

**Applied Marine Biology (AMB)**  
**Course Timetable & Syllabus**  
**2022~2023**

(Updated on April 1, 2022)

**Faculty of Agriculture**  
**Tohoku University**

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

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

Timetable (For those who are enrolled in the odd-numbered years) 授業時間割表 (奇数年入学者用)

|                  |   | 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<br>Fall Semester   | Mon.                       | 情報基礎B<br>An Introduction to Information Science B                          | 生命科学 A<br>Biology A  | 地球物質科学<br>Mineralogy, Petrology & Geochemistry  | Basic Japanese 1  |   |
|                  |   | Tues.                      | 社会学<br>Sociology   | 生命と自然<br>Life and Nature   | 物理学A(未履修者用)<br>Physics A  | 解析学概要<br>Foundations of Calculus  | Basic Japanese 1                                  |
|                  |   | Wed.                       | 歴史と人間社会<br>History and Human Society                                       | 化学A<br>Chemistry A   | (Laboratory Tour)   |   |   |
|                  |   | Thur.                      |  | Basic Japanese 1   | 芸術の世界<br>World of Fine Arts   | 化学B<br>Chemistry B  |   |
|                  |   | Fri.                       |  | 生理・生態学概論<br>Introduction to Physiology and Ecology<br>【Kawauchi C307】        | Basic Japanese 1  | 物理学 A(既履修者用)<br>Physics A   | Fundamentals of Interdisciplinary STEM Seminar    |
| 3rd Semester     | 前期<br>Spring Semester   | Mon.                       |  |  |   |   | 基礎ゼミ<br>Introductory Seminar                      |
|                  |   | Tues.                      | Basic Japanese 2   | 生命科学 B<br>Biology B  | 歴史学<br>History  | 線形代数数学概要<br>Foundations of Linear Algebra   |   |
|                  |   | Wed.                       | 物理学 C<br>Physics C   | Basic Japanese 2   | 化学 C<br>Chemistry C   |   |   |
|                  |   | Thur.                      | 生命科学 C<br>Biology C  | 物理学 B<br>Physics B   | 自然科学総合実験-1,2<br>Introductory Science Experiments-1,2  |   | Basic Japanese 2                                  |
|                  |   | Fri.                       | 水圏無脊椎動物学<br>Aquatic Invertebrate Biology<br>【Lecture Room 8】 1st Quarter   |  | 現代における農と農学<br>Modern Agriculture and Agricultural Science   | 陸圏・水圏環境コミュニケーション論<br>Introduction to Aquatic Production / Introduction to Natural and Agricultural Production |   |
|                  |   | Intensive course           | 臨海実習<br>Practice on Marine Bio-resources Science                           |  |   |   |   |
| 4th Semester     | 後期<br>Fall Semester   | Mon.                       |  |  | 水産遺伝育種学<br>Fish Genetics and Breeding science<br>【Lecture Room 8】 3rd Quarter   |   |   |
|                  |   | Tues.                      | 数理統計学<br>Probability & Statistics  | Intermediate Japanese  |   | 日本の産業と科学技術<br>Science, Technology and Industry in Japan   | キャリア教育特別講義<br>Special Lecture of Career Education |
|                  |   | Wed.                       | Intermediate Japanese  | Intermediate Japanese  |   |   |   |
|                  |   | Thur.                      | 海洋生物学<br>Marine Biology<br>【Lecture Room 8】 4th Quarter                    |  |   | 体と健康<br>Health  |   |
|                  |   | Fri.                       |  | 水産科学概論<br>Introduction to Fisheries Science<br>【Lecture Room 8】              | スポーツ A<br>Sports A  |   |   |
| 5th Semester     | 前期<br>Spring Semester   | Mon.                       | 水圏植物学 Applied Aquatic Botany<br>【Lecture Room 8】 1st Quarter               |  | 学生実験 I・基礎化学実験・基礎生物学実験<br>Fishery Science Practice I/Basic Chemistry, Practice/Basic Biology, Practice<br>【Student Laboratory】 |   |   |
|                  |   |                            | 資源動物生態学 Animal Ecology and Ethology<br>【Lecture Room 8】 2nd Quarter        |  |   |   |   |
|                  |   | Tues.                      | 水圏植物生態学 Aquatic Plant Ecology<br>【Lecture Room 8】 1st Quarter              |  |   |   |   |
|                  |   |                            | 水産化学 Marine Biochemistry<br>【Lecture Room 8】 2nd Quarter                   |  |   |   |   |
|                  |   | Wed.                       |  | 科学論文講読 I<br>Reading of Scientific Paper I<br>【Each Laboratory】 1st Quarter   |   |   |   |
|                  |   |                            | プランクトン学 Planktology<br>【Lecture Room 8】 2nd Quarter                        |  |   |   |   |
|                  |   | Thur.                      |  | 科学論文講読 II<br>Reading of Scientific Paper II<br>【Each Laboratory】 1st Quarter |   |   |   |
|                  |   |                            | 資源生物生理学 Physiology of Biological Resources<br>【Lecture Room 3】 2nd Quarter |  |   |   |   |
|                  |   | Fri.                       | 水族生理生態遺伝学 Integrate Aquatic Biology<br>【Lecture Room 8】 1st Quarter        |  |   |   |   |
|                  |   |                            | 水産増殖学 Aquacultural Biology<br>【Lecture Room 6】 2nd Quarter                 |  |   |   |   |
| 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<br>Fall Semester   | Mon.  | 水産資源生態学 Fisheries Biology and Ecology<br>【Lecture Room 8】 3rd Quarter                                 | 学生実験Ⅱ・基礎化学実験・基礎生物学実験<br>Fishery Science PracticeⅡ/Basic Chemistry,<br>Practice/Basic Biology, Practice<br>【Student Laboratory】 |             |             |  |
|              |                       |   | 沿岸生物学 Applied Genetics in Aquatic Organisms<br>【Lecture Room 4】 4th Quarter                           |  |             |             |  |
|              |                       | Tues.   | 生物生産情報処理概論<br>An Introduction to Bioindustrial Information Processing<br>【Lecture Room 8】 3rd Quarter |  |             |             |  |
|              |                       |   |   |  |             |             |  |
|              |                       | Wed.  | 水産利用学 Marine Product Technology<br>【Lecture Room 2】 3rd Quarter                                       |  |             |             |  |
|              |                       |   |   |  |             |             |  |
|              |                       | Thur.   |   |  |             |             |  |
|              | Fri.                  | 生物海洋学 Biological Oceanography<br>【Lecture Room 8】 3rd Quarter |   |  |             |             |  |
|              | Intensive course      | 実地研修 Practical Training                                       |   |  |             |             |  |
| 7th Semester | 前期<br>Spring Semester | Mon.  |   |  |             |             |  |
|              |                       | Tues.   |   |  |             |             |  |
|              |                       | Wed.  | 水産食品管理学<br>Seafood Management<br>【Lecture Room 8】 1st Quarter   | 先端植物生命科学<br>Current topics of Agricultural Plant Science<br>【Lecture Room 8】 1st Quarter                                       |             |             |  |
|              |                       |   | 先端海洋生物生態学 Current topics of Fish Ecology<br>【Lecture Room 8】 2nd Quarter                              |  |             |             |  |
|              |                       | Thur.   | 先端海洋生物生理学<br>Current topics of Shellfish Physiology<br>【Lecture Room 3】 1st Quarter                   | 食糧と化学<br>Food and Chemistry<br>【Lecture Room 8】 1st Quarter  |             |             |  |
|              |                       |   | 先端沿岸生態学<br>Current topics of Coastal Ecology<br>【Lecture Room 3】 2nd Quarter                          | 先端海洋分子生物学<br>Current topics of Fish Molecular Biology<br>【Lecture Room 8】 2nd Quarter  |             |             |  |
|              |                       | Fri.  | 先端海洋生物化学<br>Current topics of Fish Biochemistry<br>【Lecture Room 8】 1st Quarter                       | 応用動物・酪農科学概論<br>Introduction to Applied Animal and Dairy Science<br>【Lecture Room 7】 1st Quarter                                |             |             |  |
|              |                       |   | 先端プランクトン学<br>Current topics of Plankton Biology<br>【Lecture Room 6】 2nd Quarter                       | 先端海洋生物遺伝学<br>Current topics of Genetics in Aquatic organisms<br>【Lecture Room 4】 2nd Quarter                                   |             |             |  |
|              | Intensive course      | 生産フィールド実習Ⅱ Field Practice of Marine ProductionⅡ               |   |  |             |             |  |
|              |                       | 海洋応用生物化学 Marine Applied Biochemistry                          |   |  |             |             |  |
| 8th Semester | 後期<br>Fall            | Mon.<br>to<br>Wed.  | 卒業論文<br>Graduation Thesis   |  |             |             |  |
|              | Thur.                 |   |   |  |             |             |  |
|              | Fri.                  |   |   |  |             |             |  |
| 9th Semester | 前期<br>Spring Semester | Mon.  | 卒業論文<br>Graduation Thesis   |  |             |             |  |
|              |                       | Tues.   |   |  |             |             |  |
|              |                       | Wed.  |   |  |             |             |  |
|              |                       | Thur.   |   |  |             |             |  |
|              |                       | Fri.  |   |  |             |             |  |
|              |                       | Intensive course  |   |  |             |             |  |

Timetable (For those enrolled in the even-numbered years) 授業時間割表(偶数年入学者用)

|                  |   | 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<br>Fall Semester   | Mon.                       | 情報基礎B<br>An Introduction to Information Science B                          | 生命科学 A<br>Biology A  | 地球物質科学<br>Mineralogy, Petrology & Geochemistry  | Basic Japanese 1  |   |
|                  |   | Tues.                      | 社会学<br>Sociology   | 生命と自然<br>Life and Nature   | 物理学A(未履修者用)<br>Physics A  | 解析学概要<br>Foundations of Calculus  | Basic Japanese 1                                  |
|                  |   | Wed.                       | 歴史と人間社会<br>History and Human Society                                       | 化学A<br>Chemistry A   | (Laboratory Tour)   |   |   |
|                  |   | Thur.                      |  | Basic Japanese 1   | 芸術の世界<br>World of Fine Arts   | 化学B<br>Chemistry B  |   |
|                  |   | Fri.                       |  | 生理・生態学概論<br>Introduction to Physiology and Ecology<br>【Kawauchi C307】        | Basic Japanese 1  | 物理学 A(既履修者用)<br>Physics A   | Fundamentals of Interdisciplinary STEM Seminar    |
| 3rd Semester     | 前期<br>Spring Semester   | Mon.                       |  |  |   |   | 基礎ゼミ<br>Introductory Seminar                      |
|                  |   | Tues.                      | Basic Japanese 2   | 生命科学 B<br>Biology B  | 歴史学<br>History  | 線形代数学概要<br>Foundations of Linear Algebra  |   |
|                  |   | Wed.                       | 物理学 C<br>Physics C   | Basic Japanese 2   | 化学 C<br>Chemistry C   |   |   |
|                  |   | Thur.                      | 生命科学 C<br>Biology C  | 物理学 B<br>Physics B   | 自然科学総合実験-1,2<br>Introductory Science Experiments-1,2  |   | Basic Japanese 2                                  |
|                  |   | Fri.                       | 水圏無脊椎動物学<br>Aquatic Invertebrate Biology<br>【Lecture Room 8】 1st Quarter   |  | 現代における農と農学<br>Modern Agriculture and Agricultural Science   | 陸圏・水圏環境コミュニケーション論<br>Introduction to Aquatic Production / Introduction to Natural and Agricultural Production |   |
|                  |   | Intensive course           | 臨海実習<br>Practice on Marine Bio-resources Science                           |  |   |   |   |
| 4th Semester     | 後期<br>Fall Semester   | Mon.                       |  |  | 水産遺伝育種学<br>Fish Genetics and Breeding science<br>【Lecture Room 8】 3rd Quarter   |   |   |
|                  |   | Tues.                      | 数理統計学<br>Probability & Statistics  | Intermediate Japanese  |   | 日本の産業と科学技術<br>Science, Technology and Industry in Japan   | キャリア教育特別講義<br>Special Lecture of Career Education |
|                  |   | Wed.                       | Intermediate Japanese  | Intermediate Japanese  |   |   |   |
|                  |   | Thur.                      | 海洋生物学<br>Marine Biology<br>【Lecture Room 8】 4th Quarter                    |  |   | 体と健康<br>Health  |   |
|                  |   | Fri.                       |  | 水産科学概論<br>Introduction to Fisheries Science<br>【Lecture Room 8】              | スポーツ A<br>Sports A  |   |   |
| 5th Semester     | 前期<br>Spring Semester   | Mon.                       | 水圏植物学 Applied Aquatic Botany<br>【Lecture Room 8】 1st Quarter               |  | 学生実験 I・基礎化学実験・基礎生物学実験<br>Fishery Science Practice I/Basic Chemistry, Practice/Basic Biology, Practice<br>【Student Laboratory】 |   |   |
|                  |   |                            | 資源動物生態学 Animal Ecology and Ethology<br>【Lecture Room 8】 2nd Quarter        |  |   |   |   |
|                  |   | Tues.                      | 水圏植物物生態学 Aquatic Plant Ecology<br>【Lecture Room 8】 1st Quarter             |  |   |   |   |
|                  |   |                            | 水産化学 Marine Biochemistry<br>【Lecture Room 8】 2nd Quarter                   |  |   |   |   |
|                  |   | Wed.                       |  | 科学論文講読 I<br>Reading of Scientific Paper I<br>【Each Laboratory】 1st Quarter   |   |   |   |
|                  |   |                            | プランクトン学 Planktology<br>【Lecture Room 8】 2nd Quarter                        |  |   |   |   |
|                  |   | Thur.                      |  | 科学論文講読 II<br>Reading of Scientific Paper II<br>【Each Laboratory】 1st Quarter |   |   |   |
|                  |   |                            | 資源生物生理学 Physiology of Biological Resources<br>【Lecture Room 3】 2nd Quarter |  |   |   |   |
|                  |   | Fri.                       | 水族生理生態遺伝学 Integrate Aquatic Biology<br>【Lecture Room 8】 1st Quarter        |  |   |   |   |
|                  |   |                            | 水産増殖学 Aquacultural Biology<br>【Lecture Room 6】 2nd Quarter                 |  |   |   |   |
| 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<br>Fall Semester   | Mon.  | 水産資源生態学 Fisheries Biology and Ecology<br>【Lecture Room 8】 3rd Quarter                                 | 学生実験Ⅱ・基礎化学実験・基礎生物学実験<br>Fishery Science PracticeⅡ/Basic Chemistry,<br>Practice/Basic Biology, Practice<br>【Student Laboratory】 |             |   |  |
|              |                       |   | 沿岸生物学 Applied Genetics in Aquatic Organisms<br>【Lecture Room 4】 4th Quarter                           |  |             |   |  |
|              |                       | Tues.   | 生物生産情報処理概論<br>An Introduction to Bioindustrial Information Processing<br>【Lecture Room 8】 3rd Quarter |  |             |   |  |
|              |                       |   |   |  |             |   |  |
|              |                       | Wed.  | 水産利用学 Marine Product Technology<br>【Lecture Room 2】 3rd Quarter                                       |  |             |   |  |
|              |                       |   |   |  |             |   |  |
|              |                       | Thur.   |   |  |             |   |  |
|              | Fri.                  | 生物海洋学 Biological Oceanography<br>【Lecture Room 8】 3rd Quarter                   |   |  |             |   |  |
|              | Intensive course      | 実地研修 Practical Training   |   |  |             |   |  |
| 7th Semester | 前期<br>Spring Semester | Mon.  |   |  |             |   |  |
|              |                       | Tues.   |   |  |             |   |  |
|              |                       | Wed.  | 水産食品管理学<br>Seafood Management<br>【Lecture Room 8】 1st Quarter   |  |             |   |  |
|              |                       |   | 先端海洋生物生態学 Current topics of Fish Ecology<br>【Lecture Room 8】 2nd Quarter                              |  |             |   |  |
|              |                       | Thur.   | 先端海洋生物生理学<br>Current topics of Shellfish Physiology<br>【Lecture Room 3】 1st Quarter                   | 先端海洋分子生物学<br>Current topics of Fish Molecular Biology<br>【Lecture Room 8】 2nd Quarter  |             |   |  |
|              |                       |   | 先端沿岸生態学<br>Current topics of Coastal Ecology<br>【Lecture Room 3】 2nd Quarter                          |  |             |   |  |
|              |                       | Fri.  | 先端海洋生物化学<br>Current topics of Fish Biochemistry<br>【Lecture Room 8】 1st Quarter                       | 先端海洋生物遺伝学<br>Current topics of Genetics in Aquatic organisms<br>【Lecture Room 4】 2nd Quarter                                   |             |   |  |
|              |                       | 先端プランクトン学<br>Current topics of Plankton Biology<br>【Lecture Room 6】 2nd Quarter |   |  |             |   |  |
|              | Intensive course      | 生産フィールド実習Ⅱ Field Practice of Marine ProductionⅡ                                 |   |  |             |   |  |
| 8th Semester | 後期<br>Fall            | Mon.<br>to<br>Wed.  | 卒業論文<br>Graduation Thesis   |  |             |   |  |
|              |                       | Thur.   |   |  |             |   |  |
|              |                       | Fri.  |   |  |             |   |  |
| 9th Semester | 前期<br>Spring Semester | Mon.  | 卒業論文<br>Graduation Thesis   |  |             |   |  |
|              |                       | Tues.   |   |  |             |   |  |
|              |                       | Wed.  | 先端植物生命科学<br>Current topics of Agricultural Plant Science<br>【Lecture Room 8】 1st Quarter              | 卒業論文<br>Graduation Thesis  |             |   |  |
|              |                       | Thur.   | 卒業論文<br>Graduation Thesis   |  |             | 食糧と化学<br>Food and Chemistry<br>【Lecture Room 8】 1st Quarter                                     |  |
|              |                       | Fri.  |   |  |             | 応用動物・酪農科学概論<br>Introduction to Applied Animal and Dairy Science<br>【Lecture Room 7】 1st Quarter |  |
|              |                       | 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<br>芸術の世界   | M. Haga                             | 1 <sup>st</sup> | General Education Core Subjects<br>Human Studies                                 | 2          |          |   |
| History and Human Society<br>歴史と人間社会                                  | M. Nakagawa                         | 1 <sup>st</sup> | General Education Core Subjects<br>Social Studies                                | 2          |          |   |
| Life and Nature<br>生命と自然  | Y. Watanabe et al.                  | 1 <sup>st</sup> | General Education Core Subjects<br>Science Studies                               | 2          |          |   |
| History<br>歴史学  | M. Haga                             | 1 <sup>st</sup> | General Education Expansion Subjects<br>Human Sciences                           | 2          |          |   |
| Linguistics<br>言語学  |                                     | 1 <sup>st</sup> | General Education Expansion Subjects<br>Human Sciences                           |            | 2        | 2021年度開講なし<br>Not offered for AY 2021   |
| Sociology<br>社会学  | J. Liu                              | 1 <sup>st</sup> | General Education Expansion Subjects<br>Social Sciences                          | 2          |          |   |
| Foundations of Calculus<br>解析学概要                                      | X. Dahan                            | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Mathematics             | 2          |          |   |
| Foundations of Linear Algebra<br>線形代数学概要                              | M. Schroeder                        | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Mathematics             | 2          |          |   |
| Probability & Statistics<br>数理統計学                                     | M. Schroeder                        | 2 <sup>nd</sup> | General Education Expansion Subjects<br>Natural Sciences/Mathematics             | 2          |          |   |
| Physics A<br>物理学A   | TBA                                 | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Physics                 | 2          |          |   |
| Physics B<br>物理学B   | D. Fedorynenko                      | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Physics                 |            | 2        |   |
| Physics C<br>物理学C   | A. Vinicius                         | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Physics                 |            | 2        |   |
| Chemistry A<br>化学A  | D. Mott                             | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Chemistry               | 2          |          |   |
| Chemistry B<br>化学B  | D. Mott                             | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Chemistry               |            | 2        |   |
| Chemistry C<br>化学C  | D. Mott                             | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Chemistry               | 2          |          |   |
| Biology A<br>生命科学A  | TBA                                 | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Biology                 | 2          |          |   |
| Biology B<br>生命科学B  | T. Ichinose                         | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Biology                 | 2          |          |   |
| Biology C<br>生命科学C  | K. Inaba                            | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Biology                 | 2          |          | Substitute for Modern<br>Scholarship<br>現代学問論読替   |
| Mineralogy, Petrology & Geochemistry<br>地球物質科学                        | TBA                                 | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Earth and Space Science | 2          |          |   |
| Introductory Science Experiments<br>自然科学総合実験                          | N. Nakamura et al.                  | 1 <sup>st</sup> | General Education Expansion Subjects<br>Natural Sciences/Scientific Experiments  | 2          |          |   |
| Introductory Seminar<br>基礎ゼミ  | IIE Teacher                         | 1 <sup>st</sup> | General Education Common Subjects<br>Small-Group Freshmen Seminars               | 2          |          | Intensive course<br>集中講義  |
| Basic Japanese 1  | N. Sugaya et al.                    | 1 <sup>st</sup> | General Education Common Subjects<br>Subjects for International Students         | 4          |          |   |
| Basic Japanese 2  | N. Sugaya et al.                    | 1 <sup>st</sup> | General Education Common Subjects<br>Subjects for International Students         | 3          |          |   |
| Intermediate Japanese   | A. Uchiyama et al.                  | 2 <sup>nd</sup> | General Education Common Subjects<br>Subjects for International Students         | 3          |          | You may instead select 3<br>subjects (3 credits) from<br>the General Education<br>Japanese A-J classes. |
| An Introduction to Information Science B<br>情報基礎B                     | X. Dahan                            | 1 <sup>st</sup> | General Education Common Subjects<br>Information Sciences                        | 2          |          | Substitute for Intro<br>Info Sci A<br>情報基礎A読替   |
| Sports A<br>スポーツA   |                                     | 2 <sup>nd</sup> | General Education Common Subjects<br>Health Sciences                             | 1          |          |   |
| Health<br>体と健康  | R. Nagatomi                         | 2 <sup>nd</sup> | General Education Common Subjects<br>Health Sciences                             | 2          |          |   |
| Introduction to Aquatic Production<br>水圏環境コミュニケーション論                  | M. Ikeda                            | 1 <sup>st</sup> | Specialized Subjects<br>Faculty Common Subjects                                  | 1          |          | Joint class<br>日本人と共修   |
| Introduction to Natural and Agricultural Production<br>陸圏環境コミュニケーション論 | C. Yonezawa et al.                  | 1 <sup>st</sup> | Specialized Subjects<br>Faculty Common Subjects                                  | 1          |          | Joint class<br>日本人と共修   |
| Modern Agriculture and Agricultural Science<br>現代における農と農学             | The field of all<br>Agriculture 全分野 | 1 <sup>st</sup> | Specialized Subjects<br>Faculty Common Subjects                                  | 2          |          | Joint class<br>日本人と共修   |
| Introduction to Physiology and Ecology<br>生理・生態学概論                    | Cheryl Ames                         | 1 <sup>st</sup> | Specialized Subjects<br>Faculty Common Subjects                                  | 2          |          |   |
| An Introduction to Bioindustrial Information<br>Processing 生物生産情報処理概論 | Y. Sakai                            | 3 <sup>rd</sup> | Specialized Subjects<br>Faculty Common Subjects                                  |            | 2        |   |
| Reading of Scientific Paper I<br>科学論文講読I                              | M. Ikeda et al.                     | 2 <sup>nd</sup> | Specialized Subjects<br>Faculty Common Subjects                                  | 1          |          | Joint class<br>日本人と共修   |

|   |                               |                                       |   |    |   |   |
|---|-------------------------------|---------------------------------------|---|----|---|---|
| Reading of Scientific Paper II<br>科学論文講読II                        | M. Ikeda et al.               | 2 <sup>nd</sup>                       | Specialized Subjects<br>Faculty Common Subjects       | 1  |   | Joint class<br>日本人と共修                             |
| Practice on Marine Bio-resources Science<br>臨海実習                  | M. Ikeda                      | 1 <sup>st</sup>                       | Specialized Subjects<br>Faculty Common Subjects       | 1  |   | Joint class日本人と共修<br>Intensive course<br>集中講義     |
| Graduation Thesis<br>卒業論文   | Instruction teacher<br>教授・准教授 | 4 <sup>th</sup>                       | Specialized Subjects<br>Faculty Common Subjects       | 10 |   |   |
| Physiology of Biological Resources<br>資源生物生理学                     | Cheryl Ames                   | 2 <sup>nd</sup>                       | Specialized Subjects<br>Academic Common Subject       | 2  |   |   |
| Animal Ecology and Ethology<br>資源動物生態学                            | S. Katayama                   | 2 <sup>nd</sup>                       | Specialized Subjects<br>Academic Common Subject       |    | 2 |   |
| Fish Genetics and Breeding science<br>水産遺伝育種学                     | M. Nakajima                   | 2 <sup>nd</sup>                       | Specialized Subjects<br>Academic Common Subject       |    | 2 |   |
| Field Practice of Marine Production I<br>生産フィールド実習 I              | M. Ikeda                      | 2 <sup>nd</sup>                       | Specialized Subjects<br>Academic Common Subject       | 1  |   | Joint class日本人と共修<br>Intensive course<br>集中講義     |
| Field Practice of Marine Production II<br>生産フィールド実習 II            | M. Ikeda                      | 3 <sup>rd</sup>                       | Specialized Subjects<br>Academic Common Subject       | 1  |   | Joint class日本人と共修<br>Intensive course<br>集中講義     |
| Fishery Science Practice I<br>学生実験 I                              | M. Ikeda et al.               | 2 <sup>rd</sup>                       | Specialized Subjects<br>Academic Common Subject       | 4  |   | Joint class<br>日本人と共修                             |
| Fishery Science Practice II<br>学生実験 II                            | M. Ikeda et al.               | 3 <sup>rd</sup>                       | Specialized Subjects<br>Academic Common Subject       | 6  |   | Joint class<br>日本人と共修                             |
| Basic Chemistry, Practice<br>基礎化学実験                               | M. Ikeda et al.               | 2 <sup>nd</sup><br>3 <sup>rd</sup>    | Specialized Subjects<br>Academic Common Subject       | 1  |   | Joint class<br>日本人と共修                             |
| Basic Biology, Practice<br>基礎生物学実験                                | M. Ikeda et al.               | 2 <sup>nd</sup><br>3 <sup>rd</sup>    | Specialized Subjects<br>Academic Common Subject       | 1  |   | Joint class<br>日本人と共修                             |
| Aquacultural Biology<br>水産増殖学                                     | M. Osada                      | 2 <sup>rd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Fisheries Biology and Ecology<br>水産資源生態学                          | S. Katayama                   | 3 <sup>rd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Aquatic Plant Ecology<br>水圏植物生態学                                  | M. Aoki                       | 2 <sup>rd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Marine Biochemistry<br>水産化学                                       | T. Nakano                     | 2 <sup>nd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Biological Oceanography<br>生物海洋学                                  | W. Sato-Okoshi                | 3 <sup>rd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Applied Genetics in Aquatic Organisms<br>沿岸生物学                    | M. Ikeda                      | 3 <sup>rd</sup>                       | Specialized Subjects<br>Academic group Common Subject | 2  |   |   |
| Aquatic Invertebrate Biology<br>水圏無脊椎動物学                          | K. Takahashi                  | 1 <sup>st</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Applied Aquatic Botany<br>水圏植物学                                   | M. Aoki                       | 2 <sup>rd</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Marine Product Technology<br>水産利用学                                | Y. Ochiai                     | 3 <sup>rd</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Seafood Management<br>水産食品管理学                                     | Cheryl Ames                   | 3 <sup>rd</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Planktology<br>プランクトン学  | G. Nishitani                  | 2 <sup>nd</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Integrate Aquatic Biology<br>水族生理生態遺伝学                            | T. Fujii                      | 2 <sup>nd</sup>                       | Specialized Subjects<br>Technical field Subjects      |    | 2 |   |
| Marine Applied Biochemistry<br>海洋応用生物化学                           | M. Nishikawa                  | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Technical field Subjects      |    | 1 | Every other year 隔年開講<br>Intensive course<br>集中講義 |
| Related Subjects<br>関連科目  |                               |                                       | Specialized Subjects<br>Technical field Subjects      |    | 4 |   |
| Introduction to Fisheries Science<br>水産科学概論                       | M. Osada et al                | 2 <sup>nd</sup>                       | Specialized Subjects<br>Current subject               | 2  |   |   |
| Practical Training<br>実地研修  | M. Ikeda et al.               | 3 <sup>rd</sup>                       | Specialized Subjects<br>Current subject               | 1  |   |   |
| Marine Biology<br>海洋生物学   | Cheryl Ames                   | 2 <sup>nd</sup>                       | Specialized Subjects<br>Current subject               | 2  |   |   |
| Current topics of Agricultural Plant Science<br>先端植物生命科学          | H. Takahashi et al.           | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Current subject               | 2  |   | Every other year<br>隔年開講                          |
| Introduction to Resource and Environmental<br>Economics 資源環境経済学概論 |                               | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Current subject               | 2  |   | Every other year<br>隔年開講                          |
| Introduction to Applied Animal and Dairy Science<br>応用動物・酪農科学概論   | K. Sato et al.                | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Current subject               | 2  |   | Every other year<br>隔年開講                          |
| Applied Biological Chemistry<br>応用生物化学                            |                               | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Current subject               | 2  |   | Every other year<br>隔年開講                          |
| Food and Chemistry<br>食糧と化学                                       | M. Toda et al.                | 3 <sup>rd</sup> or<br>4 <sup>th</sup> | Specialized Subjects<br>Current subject               | 2  |   | Every other year<br>隔年開講                          |
| Current topics of Shellfish Physiology<br>先端海洋生物生理学               | K. Nagasawa                   | 3 <sup>rd</sup>                       | Specialized Subjects<br>Current subject               |    | 1 |   |

|  |                          |                                    |   |  |   |  |
|--|--------------------------|------------------------------------|---|--|---|--|
| Current topics of Fish Ecology<br>先端海洋生物生態学                  | H. Murakami              | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Current topics of Fish Biochemistry<br>先端海洋生物化学              | T. Nakano                | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Current topics of Genetics in Aquatic Organisms<br>先端海洋生物遺伝学 | T. Fujii                 | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Current topics of Coastal Ecology<br>先端沿岸生態学                 | H. Suzuki                | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Current topics of Fish Molecular Biology<br>先端海洋分子生物学        | H. Yokoi                 | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Current topics of Plankton Biology<br>先端プランクトン学              | G. Nishitani             | 3 <sup>rd</sup>                    | Specialized Subjects<br>Current subject |  | 1 |  |
| Marine Biotechnology<br>海洋生物工学                               | H. Yokoi,<br>K. Nagasawa | 3 <sup>rd</sup><br>4 <sup>th</sup> | Specialized Subjects<br>Current subject |  | 2 |  |

### 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 |                          |
| 理工系学際基礎セミナー<br>Fundamentals of Interdisciplinary STEM Seminar | X. Dahan et al.      | 1 <sup>st</sup> | General Education Expansion Subjects |            | 1        | ※国費学生は必修、私費学生は履修を強く推奨する  |
| Science, Technology and Industry in Japan<br>日本の産業と科学技術       | Y. Watanabe          | 2 <sup>nd</sup> | Specialized Subjects                 |            | 1        |                          |
| Multidisciplinary Internship<br>学際インターンシップ                    | H. Kumigashira et al | 2 <sup>nd</sup> | Specialized Subjects                 |            | 1        | Intensive course<br>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 111 credits from obligatory subjects 必修科目 111 単位以上
2. A minimum of 23 credits from elective specialized subjects 専門選択科目 23 単位以上

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

#### (1) General Education Subjects 全学教育科目

| Subjects                      |                           | Credits   |
|-------------------------------|---------------------------|-----------|
| Core Subjects<br>基幹科目         | Human Studies 人間論         | 2         |
|                               | Social Studies 社会論        | 2         |
|                               | Science Studies 自然論       | 2         |
|                               | Subtotal                  | 6         |
| Expansion<br>Subjects<br>展開科目 | Human Sciences 人文科学       | 2         |
|                               | Social Sciences 社会科学      | 2         |
|                               | Natural Sciences 自然科学     | 22        |
|                               | Subtotal                  | 26        |
| Common<br>Subjects<br>共通科目    | Japanese 日本語              | 10        |
|                               | Introductory Seminar 基礎ゼミ | 2         |
|                               | Information Sciences 情報科目 | 2         |
|                               | Sports スポーツ               | 1         |
|                               | Health Care 体と健康          | 2         |
|                               | Subtotal                  | 17        |
| <b>Total</b>                  |                           | <b>49</b> |

#### (2) Specialized Subjects 専門教育科目

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

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

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

|   |  |            |                         |                               |                      |
|---|--|------------|-------------------------|-------------------------------|----------------------|
| Subject   | Introduction to Aquatic Production<br>(水圏環境コミュニケーション論)           | Day/Period | Fri./4th                | Object                        | AMB                  |
| Instructor<br>(Post)  | M. Ikeda (Prof)<br>T. Fujii (Associate Prof.)                    | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 1st-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 1                    |
|   |  |            |                         | Semester                      | 3                    |
| Subject<br>Numbering  | AAL-APS202B  |            |                         | Language<br>Used in<br>Course | English/Japanese     |
| 1. Class subject<br><b>Biological productivity in aquatic zone and restoration from tsunami disaster</b>  |  |            |                         |                               |                      |
| 2. Object and summary of class<br>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<br>marine biodiversity, fisheries, aquaculture, tsunami disaster, reconstruction,   |  |            |                         |                               |                      |
| 4. Goal of study<br>At the end of the semester, students will<br>-understand about tsunami disaster.<br>-understand the importance of relationship between natural aquatic production and human activity.<br>-understand sustainable biological productivity and the application to reconstruction of human society.  |  |            |                         |                               |                      |
| 5. Contents and progress schedule of class<br>• Introduction to studies of marine science, biological productivity and restoration<br>• Field lecture about tsunami damage, the restoration of coastal ecosystems, and the circumstance of reconstruction in Onagawa Town (including Onagawa Field Center)<br>• Class room lecture<br>• Group discussion  |  |            |                         |                               |                      |
| 6. Preparation<br>For more information, note our announcement in the curriculum guidance during the first week of April.  |  |            |                         |                               |                      |
| 7. Record end evaluation method<br>• Attendance: 40%<br>• Activeness: 20%<br>• Report: 40%  |  |            |                         |                               |                      |
| 8. Textbook and references<br>Preparing textbook  |  |            |                         |                               |                      |
| 9. Self study<br>None   |  |            |                         |                               |                      |
| 10. Practical business  |  |            |                         |                               |                      |
| 11. In addition<br>Contact e-mail address:<br>• Ikeda: minoru.ikeda.a6@tohoku.ac.jp   |  |            |                         |                               |                      |

|   |   |            |                      |                         |                   |
|---|---|------------|----------------------|-------------------------|-------------------|
| Subject   | Introduction to Natural and Agricultural Production<br>(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<br><b>Ecosystems including forest, grassland, farmland, paddy field and biological productivity</b>  |   |            |                      |                         |                   |
| 2. Object and summary of class<br>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<br>agronomical science, integrated terrestrial field, ecosystem, environmental issues, animal waste treatment, grasslands, farmlands, soil science, forestry  |   |            |                      |                         |                   |
| 4. Goal of study<br>At the end of the semester, students will<br>-experience about fundamental field science<br>-understand agronomical thinking<br>-understand sustainable biological productivity   |   |            |                      |                         |                   |
| 5. Contents and progress schedule of class<br>1-5. Introduction to Agronomical science (Profs. of Field Science Center)<br>6. Field lecture about forest ecosystem (Profs. of Forest Ecology)<br>7. Field lecture about farmlands on hilly and mountainous area (Profs. of Environmental Crop Science)<br>8. Field lecture about grasslands, farm animals and environmental issues (Profs. of Land Ecology)<br>9. Field lecture about animal waste treatment, biogas production and recycling system (Profs. of Sustainable Environmental Biology)<br>10. Field lecture about andosol (volcanic ash soil) and environmental issues on farmland (Profs. of Environmental Crop Science)<br>11. Field lecture about management of animal feeding and animal welfare (Profs. of Land Ecology)<br>12. Field observations for integrated terrestrial field (Profs. of Field Science Center)<br>13. Group discussion (Profs. of Field Science Center)<br>14. Class room lecture about agriculture and ecosystem (Profs. of Field Science Center)<br>15. Class room lecture about spatial science and agronomy (Profs. of Field Science and Technology for Society) |   |            |                      |                         |                   |
| 6. Preparation<br>Read books related on agronomy, soil science, animal science, forest science and environmental science before the field trip.   |   |            |                      |                         |                   |
| 7. Record end evaluation method<br>Attendance and participation for field trip (40%)<br>Attendance and participation for classes (30%)<br>Report about field trip (30%)   |   |            |                      |                         |                   |
| 8. Textbook and references<br>URL: <a href="http://www.agri.tohoku.ac.jp/kawatabi/index.html">http://www.agri.tohoku.ac.jp/kawatabi/index.html</a>  |   |            |                      |                         |                   |
| 9. Self study<br>Write a report after the field trip. Write down what did you see, what did you feel. We welcome your consideration based on the group discussion.  |   |            |                      |                         |                   |
| 10. Practical business  |   |            |                      |                         |                   |
| 11. In addition<br>Field trip will be held in May (Fri.), 8:00 - 18:30. Gathering Spot is Aobayama Campus (Faculty of Agriculture Building).<br>Please carry rain cape, protection against cold weather, insurance card and lunch to field trip.<br>E-mail address: chinatsu@tohoku.ac.jp   |   |            |                      |                         |                   |

|   |  |            |                      |                         |                   |
|---|--|------------|----------------------|-------------------------|-------------------|
| Subject   | Modern Agriculture and Agricultural Science (現代における農と農学)         | Day/Period | Fri./3 <sup>rd</sup> | Object                  | AMB               |
| Instructor (Post)   | K. Homma (Prof.) et al   | Categories | Specialized Subjects | Preferable Participants | 1st-year students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                      | Credits                 | 2                 |
|   |  |            |                      | Semester                | 3                 |
| Subject Numbering   | AAL-OAG203B  |            |                      | Language Used in Course | English/Japanese  |
| 1. Class subject<br><b>Grasp of problems according to water, foods, energy, biomaterials, environment and health</b>  |  |            |                      |                         |                   |
| 2. Object and summary of class<br>The purpose of the course is to let participants understand and grasp the many agricultural problems such as water, foods, energy, biomaterials, environment and health through the unique lecture with laboratory tours. Students can go to more than 30 laboratories (about 3/4 of all lab. of our faculty) in the course to know and understand the characteristics of each laboratory's state of education and research.<br>Students will increase knowledge step by step through explanation of stuffs and discussion with each other.   |  |            |                      |                         |                   |
| 3. Keywords   |  |            |                      |                         |                   |
| 4. Goal of study<br>At the end of the semester, students will<br><br>-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.<br>-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<br>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.<br>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.<br><br>1. Guidance "Introduction of agricultural sciences"<br>2-15. Visit to six courses of Plant Science, Resource Environmental Economics, Applied Animal Science, Applied Marine Biology, Biochemistry, and Biological Chemistry<br>16. Examination |  |            |                      |                         |                   |
| 6. Preparation  |  |            |                      |                         |                   |
| 7. Record end evaluation method<br>Students must attend the laboratory tour more than 60% and take an examination (40%) of the last day.  |  |            |                      |                         |                   |
| 8. Textbook and references<br>Textbook and references will be notified at the class.  |  |            |                      |                         |                   |
| 9. Self study   |  |            |                      |                         |                   |
| 10. Practical business  |  |            |                      |                         |                   |
| 11. In addition<br>Students who have some questions can visit to ask to each laboratory until 18:00 after lecture time.<br>Contact persons will be notified at the class.<br>Contact: koki.homma.d6@tohoku.ac.jp  |  |            |                      |                         |                   |

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|--|--|------------|-------------------------|-------------------------------|----------------------|
| Subject  | Introduction to Physiology and Ecology<br>(生理・生態学概論)             | Day/Period | Fri./2nd                | Object                        | AMB                  |
| Instructor<br>(Post)   | Cheryl L Ames<br>(Assoc. Prof.)                                  | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 1st-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 2                    |
|  |  |            |                         | Semester                      | 2                    |
| Subject<br>Numbering   | ABS-APS235E  |            |                         | Language<br>Used in<br>Course | English              |
| 1. Class subject:<br>Introduction to Physiology and Ecology: <b>a general introduction to marine physiology and ecology.</b>   |  |            |                         |                               |                      |
| 2. Object and summary of class:<br>A beginner course in the basics of writing about marine physiology and ecology. Through reading, writing and presentations, students will gain broad basic knowledge of the functional organization of animals (e.g., evolution, nervous systems) with an emphasis on the marine realm.   |  |            |                         |                               |                      |
| 3. Keywords:<br>Nervous system, life functions, hormones, biodiversity, photosynthesis   |  |            |                         |                               |                      |
| 4. Goal of study:<br>Master the basics of physiology and ecology for future application to Applied Marine Biology specialist topics and courses.   |  |            |                         |                               |                      |
| 5. Course contents and class schedule<br>(1). Introduction. Basic principles of marine physiology, metabolism and ecology.<br>(2). Marine animal Biodiversity: bathymetric distribution of marine animals.<br>(3) Phylogenetic and evolutionary adaptations of marine animals.<br>(4) The nervous system. 1. Neuron structure & function.<br>(5) The nervous system. 2. Neuron structure & function<br>(6) The nervous system. 3. Sensory systems<br>(7) Mid-term report and examination.<br>(8) The endocrine system. 1. Cell signaling and hormone regulation.<br>(9) The endocrine system. 2. Cell signaling and hormone regulation.<br>(10) The endocrine system. 3. Cell signaling and hormone regulation.<br>(11). The endocrine system. 1. Oogenesis, spermatogenesis & fertilization.<br>(12). The endocrine system. 2. Oogenesis, spermatogenesis & fertilization.<br>(13). The endocrine system. 1. Reproductive hormones.<br>(14). The endocrine system. 2. Reproductive hormones.<br>(15). Final report, presentation and examination. |  |            |                         |                               |                      |
| 6. Preparation:<br>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:<br>Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)  |  |            |                         |                               |                      |
| 8. Textbook and references:<br>Primary reading(s) (students can 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).  |  |            |                         |                               |                      |
| 9. Self-study:<br>There is much to learn about these topics. Students are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.   |  |            |                         |                               |                      |
| 10. Practical business   |  |            |                         |                               |                      |
| 11. In addition: This course covers a broad range of topics. Later courses will explore these topics more deeply. Questions should be addressed to the lecturer directly during or after lecture, or during office hours. ames.cheryl.lynn.al@tohoku.ac.jp   |  |            |                         |                               |                      |



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



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|--|--|------------|-------------------------|-------------------------------|----------------------|
| Subject  | Reading of Scientific Paper I<br>(科学論文講読 I)                      | Day/Period | 1st Quarter<br>Wed./2nd | Object                        | AMB                  |
| Instructor<br>(Post)   | M. Ikeda (Prof.) et al   | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 2nd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 1                    |
|  |  |            |                         | Semester                      | 5                    |
| Subject<br>Numbering   | AAL-APS301B  |            |                         | Language<br>Used in<br>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 <ul style="list-style-type: none"><li>- have practical capability to read scientific paper in marine biology.</li><li>- have knowledge of technical terms on studying field of marine biology.</li></ul>   |  |            |                         |                               |                      |
| 5. Contents and progress schedule of class   |  |            |                         |                               |                      |
| The course will be conducted by AMB laboratories. <ul style="list-style-type: none"><li>- Students will take a class in each laboratory three to four times</li><li>- Scientific paper to read will be provided from each laboratory</li><li>- The format of a class follows an instruction of instructor of each laboratory</li></ul> |  |            |                         |                               |                      |
| 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. Practical business   |  |            |                         |                               |                      |
| 11. In addition  |  |            |                         |                               |                      |
| Students may visit the instructor of each class anytime.   |  |            |                         |                               |                      |

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|--|--|------------|--------------------------|-------------------------------|----------------------|
| Subject  | Reading of Scientific Paper II<br>(科学論文講読 II)                    | Day/Period | 1st Quarter<br>Thur./2nd | Object                        | AMB                  |
| Instructor<br>(Post)   | M. Ikeda (Prof.) et al   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                          | Credits                       | 1                    |
|  |  |            |                          | Semester                      | 5                    |
| Subject<br>Numbering   | AAL-APS302B  |            |                          | Language<br>Used in<br>Course | English/<br>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. Practical business   |  |            |                          |                               |                      |
| 11. In addition  |  |            |                          |                               |                      |
| Students may visit the instructor of each class anytime.   |  |            |                          |                               |                      |

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|--|--|------------|----------------------|-------------------------|-------------------|
| Subject  | Practice on Marine Bio-resources Science（臨海実習）                   | Day/Period | Intensive Course     | Object                  | AMB               |
| Instructor (Post)  | M. Ikeda (Prof)<br>T. Fujii (Associate 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<br><b>Observation of marine biodiversity and understanding the importance for sustainable productions.</b>  |  |            |                      |                         |                   |
| 2. Object and summary of class<br>To understand importance of marine biodiversity.<br>(1) Field trip to the rocky intertidal area and observation of the biodiversity.<br>(2) Observation of early development of marine invertebrates   |  |            |                      |                         |                   |
| 3. Keywords<br>marine ecosystem, biodiversity, production, aquaculture   |  |            |                      |                         |                   |
| 4. Goal of study<br>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<br><br><b>Four days in 2<sup>nd</sup> semester (August)</b> <ul style="list-style-type: none"><li>Days 1-2:Field trip to the rocky intertidal area and survey the biodiversity.</li><li>Days 3-4: Observation of early development of marine invertebrates.</li></ul> |  |            |                      |                         |                   |
| 6. Preparation<br>For more information, note our announcement on June or July.   |  |            |                      |                         |                   |
| 7. Record end evaluation method <ul style="list-style-type: none"><li>Attendance: 40%</li><li>Activeness: 20%</li><li>Report: 40%</li></ul>  |  |            |                      |                         |                   |
| 8. Textbook and references<br>Preparing textbook   |  |            |                      |                         |                   |
| 9. Self study<br>None  |  |            |                      |                         |                   |
| 10. Practical business   |  |            |                      |                         |                   |
| 11. In addition<br>Contact e-mail address: <ul style="list-style-type: none"><li>Ikeda: minoru.ikeda.a6@tohoku.ac.jp</li></ul>   |  |            |                      |                         |                   |

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

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

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|--|--|------------|------------------------------|-------------------------------|----------------------|
| Subject  | Fish Genetics and Breeding science<br>(水産遺伝育種学)                  | Day/Period | 3rd Quarter<br>Mon./3rd, 4th | Object                        | AMB                  |
| Instructor<br>(Post)   | M. Nakajima<br>(Associate Prof.)                                 | Categories | Specialized<br>Subjects      | Preferable<br>Participants    | 2nd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                              | Credits                       | 2                    |
|  |  |            |                              | Semester                      | 4                    |
| Subject<br>Numbering   | ABS-APS240E  |            |                              | Language<br>Used in<br>Course | English              |
| 1. Class subject<br>Understand the basic theory of inheritance and the application methods for the genetic improvement in aquatic organisms.   |  |            |                              |                               |                      |
| 2. Object and summary of class<br>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<br>Genetic improvement, Genetic variation, Linkage, Genetic marker, Quantitative trait, Heritability, Breeding value, Heterosis, Recombinant DNA   |  |            |                              |                               |                      |
| 4. Goal of study<br>1) Understand the basic theory of genetics in both of individual and population level<br>2) Understand the theory of the application methods of genetics for the genetic improvement<br>3) Understand the basic theory of genetics for the conservation of genetic resources.  |  |            |                              |                               |                      |
| 5. Contents and progress schedule of class<br><br>Basic theory of inheritance<br>1) Basic theory and various mode of inheritance<br>2) Genetic variations<br>3) Linkage and recombination<br>4) Basic theory of genetics in population<br>5) Genetic drift and inbreeding<br>6) Natural selection<br>7) Population structure and genetic diversity of population<br>8) Genetic markers for the analysis of populations and quantitative traits<br>Basic theory of genetic improvement<br>9) Basic theory of inheritance in quantitative traits<br>10) Heritability and breeding value<br>11) Basic theory of selection<br>12) Heterosis and hybrid vigor<br>13) Genetic improvement by recombinant DNA |  |            |                              |                               |                      |
| 6. Preparation<br>Please read a book about conservation and genetic improvement.   |  |            |                              |                               |                      |
| 7. Record end evaluation method<br>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<br>Introduction to quantitative genetics, D. S. Falconer, Longman Scientific & Technical, New York, 1989<br>Genetics for fish hatchery managers, D. Tave, An AVI Books, New York, 1992<br>Principles of population genetics, D. L. Hartl and A. G. Clark, Sinauer Associates, Inc., Massachusetts<br>Conservation and the Genetics of Populations, F. W. Allendorf and G. Luikart, Blackwell Publishing, Oxford, 2007   |  |            |                              |                               |                      |
| 9. Self study<br>Ask me the things which are not understood. Please do preparations for lecture and a review used text book shown to the above.  |  |            |                              |                               |                      |
| 10. Practical business   |  |            |                              |                               |                      |
| 11. In addition<br>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  |  |            |                              |                               |                      |

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|--|--|------------|----------------------|-------------------------|-------------------------|
| Subject  | Field Practice of Marine Production I・II<br>(生産フィールド実習 I・II)     | Day/Period | Intensive Course     | Object                  | AMB                     |
| Instructor (Post)  | M. Ikeda (Prof.)<br>T. Fujii (Associate Prof.)                   | Categories | Specialized Subjects | Preferable Participants | 2nd & 3rd-year students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                      | Credits                 | 2                       |
|  |  |            |                      | Semester                | 5&7                     |
| Subject Numbering  | ABS-APS406B  |            |                      | Language Used in Course | English/Japanese        |
| 1. Class subject<br><b>Practical field and experimental training for marine biodiversity.</b>  |  |            |                      |                         |                         |
| 2. Object and summary of class<br>To understand importance of marine biodiversity.<br>(1) Observation and analysis of marine biodiversity.<br>(2) Analysis of genetic diversity in marine organisms.<br>(3) Comparative observation of early development and morphogenesis of marine invertebrates.  |  |            |                      |                         |                         |
| 3. Keywords<br>marine ecosystem, biodiversity, genetic diversity, early development, morphogenesis   |  |            |                      |                         |                         |
| 4. Goal of study<br>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<br><br><b>Five days in 4<sup>th</sup> semester (August)</b> <ul style="list-style-type: none"><li>Days 1-2: Quantitative and qualitative of marine biodiversity.</li><li>Days 3-4: Observation of early development of marine invertebrates.</li><li>Day 5: Presentation</li></ul> <b>Five days in 6<sup>rd</sup> semester (August)</b> <ul style="list-style-type: none"><li>Days 1-2: Quantitative and qualitative of genetic diversity in marine organisms.</li><li>Days 3-4: Observation of morphogenesis of marine invertebrates.</li><li>Days 5: Presentation</li></ul> |  |            |                      |                         |                         |
| 6. Preparation<br>For more information, note our announcement on June or July.   |  |            |                      |                         |                         |
| 7. Record end evaluation method <ul style="list-style-type: none"><li>Attendance: 40%</li><li>Activeness: 20%</li><li>Report: 40%</li></ul>  |  |            |                      |                         |                         |
| 8. Textbook and references<br>Preparing textbook   |  |            |                      |                         |                         |
| 9. Self study<br>None  |  |            |                      |                         |                         |
| 10. Practical business   |  |            |                      |                         |                         |
| 11. In addition<br>Contact e-mail address: <ul style="list-style-type: none"><li>Ikeda: minoru.ikeda.a6@tohoku.ac.jp</li></ul>   |  |            |                      |                         |                         |

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|---|--|------------|--------------------------|-------------------------------|----------------------------|--|--|
| Subject   | Fishery Science Practice I・II<br>(学生実験 I・II)                     | Day/Period | Mon.- Fri.<br>/3rd & 4th | Object                        | AMB                        |  |  |
| Instructor<br>(Post)  | M. Ikeda (Prof.) et al   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd & 3rd-year<br>students |  |  |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                          | Credits                       | 10                         |  |  |
|   |  |            |                          | Semester                      | 5 & 6                      |  |  |
| Subject<br>Numbering  | AAL-APS308E/AAL-APS309E  |            |                          | Language<br>Used in<br>Course | English                    |  |  |
| 1. Class subject<br><b>Morphology, function and components of aquatic organisms, analysis of substances in environment</b>  |  |            |                          |                               |                            |  |  |
| 2. Object and summary of class<br>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<br>Experiments, anatomy, microscopy, chemical analysis, statistics  |  |            |                          |                               |                            |  |  |
| 4. Goal of study<br>Students will <ul style="list-style-type: none"><li>- have basic knowledge for anatomical structure and components of aquatic organisms and analysis of environment.</li><li>- have deeper understanding of aquatic organisms and marine environment.</li></ul>   |  |            |                          |                               |                            |  |  |
| 5. Contents and progress schedule of class<br>The course will be conducted by AMB laboratories. <ul style="list-style-type: none"><li>- Anatomy of invertebrate and teleost</li><li>- Molecular biology and genetics</li><li>- Taxonomy of aquatic organisms</li><li>- Histology</li><li>- Physiology</li><li>- Analytical chemistry of environment and organisms</li><li>- Microbiology</li><li>- Ecology</li><li>- Statistic analysis</li></ul> |  |            |                          |                               |                            |  |  |
| 6. Preparation<br>Understand the materials and methods to be used in each class in advance.   |  |            |                          |                               |                            |  |  |
| 7. Record end evaluation method<br>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<br>Text for the course will be provided and students may be recommended to prepare well.   |  |            |                          |                               |                            |  |  |
| 9. Self study<br>Refer to related books in the library for writing reports.   |  |            |                          |                               |                            |  |  |
| 10. Practical business  |  |            |                          |                               |                            |  |  |
| 11. In addition<br>Students may visit the instructor of each experiment anytime.  |  |            |                          |                               |                            |  |  |



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|---|--|------------|-------------------------|-------------------------------|----------------------------|
| Subject   | Basic Chemistry, Practice<br>(基礎化学実験)                            | Day/Period | Mon.-Fri.<br>/3rd & 4th | Object                        | AMB                        |
| Instructor<br>(Post)  | M. Ikeda (Prof.) et al   | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 2nd & 3rd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 1                          |
|   |  |            |                         | Semester                      | 5 & 6                      |
| Subject<br>Numbering  | AAL-APS310E  |            |                         | Language<br>Used in<br>Course | English                    |
| 1. Class subject<br><b>Components of aquatic organisms, analysis of substances in environment</b>   |  |            |                         |                               |                            |
| 2. Object and summary of class<br>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<br>Experiments, analysis, biogenic substances, chemical components  |  |            |                         |                               |                            |
| 4. Goal of study<br>Students will<br>- have basic knowledge of biogenic substances from aquatic organisms and analysis of the environment.<br>- have knowledge of experimental procedures.  |  |            |                         |                               |                            |
| 5. Contents and progress schedule of class<br>The course will be conducted by AMB laboratories<br>- Anatomy of fin fish<br>- Extraction and analysis of genetic material<br>- Analysis of components of seawater<br>- Evaluation of taste components<br>- Extraction and analysis of body components<br>- |  |            |                         |                               |                            |
| 6. Preparation<br>Understand the materials and methods to be used in each class in advance.   |  |            |                         |                               |                            |
| 7. Record end evaluation method<br>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<br>Texts for the course will be provided.  |  |            |                         |                               |                            |
| 9. Self study<br>Refer to related books in the library for writing reports. Prepare well before attending each practical.   |  |            |                         |                               |                            |
| 10. Practical business  |  |            |                         |                               |                            |
| 11. In addition<br>Students may visit the instructor of each experiment any time.   |  |            |                         |                               |                            |

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|--|--|------------|-------------------------|-------------------------------|----------------------------|
| Subject  | Basic Biology, Practice<br>(基礎生物学実験)                             | Day/Period | Mon.-Fri./<br>3rd & 4th | Object                        | AMB                        |
| Instructor<br>(Post)   | M. Ikeda (Prof.) et al   | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 2nd & 3rd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 1                          |
|  |  |            |                         | Semester                      | 5 & 6                      |
| Subject<br>Numbering   | AAL-APS311E  |            |                         | Language<br>Used in<br>Course | English                    |
| 1. Class subject<br><b>Body plan and function of aquatic organisms</b>   |  |            |                         |                               |                            |
| 2. Object and summary of class<br>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<br>Morphology, Genetics, Taxonomy, Cellular tissue   |  |            |                         |                               |                            |
| 4. Goal of study<br>Students will<br>- have knowledge of basic biology<br>- have knowledge of experimental procedure   |  |            |                         |                               |                            |
| 5. Contents and progress schedule of class<br><br>The course will be conducted by AMB laboratories.<br>- Anatomy of fin fish<br>- Genetics and analysis of polymorphism<br>- Cell biology of aquatic plant<br>- Histology of marine animals  |  |            |                         |                               |                            |
| 6. Preparation<br>Read textbook before the class and understand an outline of experimental procedure in advance.   |  |            |                         |                               |                            |
| 7. Record end evaluation method<br>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<br>Text for the course will be provided and students may be recommended to prepare well.  |  |            |                         |                               |                            |
| 9. Self study<br>Review the results of the experiment and summarize it in the report.  |  |            |                         |                               |                            |
| 10. Practical business   |  |            |                         |                               |                            |
| 11. In addition<br>Students may visit the instructor of each experiment anytime.   |  |            |                         |                               |                            |

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|--|--|------------|----------------------------------|-------------------------------|----------------------|
| Subject  | Aquacultural Biology（水産増殖学）                                      | Day/Period | 2nd Quarter<br>Fri./1st &<br>2nd | Object                        | AMB                  |
| Instructor<br>(Post)   | M. Osada<br>(Prof.)  | Categories | Specialized<br>Subjects          | Preferable<br>Participants    | 2nd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                                  | Credits                       | 2                    |
|  |  |            |                                  | Semester                      | 5                    |
| Subject<br>Numbering   | ABS-APS341E  |            |                                  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br><b>Underlying concept of aquaculture and overview of projects of representative aquaculture</b>  |  |            |                                  |                               |                      |
| 2. Object and summary of class<br>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<br>Teleost, Crustacea, Bivalve, Natural seed, Artificial seed  |  |            |                                  |                               |                      |
| 4. Goal of study<br>Students will <ul style="list-style-type: none"><li>- cognize the importance of aquaculture for restoration and growth of fishery product.</li><li>- have knowledge of specific issues on aquaculture.</li></ul>   |  |            |                                  |                               |                      |
| 5. Contents and progress schedule of class <ul style="list-style-type: none"><li>- Current state of world fisheries production</li><li>- Concept of aquaculture</li><li>- Salmon 1 (life cycle)</li><li>- Salmon 2 (artificial seed production and release)</li><li>- Yellowtail 1 (life cycle)</li><li>- Yellowtail 2 (natural seed collection and farming)</li><li>- Flounder 1 (life cycle)</li><li>- Flounder 2 (artificial seed production and release)</li><li>- Kuruma Prawn 1 (life cycle)</li><li>- Kuruma Prawn 2 (artificial seed production and farming)</li><li>- Scallop 1 (life cycle)</li><li>- Scallop 2 (natural seed collection and farming)</li><li>- Oyster (natural seed collection and farming)</li><li>- Others (Pearl oyster and Bluefin tuna cultivation)</li><li>- Chromosome manipulation and sex manipulation</li></ul> |  |            |                                  |                               |                      |
| 6. Preparation<br>Read textbook and handout before the class and understand an outline of life cycle and aquaculture process of each animal in advance.  |  |            |                                  |                               |                      |
| 7. Record end evaluation method<br>The academic achievement will be evaluated by report assigned in each lecture.  |  |            |                                  |                               |                      |
| 8. Textbook and references<br>Modern methods of aquaculture in Japan Vol. 24, ed. by H. Ikenoue & T. Kafuku, Elsevier, 1992  |  |            |                                  |                               |                      |
| 9. Self study<br>Read again textbook based on the information learned at the class and review the knowledge of aquaculture.  |  |            |                                  |                               |                      |
| 10. Practical business   |  |            |                                  |                               |                      |
| 11. In addition<br>Students may visit the office or contact via Email (makoto.osada.a8@tohoku.ac.jp) anytime.<br>URL of the lab “Aquacultural Biology”; <a href="http://www.agri.tohoku.ac.jp/zoshoku/english.html">http://www.agri.tohoku.ac.jp/zoshoku/english.html</a>  |  |            |                                  |                               |                      |

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|---|--|------------|--|-------------------------------|-------------------|
| Subject   | Fisheries Biology and Ecology<br>(水産資源生態学)                       | Day/Period | 3 <sup>rd</sup> quarter<br>Mon./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB               |
| Instructor<br>(Post)  | S. Katayama<br>(Prof.)   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd-year students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                 |
|   |  |            |  | Semester                      | 6                 |
| Subject<br>Numbering  | ABS-APS342E  |            |  | Language<br>Used in<br>Course | English           |
| 1. Class subject<br><b>Life history of marine resources, biology, population dynamics and methodology of population analysis.</b>   |  |            |  |                               |                   |
| 2. Object and summary of class<br>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<br>Fish biology, life history strategy, Fisheries, Population analysis  |  |            |  |                               |                   |
| 4. Goal of study<br>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<br><br>1. Status of world and Japanese fisheries production<br>2. Stock identification and population structure<br>3-4. Ichthyology (External and internal morphology)<br>5-8. Life history (Age and growth, life cycle, migration, maturing and spawning, early life history, mortality and survival)<br>9. Patterns of population dynamics<br>10-11. Data analysis and stock assessment<br>12-13. Surplus yield model and yield per recruit model<br>14. Cohort analysis<br>15. Fisheries management |  |            |  |                               |                   |
| 6. Preparation<br>There are no particular prerequisites for this course. Basic biology capabilities will ease the learning.   |  |            |  |                               |                   |
| 7. Record end evaluation method<br>Score of an end-of-term exam and attendance  |  |            |  |                               |                   |
| 8. Textbook and references<br>Marine Fisheries Ecology, Jennings et al., 2001 Wiley-Blackwell<br>Fishes: An Introduction to Ichthyology, Moyle and Cech, 2004 Pearson Prentice Hall<br>Fisheries Biology, Assessment and Management, M. King, 2007 Wiley-Blackwell  |  |            |  |                               |                   |
| 9. Self study<br>Please do not lose teaching documents and your class note for the final exam.  |  |            |  |                               |                   |
| 10. Practical business  |  |            |  |                               |                   |
| 11. In addition<br>Contact: skata@tohoku.ac.jp  |  |            |  |                               |                   |

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|---|--|------------|--|-------------------------------|-----------------------------|
| Subject   | Aquatic Plant Ecology<br>(水圏植物生態学)                               | Day/Period | 1 <sup>st</sup> quarter<br>Tue./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB/JYPE                    |
| Instructor  | M. Aoki<br>(Associate Prof.)                                     | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd-year & JYPE<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                           |
|   |  |            |  | Semester                      | 5                           |
| Subject<br>Numbering  | ABS-APS343E  |            |  | Language<br>Used in<br>Course | English                     |
| 1. Class subject<br><b>The ecology of giant kelp forests</b>  |  |            |  |                               |                             |
| 2. Object and summary of class<br>This course provides the basic knowledge about the community ecology of marine kelps through the readings of some chapters related to the ecological topics in the book ‘The biology and ecology of giant kelp forests’ by Schiel & Foster (2015).  |  |            |  |                               |                             |
| 3. Keywords<br>Kelp forest, Sea urchin, Barren, Grazing, Population dynamics, Production, Rocky subtidal ecosystem, Phase shift<br>Global warming   |  |            |  |                               |                             |
| 4. Goal of study<br>The goal is to understand the structure and function of marine kelp communities through the study of the ecology of giant kelp forests.   |  |            |  |                               |                             |
| 5. Contents and progress schedule of class<br>(1) Introduction<br>(2) The abiotic environment-1: Substratum and sedimentation<br>(3) The abiotic environment-2: Temperature, light and nutrient<br>(4) The abiotic environment-3: Water motion<br>(5) Dispersal and connectivity of populations-1: Demography and metapopulations<br>(6) Dispersal and connectivity of populations-2: Reproductive output and source of propagules<br>(7) Dispersal and connectivity of populations-3: Spore dispersal and recruitment windows<br>(8) Session review-1<br>(9) Grazing in kelp communities-1: Kelp-sea urchin interactions<br>(10) Grazing in kelp communities-2: Reversion of barrens to kelp habitat<br>(11) Grazing in kelp communities-3: Other grazers in giant kelp communities<br>(12) Predation and trophic cascades-1: Fish predation on grazers<br>(13) Predation and trophic cascades-2: Lobster predation on grazers<br>(14) Predation and trophic cascades-3: Sea otter predation on grazers<br>(15) Session review-2 |  |            |  |                               |                             |
| 6. Preparation<br>Read the relevant chapters in the textbook in advance.  |  |            |  |                               |                             |
| 7. Record and evaluation method<br>Report and attendance  |  |            |  |                               |                             |
| 8. Textbook and references<br>Reference texts:<br>Schiel DR and Foster MS (2015) The biology and ecology of giant kelp forests. University of California Press  |  |            |  |                               |                             |
| 9. Self study<br>Review is required.  |  |            |  |                               |                             |
| 10. Practical business  |  |            |  |                               |                             |
| 11. In addition<br>Office phone number: 022-757-4152<br>Mail address: masakazu.aoki.e6@tohoku.ac.jp   |  |            |  |                               |                             |

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|---|--|------------|--|-------------------------------|----------------------|
| Subject   | Marine Biochemistry（水産化学）  | Day/Period | 2 <sup>nd</sup> Quarter<br>Tue./1 <sup>st</sup> -2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)  | T. Nakano (Assoc. Prof.)   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                    |
|   |  |            |  | Semester                      | 5                    |
| Subject<br>Numbering  | ABS-APS244E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject  |  |            |  |                               |                      |
| Biochemical characterization of aquatic organisms and seafood   |  |            |  |                               |                      |
| 2. Object and summary of class  |  |            |  |                               |                      |
| The organisms inhabiting in water have unique components to adapt to and survive in the environment. To understand their ways of life, it is essential to understand the chemical components of fish and other marine organisms. 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. The class deals with the biochemical, nutritional and functional properties of the components in the organisms and the mechanisms of development as well as adaptation to habitat environment. The other related topics will also be introduced. |  |            |  |                               |                      |
| 3. Keywords   |  |            |  |                               |                      |
| Aquatic organisms, chemical components, catabolic pathways, regulatory systems  |  |            |  |                               |                      |
| 4. Goal of study  |  |            |  |                               |                      |
| To get the sufficient knowledge about the characteristics of marine organisms from a biochemical viewpoint.<br>To understand the mechanisms to survive in water.  |  |            |  |                               |                      |
| 5. Contents and progress schedule of class  |  |            |  |                               |                      |
| 1: Biochemical characteristics of marine organisms<br>2: Metabolism<br>3: Proteins<br>4: Lipids<br>5: Carbohydrates<br>6: Vitamins<br>7: Minerals<br>8: Enzymes<br>9: Bioactive components<br>10: Physical aspects of life<br>11: Functional substances<br>12: Natural toxins and food poisoning<br>13: Osmoregulation<br>14: Final presentations<br>15: Final report   |  |            |  |                               |                      |
| 6. Preparation  |  |            |  |                               |                      |
| Collect the related information in the library and through the web  |  |            |  |                               |                      |
| 7. Record end evaluation method   |  |            |  |                               |                      |
| Based on the final report and presentations (50%), homework (20%) and class attendance (30%).   |  |            |  |                               |                      |
| 8. Textbook and references  |  |            |  |                               |                      |
| Nelson & Cox: Lehninger Principles of Biochemistry 8 <sup>th</sup> edition (2021)   |  |            |  |                               |                      |
| 9. Self study   |  |            |  |                               |                      |
| Read related papers published in recent years.  |  |            |  |                               |                      |
| 10. Practical business  |  |            |  |                               |                      |
| 11. In addition   |  |            |  |                               |                      |
| Contact email: nakanot@tohoku.ac.jp   |  |            |  |                               |                      |

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

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|---|--|------------|--------------------------|-------------------------|-------------------|
| Subject   | Applied Genetics in Aquatic Organisms (沿岸生物学)                    | Day/Period | 4th Quarter Mon./1st-2nd | Object                  | AMB               |
| Instructor (Post)   | M. Ikeda (Prof.)   | Categories | Specialized Subjects     | Preferable Participants | 3rd-year students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                          | Credits                 | 2                 |
|   |  |            |                          | Semester                | 6                 |
| Subject Numbering   | ABS-APS347E  |            |                          | Language Used in Course | English           |
| 1. Class subject<br><b>Conservation and sustainable yield of marine bio-resources</b>   |  |            |                          |                         |                   |
| 2. Object and summary of class<br>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.<br>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<br>marine organisms、genetics and breeding science、population structure、conservation, aquaculture  |  |            |                          |                         |                   |
| 4. Goal of study<br>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<br>1. Introduction<br>2. Extinction<br>3. Quantification of Genetic Diversity (I)<br>4. Quantification of Genetic Diversity (II)<br>5. Quantification of Genetic Diversity (III)<br>6. Quantification of Genetic Diversity (IV)<br>7. Inbreeding & Outbreeding Depressions (I)<br>8. Inbreeding & Outbreeding Depressions (I)<br>9. Molecular Identification (VI)<br>10. Conservation Units (I)<br>11. Conservation Units (II)<br>12. Conservation Units (III)<br>13. Genetic Rescue<br>14. Translocations<br>15. Captive Breeding Program |  |            |                          |                         |                   |
| 6. Preparation<br>No need but you should survey the technical terms in the lecture and write on your note book.   |  |            |                          |                         |                   |
| 7. Record end evaluation method<br>Examination and Reports  |  |            |                          |                         |                   |
| 8. Textbook and references<br>Directing on the lecture  |  |            |                          |                         |                   |
| 9. Self study   |  |            |                          |                         |                   |
| 10. Practical business  |  |            |                          |                         |                   |
| 11. In addition<br>When you have a question, please contact me by e-mail.<br>e-mail address: minoru.ikeda.a6@tohoku.ac.jp   |  |            |                          |                         |                   |



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| Subject  | Aquatic Invertebrate Biology<br>(水圏無脊椎動物学)                       | Day/Period | 1 <sup>st</sup> quarter<br>Fri./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                              |
| Instructor<br>(Post)   | K. Takahashi<br>(Associate professor)                            | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 1 <sup>st</sup> year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                                |
|  |  |            |  | Semester                      | 3                                |
| Subject<br>Numbering   | ABS-APS348E  |            |  | Language<br>Used in<br>Course | English                          |
| 1. Class subject<br><b>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.</b>   |  |            |  |                               |                                  |
| 2. Object and summary of class<br>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.<br>To learn trained immunity of aquatic invertebrates based on host-parasite coevolution.<br>To understand structures of digestive organs and feeding and digestive mechanisms of bivalve mollusks.<br>To understand structures of heart and vessels, and circulatory system of bivalve mollusks.   |  |            |  |                               |                                  |
| 3. Keywords<br>Marine invertebrates, Bivalves, Oysters, Innate immunity, Bio defense, Digestive systems, Feeding systems   |  |            |  |                               |                                  |
| 4. Goal of study<br>Understanding the basic sciences in relation to immunology, feeding behavior and life history of aquatic invertebrates.  |  |            |  |                               |                                  |
| 5. Contents and progress schedule of class<br>1st: Guidance<br>2nd: Feeding mechanisms of bivalve mollusks 1<br>3rd: Feeding mechanisms of bivalve mollusks 2<br>4th: Feeding mechanisms of bivalve mollusks 3<br>5th: Digestion and nutrition in bivalve mollusks 1<br>6th: Digestion and nutrition in bivalve mollusks 2<br>7th: Circulatory system of bivalve mollusks 1<br>8th: Circulatory system of bivalve mollusks 2<br>9th: A thorough review and first examination (Exam 1) of the class in the first half<br>10th: Innate Immunity in Invertebrates 1: general theory<br>11th: Innate Immunity in Invertebrates 2: morphology and function of hemocytes<br>12th: Innate Immunity in Invertebrates 3: pathogen recognition receptors (PRRs) and PAMPs<br>13th: Innate Immunity in Invertebrates 4: host defense in mollusks<br>14th: Innate Immunity in Invertebrates 5: host defense in crustaceans<br>15th: Innate Immunity in Invertebrates 6: trained immunity of mollusks: model for host-parasite coevolution<br>16th: A thorough review and second examination (Exam 2) of the class in the second half |  |            |  |                               |                                  |
| 6. Preparation<br>You should study basic biology, especially immunology and molluscan biology, prior to class studying.  |  |            |  |                               |                                  |
| 7. Record end evaluation method<br>Attendance point: 300 points (20 points per one lecture time; 15 times)<br>Examination point: 200 points (100 points per one exam)<br>AA=90-100%; A=80-89%; B=70-79%; C=60-69%; D=below 60%   |  |            |  |                               |                                  |
| 8. Textbook and references<br>Brusca, R.C., 2016. Invertebrates, 1 <sup>st</sup> Edition, Sinauer, Sunderland, MA.<br>Ruppert, E.E., J.A. 2003. Invertebrate Zoology. A functional evolutionary approach. Brook/Cole, CA.<br>Murphy, K. 2016. Janeway's Immunobiology, 9 <sup>th</sup> Edition. Garland Science, New York.   |  |            |  |                               |                                  |
| 9. Self study<br>You can study by yourself using 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. Practical business   |  |            |  |                               |                                  |
| 11. In addition<br>E-mail: waradica@tohoku.ac.jp<br>Office hour: 13:00-15:00 on Tuesday and Wednesday.   |  |            |  |                               |                                  |

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| Subject  | Applied Aquatic Botany<br>(水圏植物学)                                | Day/Period | 1 <sup>st</sup> quarter<br>Mon./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)   | M. Aoki<br>(Associate Prof.)                                     | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                    |
|  |  |            |  | Semester                      | 5                    |
| Subject<br>Numbering   | ABS-APS349E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br><b>Concepts and methods for the study of marine plant life</b>   |  |            |  |                               |                      |
| 2. Object and summary of class<br>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<br>seaweed, kelp, <i>Sargassum</i> , plant-animal interactions, grazers, herbivores  |  |            |  |                               |                      |
| 4. Goal of study<br>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<br>(1) At the beginning: all about WAKAME: <i>Undaria pinnatifida</i><br>(2) Geographical distribution of marine algae<br>(3) Vertical distribution of marine algae: intertidal zone<br>(4) Vertical distribution of marine algae: subtidal zone<br>(5) Primary production of coastal marine plants<br>(6) Population analysis of marine plants<br>(7) Monitoring survey of marine plant communities<br>(8) Dispersal ability of marine plants<br>(9) Plant-animal interactions in benthic algae communities<br>(10) Epiphytic animals and tsunami impacts<br>(11) Grazing snails<br>(12) Field experiments<br>(13) Mariculture<br>(14) Pollution<br>(15) Session review  |  |            |  |                               |                      |
| 6. Preparation   |  |            |  |                               |                      |
| 7. Record and evaluation method<br>Attendance rates and test scores will be recorded and evaluated.  |  |            |  |                               |                      |
| 8. Textbook and references<br>Handouts will be available at the beginning of each lecture.   |  |            |  |                               |                      |
| 9. Self study<br>Review is required.   |  |            |  |                               |                      |
| 10. Practical business   |  |            |  |                               |                      |
| 11. In addition<br>Office phone number: 022-757-4152<br>Mail address: masakazu.aoki.e6@tohoku.ac.jp  |  |            |  |                               |                      |

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|---|--|------------|--|-------------------------------|----------------------|
| Subject   | Marine Product Technology<br>(水産利用学)                             | Day/Period | 3 <sup>rd</sup> Quarter<br>Wed./1 <sup>st</sup> -2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)  | Y. Ochiai<br>(Professor)   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                    |
|   |  |            |  | Semester                      | 6                    |
| Subject<br>Numbering  | ABS-APS350E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br><b>The biochemical characteristics and effective utilization of marine bioresources</b>   |  |            |  |                               |                      |
| 2. Object and summary of class<br>The biochemical characteristics of marine organisms as foodstuffs will be explained. The attendees are supposed to understand the principle of seafood production and the processing methods. Accurate knowledge of the hygienic control of fish and shellfish will also be dealt to understand the roles of marine organisms as resources for food. The functions of seafood for human health and the characteristics of seafood for medicinal and industrial materials will be also discussed.                        |  |            |  |                               |                      |
| 3. Keywords<br>Food preservation, Freezing and thawing techniques, Postmortem changes of fish and shellfish   |  |            |  |                               |                      |
| 4. Goal of study<br>To be able to understand the principals and methods of food processing, preservation and the control of seafood qualities and to get the knowledge for the effective utilization of marine resources.   |  |            |  |                               |                      |
| 5. Contents and progress schedule of class<br>1 Marine resources for food<br>2 Characteristics and variation of seafood<br>3 Nutritional aspects of seafood<br>4 Processing principals of typical seafood<br>5 Food poisonings related to seafood<br>6 Seafood allergy<br>7 Health-promoting functions of the substances from aquatic organisms<br>8 Biochemical substances from marine organisms for medicinal and industrial materials<br>9 Control of muscle protein quality<br>10 Report writing<br>11 Term-end exam                                  |  |            |  |                               |                      |
| 6. Preparation<br>Review the contents of the lectures on Marine Biochemistry  |  |            |  |                               |                      |
| 7. Record end evaluation method<br>The final grade will be calculated based on the mid-term reports (40%) and term-end examination (60%).   |  |            |  |                               |                      |
| 8. Textbook and references<br>Handbook of Marine Natural Products vol.1, vol.2 (Fattorusso, E. et al., ed.) Springer (2012)<br>Seafood Processing Technology, Quality and Safety (Bosiaris, I.S. ed) Wiley Blackwell (2014)<br>Food Physics Physical Properties-Measurement and Applications (Figura, L.O. and Teixeira, A.A. ed.) Springer (2007)<br>Assessment and management of seafood safety and quality Current practices and emerging issues ((Ryder, J., Iddya, K. and Ababouch, L. ed.) FAP Fisheries and Aquaculture Technical Paper 574 (2014) |  |            |  |                               |                      |
| 9. Self study<br>Refer to the websites related to the topics and also to the related papers.  |  |            |  |                               |                      |
| 10. Practical business  |  |            |  |                               |                      |
| 11. In addition   |  |            |  |                               |                      |

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

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|---|--|------------|--|-------------------------------|----------------------|
| Subject   | Planktology (プランクトン学)  | Day/Period | 2 <sup>nd</sup> Quarter<br>Wed./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)  | G. Nishitani<br>(Associate Professor)                            | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 2nd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 2                    |
|   |  |            |  | Semester                      | 5                    |
| Subject<br>Numbering  | ABS-APS252E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br><b>Systematics and biology of marine plankton</b>   |  |            |  |                               |                      |
| 2. Object and summary of class<br><br>An introduction to systematics, physiology, and ecology of marine plankton  |  |            |  |                               |                      |
| 3. Keywords<br><br>Diatom, dinoflagellate, ciliate, copepod, krill, food chain, microbial food web, vertical migration  |  |            |  |                               |                      |
| 4. Goal of study<br><br>Understanding structure and role of plankton community in marine ecosystem  |  |            |  |                               |                      |
| 5. Contents and progress schedule of class<br><br>Marine ecological division (1)<br>Classification of marine plankton (1)<br>Characteristics of phytoplankton and zooplankton (2)<br>Food chain and food web in marine plankton (1)<br>Primary production by marine phytoplankton (1)<br>Material circulation (carbon and nitrogen cycles) (2)<br>Ecology and application of useful phytoplankton (2)<br>Ecology and biology of harmful phytoplankton (2)<br>Current topics in marine plankton (2)<br>Examination |  |            |  |                               |                      |
| 6. Preparation<br><br>Basic knowledge of biology and ecology, basic understanding of marine ecosystem   |  |            |  |                               |                      |
| 7. Record and evaluation method<br><br>Presence/absence evaluation & examination  |  |            |  |                               |                      |
| 8. Textbook and references<br><br>Biological Oceanography: An Introduction, second edition<br>Lalli and Parsons, 1997, ELSEVIER Butterworth-Heinemann   |  |            |  |                               |                      |
| 9. Self study   |  |            |  |                               |                      |
| 10. Practical business  |  |            |  |                               |                      |
| 11. In addition<br><br>Contact email address: ni5@tohoku.ac.jp  |  |            |  |                               |                      |

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

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|---|--|------------|-------------------------|-------------------------------|-----------------------------|
| Subject   | Introduction to Fisheries Science<br>(水産科学概論)                    | Day/Period | Fri./2nd                | Object                        | AMB/JYPE                    |
| Instructor<br>(Post)  | M. Ikeda (Prof.) et al.  | Categories | Specialized<br>Subjects | Preferable<br>Participants    | 2nd-year & JYPE<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                         | Credits                       | 2                           |
|   |  |            |                         | Semester                      | 4                           |
| Subject<br>Numbering  | ABS-APS255E  |            |                         | Language<br>Used in<br>Course | English                     |
| 1. Class subject<br><b>Introduction to Fisheries Science</b>  |  |            |                         |                               |                             |
| 2. Object and summary of class<br>This course provides an overview of fisheries science. Students will learn the fundamentals of fisheries science as it relates broadly to marine biology, from molecules to ecosystems.   |  |            |                         |                               |                             |
| 3. Keywords<br>Fisheries science, fundamentals, overview  |  |            |                         |                               |                             |
| 4. Goal of study<br>The goal is to understand the fundamentals of fisheries science from ecology, physiology, genetics, molecular biology and evolution, and to appreciate fisheries science as it relates to applied marine biology.   |  |            |                         |                               |                             |
| 5. Contents and progress schedule of class<br><b>Topics on marine ecology and oceanography</b><br>1. “The ecology of floating seaweeds” (M. Aoki)<br>2. “Distributional pattern of seaweeds” (H. Suzuki)<br>3. “How to know the fish age” (S. Katayama)<br>4. “How to know the fish migration” (S. Katayama)<br>5. “Benthos adapted to marine environments” (W. Sato-Okoshi)<br>6. “Plankton in the ocean” (G. Nishitani)<br>7. "Coastal ecosystem dynamics and fisheries resources" (T. Fujii)<br><b>Topics on physiology, biochemistry and genetics of aquatic organisms</b><br>8. “Immunity in marine invertebrates” (K. Takahashi)<br>9. “Manipulation of reproduction in bivalve mollusks” (M. Osada)<br>10. “Food chemistry of fish and shellfish” (Y. Ochiai)<br>11. “Probiotics and bioactive substances in fish" (T. Nakano)<br>12. “Genetic conservation and sustainable use of resources in aquatic organisms” (M. Nakajima)<br>13. “Biological sequence comparison methods” (Y. Sakai)<br>14. "Evolution and fisheries resources" (M. Ikeda)<br>15. “Molecular phylogenetics: Tools and applications” (C. Ames) |  |            |                         |                               |                             |
| 6. Preparation<br>Refer to recent topics in each field.   |  |            |                         |                               |                             |
| 7. Record end evaluation method<br>Attendance and paper. Papers in which the contents of each lecture are organized should be directly submitted to the “Classroom” by the next lecture. The final report should be submitted within a week of the final lecture.   |  |            |                         |                               |                             |
| 8. Textbook and references<br>No textbook. References (books, articles, videos) will be provided  |  |            |                         |                               |                             |
| 9. Self-study<br>Summarize the content of each class promptly.  |  |            |                         |                               |                             |
| 10. Practical business  |  |            |                         |                               |                             |
| 11. In addition<br>Questions, comments, and requests should be sent to the representative instructor,<br>Prof. Ikeda: minoru.ikeda.a6@tohoku.ac.jp  |  |            |                         |                               |                             |

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|--|--|------------|----------------------|-------------------------|-------------------|
| Subject  | Practical Training (実地研修)  | Day/Period | Intensive Course     | Object                  | AMB               |
| Instructor (Post)  | M. Ikeda (Prof.) et al   | Categories | Specialized Subjects | Preferable Participants | 3rd-year students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |                      | Credits                 | 1                 |
|  |  |            |                      | Semester                | 6                 |
| Subject Numbering  | ABS-APS456E  |            |                      | Language Used in Course | English           |
| 1. Class subject   |  |            |                      |                         |                   |
| Practical training at the points of fishery production and research  |  |            |                      |                         |                   |
| 2. Object and summary of class   |  |            |                      |                         |                   |
| This course provides the tours at the point of fishery production and research.<br>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:<br>1. Aquaculture facility<br>2. Research institute of fishery<br>3. Seafood company<br>4. Fish market<br>5. Wildlife sanctuary      etc. |  |            |                      |                         |                   |
| 6. Preparation   |  |            |                      |                         |                   |
| Collect information before starting each tour.   |  |            |                      |                         |                   |
| 7. Record and evaluation method  |  |            |                      |                         |                   |
| Attendance and report.<br>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. Practical business   |  |            |                      |                         |                   |
| 11. In addition  |  |            |                      |                         |                   |
| Questions, comments, and requests are welcome.<br>Send them to the representative instructor, Prof. Ikeda: minoru.ikeda.a6@tohoku.ac.jp  |  |            |                      |                         |                   |



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

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|--|--|------------|--|-------------------------------|----------------------|
| Subject  | Current topics of Shellfish Physiology<br>(先端海洋生物生理学)            | Day/Period | 1 <sup>st</sup> quarter<br>Thu./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)   | Kazue Nagasawa<br>(Assistant Prof.)                              | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd-year<br>students |
| Position   | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 1                    |
|  |  |            |  | Semester                      | 7                    |
| Subject<br>Numbering   | ABS-APS363E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject   |  |            |  |                               |                      |
| Recent research topics in aquatic animal physiology  |  |            |  |                               |                      |
| 2. Object and summary of class   |  |            |  |                               |                      |
| Studies on aquatic animal physiology have contributed to not only aquaculture production, but also fundamental biology. In this course, some recent findings in 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 findings, scientific interests with science impact, and further application.   |  |            |  |                               |                      |
| 5. Contents and progress schedule of class   |  |            |  |                               |                      |
| 1. Guidance & Introduction<br>2. Germ cell biology in aquatic animals 1 (germ cell classification)<br>3. Germ cell biology in aquatic animals 2 (germline stem cell)<br>4. Germ cell biology in aquatic animals 1 (germ cell transplantation 1)<br>5. Germ cell biology in aquatic animals 2 (germ cell transplantation 2)<br>6. Neuroendocrinology in aquatic animals 1<br>7. Neuroendocrinology in aquatic animals 2 |  |            |  |                               |                      |
| 6. Preparation   |  |            |  |                               |                      |
| No need.   |  |            |  |                               |                      |
| 7. Record end evaluation method  |  |            |  |                               |                      |
| Evaluation is based on class attendance and quiz after each class.   |  |            |  |                               |                      |
| 8. Textbook and references   |  |            |  |                               |                      |
| Handouts will be provided.   |  |            |  |                               |                      |
| 9. Self study  |  |            |  |                               |                      |
| Review the handouts.   |  |            |  |                               |                      |
| 10. Practical business   |  |            |  |                               |                      |
| 11. In addition  |  |            |  |                               |                      |
| Students may visit to instructor office or contact by Email (kazue.magasawa.d6@tohoku.ac.jp).  |  |            |  |                               |                      |

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

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|---|--|------------|--|-------------------------------|----------------------|
| Subject   | Current topics of Fish Biochemistry<br>(先端海洋生物化学)                | Day/Period | 1 <sup>st</sup> quarter<br>Fri./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)  | T. Nakano (Associate Prof.)                                      | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 1                    |
|   |  |            |  | Semester                      | 7                    |
| Subject<br>Numbering  | ABS-APS365E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br>Marine Biochemistry and Seafood Science   |  |            |  |                               |                      |
| 2. Object and summary of class<br>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<br>Lipid; Protein; <i>Washoku</i> ; Bioactive Substance; Freshness; Quality Assessment; Stress; Growth; Transgenic Fish   |  |            |  |                               |                      |
| 4. Goal of study<br>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<br><br>1. Introduction “Current research topics in our lab at a glance”<br><i>Washoku</i> and seafoods<br>2. Functional substances from marine products<br>Quality of seafoods<br>3. Stress in fish<br>Growth and nutrition in fish<br>4. Exam |  |            |  |                               |                      |
| 6. Preparation<br>TBA (Preparation will be notified at the class)   |  |            |  |                               |                      |
| 7. Record end evaluation method<br>Class attendance, presentation, and examination  |  |            |  |                               |                      |
| 8. Textbook and references<br>References will be notified at the class.<br>(tentative) Dietary Supplements for the Health and Quality of Cultured Fish by Nakagawa, Sato and Gatlin, CABI, 2007.<br>The Physiology of Fishes 3rd ed. by Evans and Claiborne, Taylor and Francis, 2006.    |  |            |  |                               |                      |
| 9. Self-study<br>TBA (Self-study will be notified at the class)   |  |            |  |                               |                      |
| 10. Practical business<br>No  |  |            |  |                               |                      |
| 11. In addition<br>Questions, comments, and requests will be accepted during office hours.  |  |            |  |                               |                      |

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

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

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|---|--|------------|--|-------------------------|-------------------|
| Subject   | Current topics of Fish Molecular Biology (先端海洋分子生物学)             | Day/Period | 2 <sup>nd</sup> quarter<br>Thu./3 <sup>rd</sup> ~4 <sup>th</sup> | 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<br><b>Fish Molecular Biology -- Fish as a Model System</b>   |  |            |  |                         |                   |
| 2. Object and summary of class<br>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<br>Experimental model animal, genetics, developmental biology, non-conventional model animal  |  |            |  |                         |                   |
| 4. Goal of study<br>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<br><br>1. Introduction: Molecular biology as a tool for the research in biology and medicine<br>2. Advantage of nematode and fly as model system: development, genetics and mutagenesis<br>3. Advantage of fish as a model system: developmental genetics, genomics and mutagenesis<br>4. Advantage of frog and chicken as model system: development and micro-surgery<br>5. Advantage of mouse as a model system: development and stem cell technology<br>6. Advantage of using multiple model system: comparative approach and evolutionary biology<br>7. Experimental model system: past, present and future<br>8. Summary and final exam |  |            |  |                         |                   |
| 6. Preparation<br>Review the previous classes. Please feel free to ask during the class, if you have any ambiguous points.  |  |            |  |                         |                   |
| 7. Record end evaluation method<br>Attendance, participation, quiz and final exam.  |  |            |  |                         |                   |
| 8. Textbook and references<br>Developmental biology (Scott F Gilbert)<br>Others will be introduced in the class.  |  |            |  |                         |                   |
| 9. Self study<br>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. Practical business  |  |            |  |                         |                   |
| 11. In addition<br>Office hours, 10:00 to 18:00, Monday to Friday, please make an appointment beforehand.<br>Contact, hayokoi@tohoku.ac.jp  |  |            |  |                         |                   |

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|---|--|------------|--|-------------------------------|----------------------|
| Subject   | Current topics of Plankton Biology<br>(先端プランクトン学)                | Day/Period | 2 <sup>nd</sup> quarter<br>Fri./1 <sup>st</sup> ~2 <sup>nd</sup> | Object                        | AMB                  |
| Instructor<br>(Post)  | G. Nishitani<br>(Assistant Prof.)                                | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                       | 1                    |
|   |  |            |  | Semester                      | 7                    |
| Subject<br>Numbering  | ABS-APS369E  |            |  | Language<br>Used in<br>Course | English              |
| 1. Class subject<br><b>Molecular Ecology and utilization of plankton</b>  |  |            |  |                               |                      |
| 2. Object and summary of class<br>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<br>Phytoplankton, Useful and harmful species, Molecular ecology   |  |            |  |                               |                      |
| 4. Goal of study<br>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<br><br>Useful microalgae (phytoplankton) (2)<br>Harmful microalgae (2)<br>Research introduction (2)<br>Examination   |  |            |  |                               |                      |
| 6. Preparation<br>Understand an outline of each topic in advance  |  |            |  |                               |                      |
| 7. Record end evaluation method<br>Attendance and examination   |  |            |  |                               |                      |
| 8. Textbook and references<br>All handouts will be given within class   |  |            |  |                               |                      |
| 9. Self study   |  |            |  |                               |                      |
| 10. In addition<br>E-mail: ni5@tohoku.ac.jp   |  |            |  |                               |                      |



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

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|---|---|------------|--|-------------------------------|--------------------------|
| Subject   | Introduction to Applied Animal and Dairy Science<br>(応用動物・酪農科学概論) | Day/Period | 1 <sup>st</sup> quarter<br>Fri./3 <sup>rd</sup> ~4 <sup>th</sup> | Object                        | AMB/JYPE                 |
| Instructor<br>(Post)  | Kan Sato et al.   | Categories | Specialized<br>Subjects  | Preferable<br>Participants    | 3rd&4th-year<br>students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science)  |            |  | Credits                       | 2                        |
|   |   |            |  | Semester                      | 7 and 9                  |
| Subject<br>Numbering  | ABS-ANS360E   |            |  | Language<br>Used in<br>Course | English                  |
| 1. Class subject <b>Introduction to Applied Animal and Dairy Science</b>  |   |            |  |                               |                          |
| 2. Object and summary of class:<br>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<br>Animal science, Dairy science  |   |            |  |                               |                          |
| 4. Goal of study<br>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:<br>1) Overview of Animal Reproduction (Prof. Kentaro Tanemura, Assoc. Prof. Kenshiro Hara)<br>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.<br>2) Overview of Animal Nutrition (Prof. Kan Sato, Assoc. Prof. Motoi Kikusato)<br>Introduction to metabolism of protein, fat and carbohydrate in farm animals. In addition, we introduce molecular and mitochondrial nutrition to improve animal products in dairy cows and chickens.<br>3) Overview of Animal Breeding and Genetics (Prof. Masahiro Sato, Assoc. Prof. Yoshinobu Uemoto)<br>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.<br>4) Overview of Animal Physiology (Prof. Sanggun Roh)<br>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.<br>5) Overview of Animal Cell Biology (Prof. Tomonori Nochi)<br>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.<br>6) Overview of Animal Microbiology (Prof. Hiroshi Yoneyama)<br>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.<br>7) Overview of Animal Food Science (Prof. Haruki Kitazawa)<br>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.<br>8) Overview of Grazing Management (Prof. Shin-ichiro Ogura, Assoc. Prof. Michiru Fukasawa)<br>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.<br>9) Overview of Animal Health and Management (Prof. Kentaro Kato, Assoc. Prof. Chika Tada)<br>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<br>NO need   |   |            |  |                               |                          |
| 7. Record end evaluation method Attendance to the lectures 50%, reports 50%   |   |            |  |                               |                          |
| 8. Textbook and references We will introduce in each category of class.   |   |            |  |                               |                          |
| 9. Self study   |   |            |  |                               |                          |
| 10. Practical business  |   |            |  |                               |                          |
| 11. In addition   |   |            |  |                               |                          |

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|---|--|------------|---|-------------------------------|---------------------------------|
| Subject   | Food and Chemistry<br>(食糧と化学)                                    | Day/Period | 1 <sup>st</sup> quarter<br>Thur./3 <sup>rd</sup> ~4 <sup>th</sup> | Object                        | AMB/JYPE                        |
| Instructor<br>(Post)  | M. Ishikawa (Prof.) et al.                                       | Categories | Specialized<br>Subjects   | Preferable<br>Participants    | 3rd&4th-year &<br>JYPE students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |   | Credits                       | 2                               |
|   |  |            |   | Semester                      | 7 and 9                         |
| Subject<br>Numbering  | ABS-AGC362E  |            |   | Language<br>Used in<br>Course | English                         |
| 1. Class subject: <b>Biochemistry and chemistry of food and bioactive natural products</b>  |  |            |   |                               |                                 |
| 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? ( <b>Prof. Masako TODA</b> )<br>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.( <b>Prof. Hitoshi SHIRAKAWA</b> )<br>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 ( <b>Prof. Kiyotaka NAKAGAWA</b> )<br>This lecture will give you basic understanding of the roles of food and bioactive natural products to prevent against ageing and oxidative damages (e.g., dementia, cancers, atherosclerosis). This lecture will also address the development of food for human health.   |  |            |   |                               |                                 |
| 4. Beneficial health effects of dietary lipids ( <b>Assoc. Prof. Takahiro EITSUKA</b> )<br>Lipids play important roles in the function of our body in both health and disease. This lecture will provide basic knowledge of health functions of dietary lipids and their mechanisms of action.  |  |            |   |                               |                                 |
| 5. Chemistry and biochemistry of marine toxins I ( <b>Prof. Mari YAMASHITA</b> )<br>Some of the marine animals contain highly toxic compounds which could cause food intoxication. Isolation, structural determination, analytical methods and pharmacology of these compounds will be presented.   |  |            |   |                               |                                 |
| 6. Chemistry and biochemistry of marine toxins II ( <b>Assoc. Prof. Keiichi KONOKI</b> )<br>Isolation, structural determination, analytical methods and pharmacology of marine toxins will be presented. (This lecture is the second part of lecture about the marine toxins.)  |  |            |   |                               |                                 |
| 7. Application of high pressure to food processing. ( <b>Prof. Tomoyuki FUJII</b> )<br>High pressure technique is one of non-thermal processing of food. In this lecture, the quality of the pressurized food will be discussed from the viewpoint of the high pressure effect on food structure.   |  |            |   |                               |                                 |
| 8. Protein chemistry ( <b>Prof. Yoshikazu TANAKA</b> )<br>To understand function of protein, determining its 3D structure is of significance. In this lecture, basic principle of 3D structure determination is introduced. The practical experiment will be carried out as well.   |  |            |   |                               |                                 |
| 9. Bioactive molecules and their application for drug discovery ( <b>Prof. Minoru ISHIKAWA</b> )<br>There are many biologically active compounds in natural products. This lecture will focus on bioactive compounds in human health, their target molecules, and applications for drug discovery and medicinal chemistry.  |  |            |   |                               |                                 |
| 10. Medicinal chemistry of antibacterial and antiviral agents ( <b>Prof. Hirokazu ARIMOTO</b> )<br>Selected topics in anti-infective agents will be discussed with an emphasis on how organic chemistry is used in the drug development process.  |  |            |   |                               |                                 |
| 11. Synthetic and medicinal chemistry of marine natural products ( <b>Prof. Makoto SASAKI</b> )<br>Marine natural products that display important biological activities with remarkable potency and specificity are known to be useful for understanding/regulating biological events. This lecture will give an overview of the synthetic and medicinal chemistry of some important marine natural products.   |  |            |   |                               |                                 |
| 12. Nutrient-inspired biomaterials and its applications for the health purpose ( <b>Assoc. Prof. Taiki MIYAZAWA</b> )<br>There are different types of nutrients in nature, which have a variety of different biological activities and physical properties. The challenge of biomaterials, composed primarily of these properties, is one of the important topics for human health. The basic outline and application of this research area are introduced in this lecture. |  |            |   |                               |                                 |
| 13. Lecture is given by Assoc. Prof. appointed in 2022  |  |            |   |                               |                                 |
| 14. Lecture is given by Assoc. Prof. appointed in 2022  |  |            |   |                               |                                 |
| 6. Preparation:   |  |            |   |                               |                                 |
| 7. Record and evaluation method: Attendance to the lectures 50%, reports 50%  |  |            |   |                               |                                 |
| 8. Textbook and references: Textbook and references will be introduced by each professor.   |  |            |   |                               |                                 |
| 9. Self study: Read textbooks and references to advance knowledge about related topics  |  |            |   |                               |                                 |
| 10. In addition: For inquiry, please contact Prof. Minoru Ishikawa: minoru.ishikawa.e4@tohoku.ac.jp   |  |            |   |                               |                                 |

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|---|--|------------|--|-------------------------|--------------------------------|
| Subject   | Current topics of Agricultural Plant Science (先端植物生命科学)          | Day/Period | 1 <sup>st</sup> quarter<br>Wed./3 <sup>rd</sup> ~4 <sup>th</sup> | Object                  | AMB/JYPE                       |
| Instructor (Post)   | H. Takahashi (Prof.) et al.                                      | Categories | Specialized Subjects   | Preferable Participants | 3rd & 4th-year & JYPE students |
| Position  | Faculty of Agriculture (Graduate School of Agricultural Science) |            |  | Credits                 | 2                              |
|   |  |            |  | Semester                | 7 and 9                        |
| Subject Numbering   | ABS-PLA358E  |            |  | Language Used in Course | English                        |
| 1. Class subject<br><b>Professors and associate professors in Course of Plant Science introduce current topics of agricultural plant science.</b>   |  |            |  |                         |                                |
| 2. Object and summary of class<br>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<br>Crop, Plant, Soil, Insect.   |  |            |  |                         |                                |
| 4. Goal of study<br>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<br>Each week there will be lectures and discussions of the following topics:<br>1) Introduction<br>Plant pathology-1: Virus infection and plant immune system (Prof. Takahashi)<br>2) Plant pathology-2: Variety of plant pathogens and plant immunity (Assoc. Prof. Ando)<br>3) Plant pathology-3: Plant antiviral resistance from the viewpoint of evolution (Assistant Prof. Miyashita)<br>4) Crop science (Prof. Homma)<br>5) Plant breeding and genetics-1: Nanohana-Project (Prof. Kitashiba)<br>6) Plant breeding and genetics-2: Molecular mechanism of self-incompatibility (Assistant Prof. Yamamoto)<br>7) Horticultural science -1: Fruit production and research (Prof. Kanayama)<br>8) Horticultural science -2: Functional properties of fruit and vegetable crops (Assoc. Prof. Kato)<br>9) Soil science-1: Soil science on the risk alleviation methods for heavy metal contamination in soil and rice (Prof. Makino)<br>10) Soil science-2 : Toward “just enough” in agroecosystems (Ass. Prof. Hamamoto)<br>11) Applied Entomology (Prof. Hori)<br>12) Environmental plant biotechnology-1: Introduction of genetically modified plants (Prof. Toriyama)<br>13) Environmental plant biotechnology-2: Genetics and genetic engineering of plants (Assoc. Prof. Ito)<br>14) Environmental crop science (Prof. Nishida)<br>15) Forest ecology (Prof. Suyama) |  |            |  |                         |                                |
| 6. Preparation<br>Briefly understand each field on the website below.   |  |            |  |                         |                                |
| 7. Record end evaluation method<br>Attendance (30%), class participation (30%), and report (40%).   |  |            |  |                         |                                |
| 8. Textbook and references<br><a href="http://www.agri.tohoku.ac.jp/en/about/organization/faculty/index.html">http://www.agri.tohoku.ac.jp/en/about/organization/faculty/index.html</a>   |  |            |  |                         |                                |
| 9. Self study<br>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<br>Contact: Prof. Hideki Takahashi<br>E-mail: <a href="mailto:hideki.takahashi.d5@tohoku.ac.jp">hideki.takahashi.d5@tohoku.ac.jp</a><br>Office: Room S407   |  |            |  |                         |                                |

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|--|---|------------|-------------------------|----------|-----|
| Subject  | Multidisciplinary Internship<br>(学際インターンシップ)              | Day/Period | Intensive course        | Target   | FGL |
| Instructor   | Kumigashira H. (Professor)<br>Breedlove B. (Assoc. Prof.) | Categories | Specialized<br>Subjects | Credits  | 1   |
|  |   |            |                         | Semester | 5   |
| Position   | Faculty of Science  |            |                         |          |     |
| <b>1. Class subject</b><br>Introduction to the Research Center for Electron Photon Science (ELPH) of Tohoku University   |   |            |                         |          |     |
| <b>2. Object and summary of class</b><br>The Research Center for Electron Photon Science (ELPH) of Tohoku University was established in 1966, and a 300 MeV electron linear accelerator (linac) became operational. During the Great East Japan Earthquake of 2011, the linac was damaged. However, until then, it provided high energy beams with high repetition rates for nuclear physics and other fields. When ELPH reopened in 2013 after repairs and renovations, new technologies made it possible to perform research in a variety of fields, such as non-linear beam dynamics, quark nuclear physics, the structure of unstable radioisotopes, etc. The object of the internship is to introduce students to the ELPH center and how experiments in nuclear physics, nuclear and radiochemistry, etc. are conducted. |   |            |                         |          |     |
| <b>3. Goal of study</b><br>Students will:<br>1. learn about the ELPH center and the research being conducted,<br>2. learn about technologies currently available at the center,<br>3. understand how research in high energy fields in conducted.  |   |            |                         |          |     |
| <b>4. Contents and progress schedule of class</b><br>July 27 and 28, 2022<br>The course will consist of:<br>– a field trip to ELPH which will consist of a lecture and tour<br>– a general lecture about chemistry using high energy accelerators<br>– group discussions and reports   |   |            |                         |          |     |
| <b>5. Record end evaluation method</b><br>Attendance, participation, and a report  |   |            |                         |          |     |
| <b>6. Preparation</b><br>Detailed schedule will be provided in July.   |   |            |                         |          |     |
| <b>7. Contact</b><br>kumigashira@tohoku.ac.jp (Prof. Hiroshi Kumigashira)<br>breedlove.brian.b1@tohoku.ac.jp (Assoc. Prof. Brian Breedlove)  |   |            |                         |          |     |