry, condensed matter nuclear reactions, etc.

5. Contents and progress schedule of class

September 10 and 11, 2019
The course will consist of
- a field trip to ELPH, including lecture and tour
- a general lecture about chemistry using high energy accelerators
- group discussion and reports

6. Preparation

Detailed schedule will be distributed in July 2019.

7. Record end evaluation method

Attendance, participation and a report

8. Textbook and references

9. Self study

10. In addition

fukuzawa@tagen.tohoku.ac.jp (Assist. Prof. Fukazawa Hironobu)