Bachelor of Science Program

in

Bioresources and Environmental Biology

(International Program)

Department of Biology Faculty of Science

Mahidol University

Revised Program of Academic Year 2019

Program Specification

Bachelor of Science Program
in Bioresources and Environmental Biology (International Program)
Revised Program of Academic Year 2019

Name of Institution Mahidol University

Campus / Faculty / Department Faculty of Science / Department of Biology

Section 1 General Information

1. Code and Program Title

In Thai : หลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ)

In English : Bachelor of Science Program in Bioresources and Environmental Biology (International Program)

2. Degree Offered and Field of Study

In Thai Full Name : วิทยาศาสตรบัณฑิต (ทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม)
Abbreviation : วท.บ. (ทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม)

In English Full Name : Bachelor of Science (Bioresources and Environmental Biology)
Abbreviation : B.Sc. (Bioresources and Environmental Biology)

3. Major Subject (If Applicable) None

4. Total Credits Required Plan A - no less than 126 credits of courses taken while studying at Faculty of Science, Mahidol University
Plan B - no less than 83 credits of courses taken while studying at Faculty of Science, Mahidol University and

no less than 43 credits of courses taken while studying at State University of New York, College of Environmental Science and Forestry (SUNY-ESF)

5. Program Characteristics

5.1 Degree Level Bachelor's Degree, four-year program

5.2 Type of the Program Academic program

5.3 Language English

5.4 Admission Thai and International Students

5.5 Collaboration with Other Institutions

the State University of New York, College of Environmental Science and Forestry (SUNY-ESF), USA

5.6 Degree Offered

Plan A - one degree (B.Sc. in Bioresources and Environmental Biology offered by Mahidol University)

Plan B - dual degree (one B.Sc. degree from Mahidol University and the other B.Sc. degree from SUNY-ESF)

6. Record of Program Status and Approval / Endorsement

6.1 The program first started in the academic year 2014.

6.2 The program revised from the program of the academic year 2014 will start in Semester 1 of the academic year 2019.

6.3 The SC Faculty curriculum screening procedure committee approved the program in its meeting no. 06/2018 on December 12, 2018.

6.4 The MU curriculum screening procedure committee approved the program in its meeting no. 02/2019 on March 14, 2019.

6.5 The Deans approved the program in its meeting no. 11/2019 on June 12, 2019.

6.6 The MU council approved the program in its meeting no. 545 on June 19, 2019.

7. Expected Date for the Implementation of Program under the Thai Qualifications Register (TQR) Record

The program will be ready to publicize its quality and standards according to National Qualifications Framework for Higher Education in Thailand in academic year 2021 (2 years after program starts).

8. Career Opportunities after Graduation

Graduates of the Bachelor of Science Program in Bioresources and Environmental Biology can find employment in

8.1 Researcher and research assistant in any government research unit, academic institutes or universities related to bioresources and environmental biology.

8.2 Teaching career as primary- and secondary-school teachers in the field of bioresources, environment and biology at any schools, especially in the English Program (EP) section.

8.3 Personnel performing quality control/assurance and conducting experiments and reports for biological and environmental-related issues in any companies or manufacturers

8.4. Sale or marketing person in scientific instruments and chemical trading and services companies.

8.5 Customer relations for biological or environmental product companies that require personnel with good command of English.

8.6 Entrepreneur of the companies related to products or services in the field of bioresources and environmental biology.

9. Name, Surname, Identification Number, Academic Position, Educational Qualifications, and Academic Works published in the past 5 years of the Instructors Responsible for the Program

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent academic works in 5 years
1	Mr. Prayad Pokethitiyook National ID	Associate Professor	- Ph.D. (Chemical Engineering), University of Melbourne, Australia, 1999	Yongpisanphop J, Babel S, Kurisu F, Kruatrachue M, **Pokethitiyook P**. (2019).

	number 374980000xxxx		- M.S. (Environmental Science and Engineering), Virginia Polytechnic Institute and State University, USA, 1989 - M.Sc. (Environmental Biology), Mahidol University, 1981 - B.Sc. (Biology), Mahidol University, 1978	Isolation and characterization of Pb-resistant plant growth promoting endophytic bacteria and their role in Pb accumulation by fast-growing trees. *Environmental Technology* 9:1-28.
2	Mr. Patompong Saengwilai National ID number 110140053xxxx	Assistant Professor	- Ph.D. (Plant Biology), Pennsylvania State University, USA, 2013 - B.Sc. (Biology), Mahidol University, 2007	Meeinkuirt, W., Phusantisampan, T., **Saengwilai, P.** (2018). Root system architecture influencing cadmium accumulation in rice (Oryza sativa L.). *International journal of phytoremediation*, 21, 19-26.
3	Mr. Puey Ounjai National ID number 310200197xxxx	Assistant Professor	- Ph.D. (Molecular Genetics and Genetic Engineering), Mahidol University, 2007 - B.Sc. Biotechnology King Mongkut Institute of Technology Ladkrabang, 2001	Samranwanich T, Boonthaworn K, Singhakaew S, **Ounjai P** (2019) Time-Restricted Inquiry-Based Learning Promotes Student Active Engagement in Undergraduate Zoology Laboratory. *Journal of Microbiology and Biology*

				Education. https://doi.org/10.1128/jmbe.v20i1.1571
4.	Miss Prinpida Sonthiphand National ID number 310050155xxxx	Lecturer	- Ph.D. (Biology), University of Waterloo, Canada, 2014 - M.Sc. (Environmental Management), Chulalongkorn University, 2009 - B.Sc. (Biochemistry), Chulalongkorn University, 2005	Tiralerdpanich P, **Sonthiphand P**, Luepromchai E, Pinyakong O, Pokethitiyook P. (2018) Potential microbial consortium involved in the biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Mar Pollut Bull*.;133:595-605. doi: 10.1016/j.marpolbul.2018.06.015.
5.	Miss Alyssa B. Stewart National ID number 590800000xxxx	Lecturer	- Ph.D. (Biology), University of Maryland at College Park, USA, 2015 - B.S. (Biology), University of North Carolina at Chapel Hill, USA, 2007	**Stewart AB,** Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. *Biotropica*, 50:98-105.
6.	Mr. Pahol Kosiyachinda National ID number	Lecturer	- Ph.D. (Plant Pathology) Cornell University, USA: 2002 - B.Sc. (Biology), Mahidol	Pheungtheun, P., Senarat, S., Poonprasert, P., Kanchanareka, T., Kettratad, J.,

	310220061xxxx		University, 1996	**Kosiyachinda, P.** (2018) Ovarian histology of *Trypauchen vagina* (Bloch & Schneider, 1801) during breeding season from Samut Songkhram Province. *KKU Sci. J*: 46(3) 462-468.

10. Study Site Location

Plan A - Mahidol University, Salaya Campus, Phutthamonthon District, Nakhon Pathom Province

Plan B - The State University of New York, College of Environmental Science and Forestry (SUNY-ESF), Syracuse, U.S.A.

11. External Factors and/or Development Considered in Program Planning

11.1 Economic Circumstances / Development

The curriculum is revised according to the 12th National Economic and Social Development Plan (2017-2021), especially the policies to pull the country out of the middle-income trap and to promote Thailand 4.0. In order to cope with the challenges of economic and social development dynamic, natural resource depletion, and environment crises, building human capital for science, technology, and innovation readiness is a key strategy. In particular, knowledge in all biological science fields, including agriculture, biotechnology, health sciences and environmental biology and sustainability continues to grow deeply. The development of innovations in biological sciences and technology, such as microbial fuel cell, new crop technology, biosensor for toxic pollutants, the availability of cheap genetic test kits, environmental risk management and stem cell for medical purposes will affect the way we live, and the way we learn. Consequently, the curriculum is planned to support, augment and advance this inevitable sustainable development to the 21st century education graduates and to produce the science and technology personnel who are ready for any workplace.

11.2 Social and Cultural Circumstances / Development

Overusing of fossil fuel and overexploitation of mineral resources resulting in the global warming, thus, the world environment has been changed forever. In addition, technological advances in communication have changed the face and the pace of the world. It provides convenience and speeds up information delivery. However, not all massive information can be trusted. The curriculum is, therefore, planned to produce graduates that have well-rounded knowledge in changing the use of conventional resources to sustainable biological resources as well as their fate in the environment and are fully-equipped graduates with intercultural communications, analytical skills, and creative ideas which are required as important skills for the 21st century.

12. Impacts of Factors in 11.1 and 11.2 on Curriculum Development and Related Institutional Missions

12.1 Curriculum Development

To develop the revised curriculum effectively, aforementioned changes and developments in science, technology, and the socio-economic structure must be taken into consideration. Consequently, the students must be prepared with 21st century knowledge and skills in order to be ready for change, transformation, and adaptation. Both Plan A (one degree from MU) and Plan B (one degree from MU and the other from SUNY-ESF) curricula will provide the foundation of sustainable learning and competence for Bioresources and Environmental Biology graduates to fit their future work place. Students will be able to analyze international academic data and can handle them under the rapid change of technology and knowledge. These curricula will allow students to think rationally worldwide with the knowledge and skills to work effectively on the basis of morality and ethics. Moreover, students will have good English communication skills. Besides the core science knowledge, the curriculum also recognizes and respects the value and diversity of cultures and lifestyles of different social status by having the students taking diverse elective courses and general education in social sciences and humanity. Broadening of courses will harness students to the idea of global citizen. Integrating the technical skills with critical thinking will enable detailed analysis, solution-creation and solution-implementation. The curriculum is developed under the guidelines of Thai Quality Framework (TQF), focusing on the learning areas including ethics and moral, knowledge, cognitive skills, interpersonal skills and responsibility, and numerical analysis, communication, and

information technology skills, and the guidelines of AUN-QA, focusing on the expected learning outcome.

12.2 Related Institutional Missions

The mission of Mahidol University is to excel in health, sciences, arts, and innovation with integrity for the betterment of Thai society and the benefit of mankind. Thus, the revised curriculum aims to provide outcome-based education, in order to produce graduates who are able to develop their potential of using undergraduates' knowledge and skills. Most importantly, the curriculum enables lifelong learning to ensure that graduates are able to contribute throughout their lives and not simply acquire popular short-term trends that may dominate academia during their tenure here. The graduates are expected to acquire MU graduate attributes; i.e., T-shape breadth and depth, globally talented, socially contributing and entrepreneurially minded (see Appendix 2.2 page 149).

13. Relations to Other Programs Offered by Other Faculties / Departments in the Institution

13.1 Course(s) offered by other departments / faculties

The General Education courses and some of core courses are offered by other departments in the Faculty of Science and other faculties including

credits (theory–laboratory– self-study)

13.1.1 Faculty of Environment and Resource Studies

ENGE 105	Integrating Health and Environment	3 (3-0-6)

13.1.2 Faculty of Liberal Arts

LEAN 180	English for Academic Purpose I	2 (2-0-4)
LEAN 181	English for Academic Purpose II	2 (2-0-4)
LEAN 380	Academic Presentations in English	2 (2-0-4)

13.1.3 Institute of Population and Social Research

PRPR 101	Population and Development	2 (2-0-4)
PRPR 102	Regional Studies	2 (2-0-4)

13.1.4 Faculty of Science

SCBM 104	Proper Etiquette for Socialization	2 (2-0-4)

SCBM 281	Basic Biochemistry	3 (3-0-6)
SCBM 282	Biochemistry Laboratory	1 (0-3-1)
SCCH 161	General Chemistry	3 (3-0-6)
SCCH 172	Organic Chemistry	3 (3-0-6)
SCCH 189	Chemistry Laboratory	1 (0-3-1)
SCMA 174	Calculus and Systems of Ordinary Differential Equations	3 (3-0-6)
SCPY 160	General Physics Laboratory	1 (0-3-1)
SCGI 103	Physics for future entrepreneurs	3 (3-0-6)

13.2 Courses Offered by Bioresources and Environmental Biology to Other Departments/Faculties

	credits (theory–laboratory– self-study)
SCBE 100 Wonder of Life	3 (3-0-6)
SCBE 101 General Biology 1	3 (3-0-6)
SCBE 102 General Biology Laboratory 1	1 (0-3-1)
SCBE 103 General Biology 2	3 (3-0-6)
SCBE 104 General Biology Laboratory 2	1 (0-3-1)
SCBE 109 Human and its surroundings	2 (2-0-4)
SCBE 121 Essential Biology	2 (2-0-4)
SCBE 150 Science Communication for Life Sciences	3 (3-0-6)
SCBE 151 Plants and Civilization	3 (2-2-5)
SCBE 152 Natural Science Illustration	3 (1-4-4)
SCBE 253 Fundamental to Finesse: Microbes for Quality Life	3 (2-3-5)
SCBE 254 Gardening	3 (3-0-6)
SCBE 255 Aesthetics for Fragrance and Flavor	3 (3-0-6)

13.3 Coordination

The Program Director will coordinate with other relevant programs/faculty under the university regulations.

Section 2 Specific Data of the Program

1. Philosophy, Rationale, and Objectives of the Program

1.1 Program Philosophy

Our primary focus is on educating the learners, as for them to attain academic achievement through learning-centered education, outcome-based education and constructivism. To become a wisdom graduate, learners combine what they have learned so far with the new knowledge, and with experiential learning activities. While the role of a lecturer in the learning process is shift from an information provider to a coach or a facilitator creating challenge-based activities.

1.2 Program Objectives

1.2.1 Program Objectives

To produce graduates who have the characteristics, knowledge and skills as follows:

1. Describe and analyze various global and regional environmental concerns that affect humans and various forms of organisms.
2. Recognize the structure, function, interactions, and future trends of key environmental systems including water, climate, plants, animals, and microorganisms.
3. Observe analytically and integrate diverse information from variable sources outside the classroom.
4. Design an independent scientific inquiry, from raising the question to designing the study to interpretation of the results.

1.2.2 Program–level Learning Outcomes: PLOs

At the end of the program, successful students will be able to:

1. **PLO1**: Solve biological- and environmental-related problem logically and systematically at local, regional and global levels by applying interdisciplinary approaches.
2. **PLO2**: Carry out laboratory-based and field-based experiments to address biological and environmental impacts on sustainability with international standard methodologies.
3. **PLO3**: Create an independent project in bioresources and environmental biology, analyzed from scientific journals and laboratory reports along with laboratory safety skills and professional code of conduct.
4. **PLO4**: Communicate concepts of bioresources and environmental biology clearly and purposefully with target audiences in English, in both written and oral forms with appropriate technologies in an organized manner.
5. **PLO5**: Work independently and coordinate with others to achieve team goals based on roles and responsibilities of an environmental biologist.

2. Improvement Plan

Improvement / Modification Plan	Strategy	Evidence / Indicators
1. To revise curriculum continuously according to social and economic changes including labour market demands	1. Develop a new outcome-based curriculum based on stakeholders' inputs 2. Obtain constants feedbacks on the characteristics, knowledge and skills of graduates to improve upon the curriculum 3. Review the curriculum to	1. TQF 5, TQF 7 2. Summary of stakeholders' input 3. Academic meeting report, Employers' Satisfaction Survey results, Students' Teaching Evaluation, and a summary of focus group research with students,

Improvement / Modification Plan	Strategy	Evidence / Indicators
	match international standards	parents, and alumni
2. To ensure the quality of teaching and learning activities	1. Enhance a faculty's teaching techniques to promote practical learning through faculty trainings and seminars 2. Monitor and improve upon a faculty's teaching performance 3. Encourage lecturers to frequently update and incorporate their research experience in teaching materials	1. Faculty's training needs survey, and a summary of new teaching techniques deployment 2. Teaching evaluation records with continuous improvement goal
3. To improve students' soft skills	1. Provide in-class opportunities for students to work as a team. 2. Encourage students' participation in extra-curricular activities through student clubs and academic activities organized by external organizations	1. Team and individual evaluation in a classroom 2. Activity transcript, certifications and awards

Section 3 Educational Management System, Program Implementation, and Structure

1. Educational Management System

1.1 System

Semester system

1.2 Summer Sessions

According to Mahidol University Regulations on Diploma and Undergraduate Studies of the Year B.E. 2552-2560 and SC's Announcement of the Year B.E. 2553, the summer session is not compulsory session. For Faculty of Science, each course offered in the summer session must have at least 15 failing students.

1.3 Credit Equivalence Ratio (In Reference to Semester System)

None

2. Program Implementation

2.1 Academic Calendar

In regular management, the offered courses are scheduled during normal working hours (08:30 a.m. – 04:30 p.m.) on a weekday (Monday – Friday). However, teaching and learning outside of normal working hour are possible with appropriate management.

Semester: 1st Semester : August-December

2nd Semester : January-May

The academic calendar is subject to change in the process of approval by the University Council.

2.2 Admission Requirements

Mahidol Admission Requirements for Plan A and Plan B

1. Graduate from Mathayom Suksa 6 of Secondary Education in Thailand (M.6), or high school, or its equivalent certificate or studying in the final term of grade 12 or M. 6, or equivalent, following the admission regulation of the Office of the Higher Education Commission and/or the regulation of direct admission of Mahidol University or other rules and regulations for special admission approved by Mahidol University Council.

2. Qualify to be undergraduate students by passing
   (1) the university entrance process managed by the Office of the Higher Education Commission or
   (2) the special admission process organized by the Faculty of Science and Mahidol University
3. No health or mental problems that could affect the studying

SUNY-ESF Admission Requirements for Plan B

B.Sc. students in Bioresources and Environmental Biology who would like to study at the SUNY-ESF to develop learning experience in the field of biomedical science in a multicultural-international environment during the 3rd and 4th years of study has to meet the following criteria:

1. Have a successful completion of years 1 and 2 of the B. Sc. Bioresources and Environmental Biology at Faculty of Science, Mahidol University (MUSC) with a cumulative grade point average of 2.75 or above in Year 2

2. Obtain an IELTS score of 6.5 overall, with not less than 5.0 in Writing, or a Pearson's Test of English (Academic) with 62 overall and at least 56 in all four skills, or a minimum TOEFL score of 550 (paper-based test), 213 (computer-based test), or 79 (internet-based test)

3. Have a successful performance at an interview, to be jointly held at MUSC by staff of both MUSC and the SUNY-ESF

2.3 Limitations for Certain Groups of Newly Enrolled Students/ 2.4 Strategies to Resolve Students' Limitations in 2.3

Limitations of Newly Enrolled Students	Strategies to Resolve Students' Limitations
1. English and math skills	1. Students with limited English and/or math skills are required to enroll in a preparation course prior to the first semester begins. 2. The curriculum provides a series of English writing and communication courses from the remedial level (if needed) for students to gain proficiency and confidence. 3. The curriculum provides a specified

	academic consulting time to students to consult with lecturers individually.
2. Adapting to university studies and environment	1. The curriculum offers an orientation class (SCBE 106) in the first semester. 2. The curriculum provides mentors for every student throughout the course of their studies to give advice on both academic and non-academic matters. 3. Student activities and clubs or provide courses that facilitate group learning situations.

2.5 A Five-year Plan for Admission and Graduation

Academic Year	2019	2020	2021	2022	2023
First-year student	30	35	40	45	50
Second-year student	-	30	35	40	45
Third-year student	-	-	30	35	40
Fourth-year student	-	-	-	30	35
Cumulative number	-	65	105	150	170
Number of expected graduates	-	-	-	-	30

2.6 Budget Plan

Investment

Plan A

2.6.1 Breakeven/worthiness

- Income per person/throughout the program: ..... 580,000.....baht
- Expenses per person/ throughout the program ..... 149,522.....baht
- The smallest number of students above the breakeven point: ..... 10.....
- The expected number of students: ..... 50 .....

Program below the breakeven but worthy

(Explain).....

2.6.2 Budget and costs for producing graduates (baht per year)

1) Costs in producing graduates

No.	Costs	Baht per Year
๑	Costs on personnel	2,116,800.00
๒	Hire, supplies and materials	600,000.00
๓	Public utilities	30,000.00
๔	Depreciation	150,000.00
๕	Subsidy	641,250.00
๖	Others	200,000.00
	Total	3,738,050.00

2) Income from tuition fee and others

No.	Incomes	Bath/year/program
๑	Tuition fee / course credits	6,412,500.00
๒	Outsource fund or income that supports the program	150,000.00
๓	Others	0
	Total	6,562,500.00

Others.....

Plan B

As the students in Plan B will share the class with students in Plan A during the first- and second-year study at Faculty of Science, Mahidol University, so the budget and cost are equivalent. The students who will study at State University of New York, College of Environmental Science and Forestry (SUNY-ESF) will have to pay for approximately 450,000 Thai Baht for tuition fee* and 480,000 Thai baht for living expense in Syracuse per year.

* Tuition fee at SUNY-ESF is subsidized, through MOU, by 4,000.00 USD per year.

2.7 Academic System

Plan A	Plan B	
☑	☑	In Class
☐	☐	Distance Learning Mainly Through Printed Materials
☐	☐	Distance Learning Mainly Through Broadcast Media
☐	☐	Distance Learning Mainly Through Electronic Media (E-learning)
☐	☐	Distance Learning Through the Internet
☐	☐	Others (Please Specify)

2.8 Credit Transfer and Cross-institutional Enrollment (If any)

According to Mahidol University Regulations on Diploma and Undergraduate Studies of the Year B.E. 2552-2560 and MOU with the State University of New York, College of Environmental Science and Forestry (SUNY-ESF) (Bachelor of Science, Dual Degree Program Agreement between SUNY ESF and Mahidol University)

3. Curriculum and Faculty Members

3.1 Curriculum

3.1.1 Number of Credits

For Plan A: The required number of credits in total must not be less than 126 credits of courses taken while studying at Mahidol University.

For Plan B: Students are required to complete no less than 83 credits during the two academic years at Mahidol University and complete a minimum of 43 credits hours of study in residence at State University of New York, College of Environmental Science and Forestry (SUNY-ESF)

3.1.2 Curriculum Structure of the Bachelor of Science Program in Bioresources and Environmental Biology (International Program) complies with the Standard of Undergraduate Programs of Study announced by the Ministry of Education in 2015.

Course Category	Standard guideline of the Ministry of Education for the undergraduate level of education of the year B.E. 2558. (4-year program) (credits)	Plan A (credits)	Plan B (credits)
1. General Education Courses 1. Social Sciences and Humanities 2. Languages 3. Science and Mathematics 4. Health and Recreation	**no less than 30**	**30#**	**30#**
2. Specific Courses 1. Core Courses 2. Major Required Courses 3. Major Elective Courses	**no less than 72**	**90** 34 41 15	**51+39*** 27+7* 24+17* 0+15*
3. Free Elective Courses	**no less than 6**	**6**	**2+4***
Total Credits	**no less than 120**	**126**	**83+43***

* credits while studying at SUNY-ESF

Students have the choice of completing the General Education courses provided by other programs/departments/faculties to fulfill the credit requirement.

3.1.3 Courses of the Program

Courses are listed respectively in the categories: general education courses, core courses and free electives, each with course codes alphabetically listed.

In each course code, credit numbers are shown before the parentheses, and teaching hours and/or practicing hours and self-study hours are shown in the parentheses. For example,

SCBE101 3(3-0-6) refers to a four-letter code of the course, three digits, and number of total credit hours (theory- practice- self-study).

Course codes of the Bachelor of Science Program in Bioresources and Environmental Biology at the Faculty of Science, Mahidol University, consist of 7 characters: 4 letters and 3 numbers. Below is how the course codes are set.

a. Meaning of the 4 letters:

- **The first 2 letters** are the initials of the faculty/institution in charge, namely

มม : MU indicates that the course is jointly managed by different faculties in Mahidol University

วท : SC indicates that the course is managed by Faculty of Science

วจ : PR indicates that the course is managed by Institute for Population and Social Research

สว : EN indicates that the course is managed by Faculty of Environment and Resource Studies

ศศ : LA indicates that the course is managed by Faculty of Liberal Arts

สม : SH indicates that the course is managed by Faculty of Social Science and Humanities

วศ : EG indicates that the course is managed by Faculty of Engineering

- **The last 2 letters** are the initials of the department/program in charge of teaching management.

Faculty of Science

ทส : BE indicates that the course is in charged by Program of Bioresources and Environmental Biology

ชว : BI indicates that the course is in charged by Department of Biology

ชพ : BM indicates that the course is in charged by Program of Biomedical Science

คม : CH indicates that the course is in charged by Department of Chemistry

ศน : GI indicates that the course is a general education course for international degree programs

คณ : MA indicates that the course is in charged by Department of Mathematics

วน : ME indicates that the course is in charged by Program of Material Science and Nanotechnology

ฟส : PY indicates that the course is in charged by Department of Physics

Faculty of Environment and Resource Studies

ศท : GE indicates General education

Faculty of Liberal Arts

ภอ : EN indicates that the course is in charged by Department of English Institute for Population and Social Research

ปส : PR indicates Population and Social Research Faculty of Social Science and Humanities

สค : SS indicates Social Science

มน : HU indicates Humanities

ศษ : ED indicates Education

b. The 3 digits after the course initials

- **The first digit** indicates the year of study.
- **The last 2 digits** indicate the order of the course offered in each course category to avoid repetition.
- Interpretation of total credits: Define the meaning of the number.

Courses in Bachelor of Science Program in Bioresources and Environmental Biology

a. General Education (no less than 30 credits)

Courses are selected from the following course list.

		credit (theory – lab/practice – self-study)
1.1 Social Sciences and Humanities		(4 credits)
PRPR 101	Population and Development	2 (2-0-4)
วจปส ๑๐๑	ประชากรและการพัฒนา	๒ (๒-๐-๔)
PRPR 102	Regional Studies	2 (2-0-4)
วจปส ๑๐๒	ภูมิภาคศึกษา	๒ (๒-๐-๔)
SCBE 153	Computer for Science Research and Presentation	2 (2-0-4)
วททส ๑๕๓	คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์	๒ (๒-๐-๔)
SCBM 103	Figurative Language for Everyday Life	1 (1-0-2)
วทชพ ๑๐๓	โวหารภาพพจน์สำหรับชีวิตประจำวัน	๑ (๑-๐-๒)
SHHU 125	Professional Code of Ethics	2 (2-0-4)
สมมน ๑๒๕	จรรยาบรรณวิชาชีพ	๒ (๒-๐-๔)
SHHU 116	Comparative Culture	2 (2-0-4)

สมมน ๑๑๖	วัฒนธรรมเปรียบเทียบ	๒ (๒-๐-๔)

NB: *Students can choose any other courses (listed as “for international program”) under Social Science and Humanity section offer within Mahidol University under the consent of the Program Director or Curriculum Committee.

1.2 Languages (8 credits)

		credit (theory – lab/practice – self-study)
LAEN 180	English for Academic Purpose I	2 (2-0-4)
ศศภอ ๑๘๐	ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๑	๒ (๒-๐-๔)
LAEN 181	English for Academic Purpose II	2 (2-0-4)
ศศภอ ๑๘๑	ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๒	๒ (๒-๐-๔)
LAEN 280	Science Fiction and Society	2 (2-0-4)
ศศภอ ๒๘๐	วรรณกรรมวิทยาศาสตร์กับสังคม	๒ (๒-๐-๔)
LAEN 281	The Science of Speech Sounds	2 (2-0-4)
ศศภอ ๒๘๑	วิทยาศาสตร์ด้านเสียงพูด	๒ (๒-๐-๔)
LAEN 282	Multilingualism and Multiculturalism	2 (2-0-4)
ศศภอ ๒๘๒	พหุภาษาและพหุวัฒนธรรม	๒ (๒-๐-๔)
LAEN 380	Academic Presentations in English	2 (2-0-4)
ศศภอ ๓๘๐	การนำเสนอผลงานเป็นภาษาอังกฤษ	๒ (๒-๐-๔)

NB: *Students can choose any other courses (listed as “for international program”) under Languages section offer within Mahidol University under the consent of the Program Director or Curriculum Committee.

1.3 Science and Mathematics (16 credits)

		credit (theory – lab/practice – self-study)
SCBE 100	Wonder of Life	3 (3-0-6)
วททส ๑๐๐	มหัศจรรย์แห่งชีวิต	๓ (๓-๐-๖)
SCBE 109	Human and its surroundings	2 (2-0-4)
วททส ๑๐๙	มนุษย์และสิ่งรอบตัว	๒ (๒-๐-๔)
SCBE 150	Science Communication for Life Sciences	3 (3-0-6)
วททส ๑๕๐	การสื่อสารวิทยาศาสตร์เพื่อวิทยาศาสตร์ชีวภาพ	๓ (๓-๐-๖)

SCBE 151	Plants and Civilization	3 (2-2-5)
วททส ๑๕๑	พืชและอารยธรรม	๓ (๒-๒-๕)
SCBE 152	Natural Science Illustration	3 (1-4-4)
วททส ๑๕๒	นิทัศน์ทางวิทยาศาสตร์ธรรมชาติ	๓ (๑-๔-๔)
SCBE 153	Computer for Science Research and Presentation	2 (2-0-4)
วททส ๑๕๓	คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์	๒ (๒-๐-๔)
SCBE 253	Fundamental to Finesse: Microbes for Quality life	3 (2-3-5)
วททส ๒๕๓	พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ	๓ (๒-๓-๕)
SCBE 254	Gardening	3 (3-0-6)
วททส ๒๕๔	งานสวน	๓ (๓-๐-๖)
SCBE 255	Aesthetics for Fragrance and Flavor	3 (3-0-6)
วททส ๒๕๕	สุนทรียศาสตร์ของกลิ่นและรส	๓ (๓-๐-๖)
SCBE 256	Natural Products	3 (2-3-5)
วททส ๒๕๖	ผลิตภัณฑ์ธรรมชาติ	๓ (๒-๓-๕)
SCBE 325	Environmental Economics	2 (2-0-4)
วททส ๓๒๕	เศรษฐศาสตร์สิ่งแวดล้อม	๒ (๒-๐-๔)
SCBM 101	Basic Information Literacy	1 (1-0-2)
วทชพ ๑๐๑	การเรียนรู้สารสนเทศพื้นฐาน	๑ (๑-๐-๒)
ENGE 105	Integrating Health and Environment	3 (3-0-6)
สวศท ๑๐๕	บูรณาการสุขภาพและสิ่งแวดล้อม	๓ (๓-๐-๖)
SCGI 103	Physics for future entrepreneurs	3 (3-0-6)
วทศน ๑๐๓	ฟิสิกส์สำหรับผู้ประกอบการในอนาคต	๓ (๓-๐-๖)
SCBC 207	Science in Social Media	2 (2-0-4)
วทชค ๒๐๗	วิทยาศาสตร์ในสื่อสังคม	๒ (๒-๐-๔)
SCPA 203	Young Blood Detective	2 (2-0-4)
วทพธ ๒๐๓	ยอดนักสืบสายเลือดใหม่	๒ (๒-๐-๔)

1.4 Health and Recreation (2 credits)

credit (theory – lab/practice – self-study)

SCPA 204	Common Diseases in Various Age Groups	2 (2-0-4)
วทพธ ๒๐๔	โรคทั่วไปในกลุ่มวัยต่าง ๆ	๒ (๒-๐-๔)

SPGE 201	Basketball	2 (1-2-3)
วกศท ๒๐๑	บาสเกตบอล	๒ (๑-๒-๓)
SPGE 202	Art of Self-defense for Health and Recreation	2 (1-2-3)
วกศท ๒๐๒	ศิลปะการต่อสู้ป้องกันตัว	๒ (๑-๒-๓)
SPGE 203	Bike for Health and Recreation	2 (1-2-3)
วกศท ๒๐๓	จักรยานเพื่อสุขภาพและนันทนาการ	๒ (๑-๒-๓)
SCPM 203	General Principles of Drug and Herbal Usage	2 (2-0-4)
วทภส ๒๐๓	หลักการทั่วไปของการใช้ยาและสมุนไพร	๒ (๒-๐-๔)
SCPS 101	Health and Wellness	2 (2-0-4)
วทสร ๑๐๑	สุขภาพเพื่อการพัฒนาคุณภาพชีวิต	๒ (๒-๐-๔)

Note: Students can choose to study other courses in general education course category offered at Mahidol University with the approval of the advisor as can be implemented and not contrary to the regulations of the university.

b. Specific Courses (90 credits)

1. Core Courses (34 credits)

		credit (theory – lab/practice – self-study)
SCBE 111	Principles of Biology I	3 (3-0-6)
วททส ๑๑๑	หลักการทางชีววิทยา ๑	๓ (๓-๐-๖)
SCBE 102	General Biology Laboratory I	1 (0-3-1)
วททส ๑๐๒	ปฏิบัติการชีววิทยาทั่วไป ๑	๑ (๐-๓-๑)
SCBE 113	Principles of Biology II	3 (3-0-6)
วททส ๑๑๓	หลักการทางชีววิทยา ๒	๓ (๓-๐-๖)
SCBE 104	General Biology Laboratory II	1 (0-3-1)
วททส ๑๐๔	ปฏิบัติการชีววิทยาทั่วไป ๒	๑ (๐-๓-๑)
SCBE 105	Global Environment	๓ (3-0-6)
วททส ๑๐๕	สิ่งแวดล้อมโลก	3 (๓-๐-๖)
SCBE 106	Orientation Seminar	1 (0-3-1)
วททส ๑๐๖	ปฐมนิเทศ	๑ (๐-๓-๑)
SCBE 220	Principles of Water Chemistry	3 (3-0-6)
วททส ๒๒๐	หลักการทางเคมีของน้ำ	๓ (๓-๐-๖)

SCBE 221	Water Chemistry Laboratory	1	(0-3-1)
วททส ๒๒๑	ปฏิบัติการเคมีของน้ำ	๑	(๐-๓-๑)
SCBE 301	Principles of Environmental Science	2	(2-0-4)
วททส ๓๐๑	หลักการวิทยาศาสตร์สิ่งแวดล้อม	๒	(๒-๐-๔)
SCCH 161	General Chemistry	3	(3-0-6)
วทคม ๑๖๑	เคมีทั่วไป	๓	(๓-๐-๖)
SCCH 172	Organic Chemistry	3	(3-0-6)
วทคม ๑๗๒	เคมีอินทรีย์	๓	(๓-๐-๖)
SCCH 189	Chemistry Laboratory	1	(0-3-1)
วทคม ๑๘๙	ปฏิบัติการเคมี	๑	(๐-๓-๑)
SCPY 160	General Physics Laboratory	1	(0-3-1)
วทฟส ๑๖๐	ปฏิบัติการฟิสิกส์	๑	(๐-๓-๑)
SCMA 174	Calculus and System of Differential Equations	3	(3-0-6)
วทคณ ๑๗๔	แคลคูลัสและระบบสมการเชิงอนุพันธ์	๓	(๓-๐-๖)

Note: Students can choose to study other courses in core course category offered at Mahidol University with the approval of the advisor as can be implemented and not contrary to the regulations of the university.

2. Major Required Courses (41 credits)

		credit	(theory – lab/practice – self-study)
SCBE 201	General Zoology	3	(3-0-6)
วททส ๒๐๑	สัตววิทยาทั่วไป	๓	(๓-๐-๖)
SCBE 202	General Zoology Laboratory	1	(0-3-1)
วททส ๒๐๒	ปฏิบัติการสัตววิทยาทั่วไป	๑	(๐-๓-๑)
SCBE 203	General Genetics	3	(3-0-6)
วททส ๒๐๓	พันธุศาสตร์ทั่วไป	๓	(๓-๐-๖)
SCBE 204	General Genetics Laboratory	1	(0-3-1)
วททส ๒๐๔	ปฏิบัติการพันธุศาสตร์ทั่วไป	๑	(๐-๓-๑)
SCBE 205	General Botany	3	(3-0-6)
วททส ๒๐๕	พฤกษศาสตร์ทั่วไป	๓	(๓-๐-๖)

SCBE 206	General Botany Laboratory	1 (0-3-1)
วททส ๒๐๖	ปฏิบัติการพฤกษศาสตร์ทั่วไป	๑ (๐-๓-๑)
SCBE 207	Basic Cell and Molecular Biology	3 (3-0-6)
วททส ๒๐๗	เซลล์และชีววิทยาระดับโมเลกุล	๓ (๓-๐-๖)
SCBE 208	General Ecology	3 (3-0-6)
วททส ๒๐๘	นิเวศวิทยาทั่วไป	๓ (๓-๐-๖)
SCBE 209	Ecological Monitoring and Assessment of Bioresources	4 (3-3-7)
วททส ๒๐๙	การเฝ้าติดตามทางนิเวศและการตรวจสอบทรัพยากรชีวภาพ	๔ (๓-๓-๗)
SCBE 210	General microbiology	3 (2-3-5)
วททส ๒๑๐	จุลชีววิทยาทั่วไป	๓ (๒-๓-๕)
SCBM 281	Biochemistry	3 (3-0-6)
วทชพ ๒๘๑	ชีวเคมี	๓ (๓-๐-๖)
SCBM 282	Biochemistry Laboratory	1 (0-3-1)
วทชพ ๒๘๒	ปฏิบัติการชีวเคมี	๑ (๐-๓-๑)
SCBE 302	Biostatistics	3 (3-0-6)
วททส ๓๐๒	ชีวสถิติ	๓ (๓-๐-๖)
SCBE 303	Evolution	3 (3-0-6)
วททส ๓๐๓	วิวัฒนาการ	๓ (๓-๐-๖)
SCBE 304	Bioethics	2 (2-0-4)
วททส ๓๐๔	ชีวจริยธรรม	๒ (๒-๐-๔)
SCBE 305	Scientific Research and Presentation	1 (0-3-1)
วททส ๓๐๕	การวิจัยและการนำเสนอทางวิทยาศาสตร์	๑ (๐-๓-๑)
SCBE 497	Seminar in Bioresources and Environmental Biology	1 (0-3-1)
วททส ๔๙๗	สัมมนาทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๑ (๐-๓-๑)
SCBE 402	Internship in Bioresources and Environmental Biology	3 (0-9-3)
วททส ๔๐๒	การฝึกงานทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๓ (๐-๙-๓)
	OR (หรือ)	
SCBE 499	Independent Research Project in Bioresources and Environmental Biology	3 (0-9-3)
วททส ๔๙๙	โครงงานวิจัยอิสระทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๓ (๐-๙-๓)

Note: Students can choose to study other courses in Major Required course category offered

at Mahidol University with the approval of the advisor as can be implemented and not contrary to the regulations of the university.

3. Major Elective Courses (15 credits)

To fulfil the degree requirement, each student needs at least 15 credits of Major Elective Courses. The Major Elective Courses are divided into 3 tracks:

1. Environmental Science and Health Track
2. Environmental Biotechnology Track
3. Bioresources and Environmental Biology Track

However, students who register courses in Bioresources and Environmental Biology track must take the Major Elective Courses from the following 3 modules.

a. Structure and Function Module (choose at least 3 credits)

b. Biodiversity Module (choose at least 9 credits from at least 3 sub-modules from the following sub-modules)

- Sub-module 1: Microbial Diversity
- Sub-module 2: Plant Diversity
- Sub-module 3: Invertebrate Diversity
- Sub-module 4: Vertebrate Diversity

c. Bioresources and Environmental Biology Application Module (choose at least 3 credits)

3.1 Environmental Science and Health Track

		credit (theory – lab/practice – self-study)
SCBE 222	Fundamentals of Environmental Health and Toxicology	2 (2-0-4)
วททส ๒๒๒	หลักการพื้นฐานทางอนามัยสิ่งแวดล้อมและพิษวิทยา	๒ (๒-๐-๔)
SCBE 223	Toxicology in Public Health	3 (3-0-6)
วททส ๒๒๓	พิษวิทยาทางสาธารณสุข	๓ (๓-๐-๖)
SCBE 224	Urban Ecology	3 (3-0-6)
วททส ๒๒๔	นิเวศวิทยาชุมชนเมือง	๓ (๓-๐-๖)
SCBE 306	Marine Biology	4 (3-2-7)
วททส ๓๐๖	ชีววิทยาทางทะเล	๔ (๓-๒-๗)

SCBE 307	Water Pollution Control and Management	3 (2-3-5)
วททส ๓๐๗	การควบคุมและจัดการมลพิษทางน้ำ	๓ (๒-๓-๕)
SCBE 317	Hazardous and Toxic Wastes	3 (3-0-6)
วททส ๓๑๗	ของเสียอันตรายและเป็นพิษ	๓ (๓-๐-๖)
SCBE 318	Environmental Risk Assessment	3 (3-0-6)
วททส ๓๑๘	การประเมินความเสี่ยงด้านสิ่งแวดล้อม	๓ (๓-๐-๖)
SCBE 319	Renewable Energy	3 (3-0-6)
วททส ๓๑๙	พลังงานทดแทน	๓ (๓-๐-๖)
SCBE 320	Occupational Health and Safety	3 (3-0-6)
วททส ๓๒๐	อาชีวอนามัยและความปลอดภัย	๓ (๓-๐-๖)
SCBE 321	Epidemiology and Disease Control	3 (3-0-6)
วททส ๓๒๑	ระบาดวิทยาและการควบคุมโรค	๓ (๓-๐-๖)
SCBE 322	Air Quality Monitoring and Management	3 (3-2-5)
วททส ๓๒๒	การจัดการและการตรวจวัดมลพิษทางอากาศ	๓ (๓-๒-๕)
SCBE 323	Noise and Vibration	3 (3-2-5)
วททส ๓๒๓	เสียงและการสั่นสะเทือน	๓ (๓-๒-๕)
SCBE 324	Solid Waste and Sewage	3 (3-2-5)
วททส ๓๒๔	สิ่งปฏิกูลและน้ำเสีย	๓ (๓-๒-๕)
SCBE 330	Environmental Microbiology	3 (3-0-6)
วททส ๓๓๐	จุลชีววิทยาสิ่งแวดล้อม	๓ (๓-๐-๖)
SCBE 401	Hazardous Waste Management	3 (3-0-6)
วททส ๔๐๑	การจัดการของเสียอันตราย	๓ (๓-๐-๖)
SCBE 403	Sustainable Technology	3 (3-0-6)
วททส ๔๐๓	เทคโนโลยีที่ยั่งยืน	๓ (๓-๐-๖)
SCBE 404	Water and Wastewater Treatment	3 (3-0-6)
วททส ๔๐๔	การบำบัดน้ำและน้ำเสีย	๓ (๓-๐-๖)
SCBE 411	Molecular Biology Applications	3 (3-0-6)
วททส ๔๑๑	การประยุกต์ชีววิทยาระดับโมเลกุล	๓ (๓-๐-๖)
SCBE 417	Natural Resources and Environmental Management	3 (3-0-6)
วททส ๔๑๗	การจัดการทรัพยากรธรรมชาติและสิ่งแวดล้อม	๓ (๓-๐-๖)

3.2 Environmental Biotechnology Track

		credit (theory – lab/practice – self-study)
SCBE 222	Fundamentals of Environmental Health and Toxicology	2 (2-0-4)
วททส ๒๒๒	หลักการพื้นฐานทางอนามัยสิ่งแวดล้อมและพิษวิทยา	๒ (๒-๐-๔)
SCBE 307	Water Pollution Control and Management	3 (2-3-5)
วททส ๓๐๗	การควบคุมและจัดการมลพิษทางน้ำ	๓ (๒-๓-๕)
SCBE 310	Plant Physiology	3 (2-3-5)
วททส ๓๑๐	สรีรวิทยาของพืช	๓ (๒-๓-๕)
SCBE 311	Principles of Animal Physiology	4 (3-2-7)
วททส ๓๑๑	หลักสรีรวิทยาของสัตว์	๔ (๓-๒-๗)
SCBE 313	Plant Molecular Genetics	3 (3-0-6)
วททส ๓๑๓	พันธุศาสตร์ระดับโมเลกุลของพืช	๓ (๓-๐-๖)
SCBE 316	Biological Microtechnique	3 (2-3-5)
วททส ๓๑๖	ชีววิทยาไมโครเทคนิค	๓ (๒-๓-๕)
SCBE 330	Environmental Microbiology	3 (3-0-6)
วททส ๓๓๐	จุลชีววิทยาสิ่งแวดล้อม	๓ (๓-๐-๖)
SCBE 331	Industrial Microbiology	3 (2-3-5)
วททส ๓๓๑	จุลชีววิทยาทางอุตสาหกรรม	๓ (๒-๓-๕)
SCBE 411	Molecular Biology Applications	3 (3-0-6)
วททส ๔๑๑	การประยุกต์ชีววิทยาระดับโมเลกุล	๓ (๓-๐-๖)
SCBE 416	In vitro Propagation for Plant Resource Conservation	3 (1-6-4)
วททส ๔๑๖	การขยายพันธุ์ในสภาพปลอดเชื้อเพื่อการอนุรักษ์ทรัพยากรพืช	๓ (๑-๖-๔)

3.3 Bioresources and Environmental Biology Track

Choose from the following modules

a) Structure and Function Module (choose at least 3 credits)

		credit (theory – lab/practice – self-study)
SCBE 308	Developmental Biology	3 (3-0-6)
วททส ๓๐๘	ชีววิทยาการเจริญ	๓ (๓-๐-๖)

SCBE 309	Plant Developmental Biology	3 (3-0-6)
วททส ๓๐๙	ชีววิทยาการพัฒนาการของพืช	๓ (๓-๐-๖)
SCBE 310	Plant Physiology	3 (3-0-6)
วททส ๓๑๐	สรีรวิทยาของพืช	๓ (๒-๓-๕)
SCBE 311	Principles of Animal Physiology	4 (3-2-7)
วททส ๓๑๑	หลักสรีรวิทยาของสัตว์	๔ (๓-๒-๗)
SCBE 313	Plant Molecular Genetics	3 (3-0-6)
วททส ๓๑๓	พันธุศาสตร์ระดับโมเลกุลของพืช	๓ (๓-๐-๖)
SCBE 314	Insect Physiology	3 (3-0-6)
วททส ๓๑๔	สรีรวิทยาแมลง	๓ (๓-๐-๖)
SCBE 315	Coevolution	3 (3-0-6)
วททส ๓๑๕	วิวัฒนาการร่วม	๓ (๓-๐-๖)
SCBE 316	Biological Microtechnique	3 (2-3-5)
วททส ๓๑๖	ชีววิทยาไมโครเทคนิค	๓ (๒-๓-๕)

b) Biodiversity Module (choose at least 9 credits from at least 3 sub-modules)

Sub-module 1: Microbial Diversity

สาขาที่ ๑: ความหลากหลายของจุลินทรีย์

		credit (theory – lab/practice – self-study)
SCBE 330	Environmental Microbiology	3 (3-0-6)
วททส ๓๓๐	จุลชีววิทยาสิ่งแวดล้อม	๓ (๓-๐-๖)
SCBE 331	Industrial Microbiology	3 (2-3-5)
วททส ๓๓๑	จุลชีววิทยาทางอุตสาหกรรม	๓ (๒-๓-๕)
SCBE 332	Host-microbe Interactions	3 (2-3-5)
วททส ๓๓๒	ปฏิสัมพันธ์ระหว่างโฮสท์และจุลินทรีย์	๓ (๒-๓-๕)
SCBE 333	Plant Virology	3 (3-0-6)
วททส ๓๓๓	ไวรัสวิทยาพืช	๓ (๓-๐-๖)
SCBE 334	Biology of Plankton	3 (2-3-5)
วททส ๓๓๔	ชีววิทยาของแพลงก์ตอน	๓ (๒-๓-๕)
SCBE 335	Fungal Diversity and Ecology	3 (3-0-6)
วททส ๓๓๕	ความหลากหลายและนิเวศวิทยาของเห็ดรา	๓ (๓-๐-๖)

SCBE 336	Mycorrhizal Ecology	3 (2-3-5)
วททส ๓๓๖	นิเวศวิทยาของไมคอร์ไรซา	๓ (๒-๓-๕)

Sub-module 2: Plant Diversity

สาขาที่ ๒: ความหลากหลายของพืช

		credit (theory – lab/practice – self-study)
SCBE 350	Diversity of Plants	3 (2-3-5)
วททส ๓๕๐	ความหลากหลายของพืช	๓ (๒-๓-๕)
SCBE 351	Tropical Plants and Gardens	3 (2-3-5)
วททส ๓๕๑	พืชเขตร้อนและสวน	๓ (๒-๓-๕)
SCBE 352	Orchid Biology	3 (2-3-5)
วททส ๓๕๒	ชีววิทยาของกล้วยไม้	๓ (๒-๓-๕)
SCBE 450	Flowering Plants: Diversity, Evolution, and Systematics	3 (2-3-5)
วททส ๔๕๐	พืชดอก: ความหลากหลาย วิวัฒนาการ และซิสเตมาติกส์	๓ (๒-๓-๕)
SCBE 451	Dendrology	3 (2-3-5)
วททส ๔๕๑	รุกขวิทยา	๓ (๒-๓-๕)
SCBE 452	Flora of Thailand	3 (3-0-6)
วททส ๔๕๒	พรรณพฤกษชาติประเทศไทย	๓ (๓-๐-๖)

Sub-module 3: Invertebrate Diversity

สาขาที่ ๓: ความหลากหลายของสัตว์ไม่มีกระดูกสันหลัง

		credit (theory – lab/practice – self-study)
SCBE 370	Invertebrate Zoology	4 (3-2-7)
วททส ๓๗๐	วิทยาสัตว์ไม่มีกระดูกสันหลัง	๔ (๓-๒-๗)
SCBE 371	Parasitology	4 (3-2-7)
วททส ๓๗๑	ปรสิตวิทยา	๔ (๓-๒-๗)
SCBE 372	Basic Entomology	4 (3-2-7)
วททส ๓๗๒	กีฏวิทยาพื้นฐาน	๔ (๓-๒-๗)

SCBE 373	Vector Biology	4 (3-2-7)
วททส ๓๗๓	ชีววิทยาของพาหะนำโรค	๔ (๓-๒-๗)
SCBE 374	Aquatic Entomology	4 (3-2-7)
วททส ๓๗๔	กีฏวิทยาสัตว์น้ำ	๔ (๓-๒-๗)
SCBE 375	Acarology	4 (3-2-7)
วททส ๓๗๕	ชีววิทยาของเห็บและไร	๔ (๓-๒-๗)

Sub-module 4: Vertebrate Diversity

สาขาที่ ๔: ความหลากหลายของสัตว์มีกระดูกสันหลัง

credit (theory – lab/practice – self-study)

SCBE 390	Vertebrate Zoology	4 (3-2-7)
วททส ๓๙๐	วิทยาสัตว์มีกระดูกสันหลัง	๔ (๓-๒-๗)
SCBE 391	Ichthyology	4 (3-2-7)
วททส ๓๙๑	มีนวิทยา	๔ (๓-๒-๗)
SCBE 392	Herpetology	4 (3-2-7)
วททส ๓๙๒	ชีววิทยาสัตว์ครึ่งบกครึ่งน้ำและเลื้อยคลาน	๔ (๓-๒-๗)
SCBE 393	Ornithology	4 (3-2-7)
วททส ๓๙๓	ปักษีวิทยา	๔ (๓-๒-๗)
SCBE 394	Mammal Diversity	4 (3-2-7)
วททส ๓๙๔	ความหลากหลายของสัตว์เลี้ยงลูกด้วยนม	๔ (๓-๒-๗)

c) Bioresources and Environmental Biology Application Module (choose at least 3 credits)

credit (theory – lab/practice – self-study)

SCBE 410	Environmental and Biodiversity Communication: Theory and Practice	3 (3-0-6)
วททส ๔๑๐	การสื่อสารทางสิ่งแวดล้อมและความหลากหลายทางชีวภาพ: ทฤษฎีและปฏิบัติ	๓ (๓-๐-๖)
SCBE 411	Molecular Biology Applications	3 (3-0-6)
วททส ๔๑๑	การประยุกต์ชีววิทยาระดับโมเลกุล	๓ (๓-๐-๖)

SCBE 412	Biological Control	3 (3-0-6)
วททส ๔๑๒	การควบคุมโดยชีววิธี	๓ (๓-๐-๖)
SCBE 413	Integrated Pest Management	3 (3-0-6)
วททส ๔๑๓	การจัดการแมลงศัตรูแบบบูรณาการ	๓ (๓-๐-๖)
SCBE 414	Conservation Biology: Asia Perspectives	3 (3-0-6)
วททส ๔๑๔	ชีววิทยาเชิงอนุรักษ์ : มุมมองภูมิภาคเอเชีย	๓ (๓-๐-๖)
SCBE 415	Biodiversity Sciences	3 (3-0-6)
วททส ๔๑๕	วิทยาศาสตร์ชีวนานาพันธุ์	๓ (๓-๐-๖)
SCBE 416	In vitro Propagation for Plant Resource Conservation	3 (1-6-4)
วททส ๔๑๖	การขยายพันธุ์ในสภาพปลอดเชื้อเพื่อการอนุรักษ์ทรัพยากรพืช	๓ (๑-๖-๔)
SCBE 417	Natural Resources and Environmental Management	3- (3-0-6)
วททส ๔๑๗	การจัดการทรัพยากรธรรมชาติและสิ่งแวดล้อม	๓ (๓-๐-๖)
SCBE 418	Economic Botany	3 (2-3-5)
วททส ๔๑๘	พฤกษศาสตร์พืชเศรษฐกิจ	๓ (๒-๓-๕)
SCBE 419	Organismic Ecology to Eco-complexity	3 (2-3-5)
วททส ๔๑๙	นิเวศวิทยาระดับตัวตนสู่ความซับซ้อนทางนิเวศวิทยา	๓ (๒-๓-๕)
SCBE 420	Biogeography and Paleontology	3 (3-0-6)
วททส ๔๒๐	ชีวภูมิศาสตร์และบรรพชีววิทยา	๓ (๓-๐-๖)

Note: Students can choose to study other courses in Major Elective course category offered at Mahidol University with the approval of the advisor as can be implemented and not contrary to the regulations of the university.

c. Free Electives (no less than 6 credits) (lecture - lab/practice – self-study)

Students are allowed to choose courses in any field based on their interests at Mahidol University or any overseas educational institution approved by Mahidol University under the approval of the Program Director.

These are some of the elective courses that are offered by the State University of New York, College of Environmental Science and Forestry (SUNY-ESF) for each curriculum. These courses are subjected to availability and to be offered in certain semester and academic year. Full details are in the website https://www.esf.edu/academics/

Bachelor of Science in Environmental Biology

APM 391	Introduction to Probability and Statistics	(3)

Structure and Function **Credits**

EFB 385	Comparative Vertebrate Anatomy	(4)
EFB 427	Plant Developmental Biology	(3)
EFB 462	Animal Physiology: Environmental and Ecological	(3)
EFB 530	Plant Physiology	(3)
EFB 570	Insect Physiology	(3)

Organismal Diversity

1. Diversity of Microorganisms **Credits**

EFB 303	Introductory Environmental Microbiology	(4)
EFB 340	Forest and Shade Tree Pathology	(3)
EFB 342	Fungal Diversity and Ecology	(3)
EFB 428	Mycorrhizal Ecology	(3)
EFB 440	Mycology	(3)

2. Diversity of Plants

EFB 326	Diversity of Plants	(3)
EFB 336	Dendrology	(3)
EFB 327	Adirondack Flora	(3)
EFB 435	Flowering Plants: Diversity, Evolution, and Systematics	(3)
EFB 446	Ecology of Mosses	(3)

3. Diversity of Invertebrate Animals **Credits**

EFB 351	Forest Entomology	(3)
EFB 352	Elements of Entomology	(3)
EFB 355	Invertebrate Zoology	(4)
EFB 453	Parasitology	(3)
EFB 554	Aquatic Entomology	(3)

4. Diversity of Vertebrate Animals		Credits
EFB 384	Field Herpetology	(3)
EFB 385	Comparative Vertebrate Anatomy	(4)
EFB 388	Ecology of Adirondack Fishes	(3)
EFB 482	Ornithology	(4)
EFB 483	Mammal Diversity	(4)
EFB 485	Herpetology	(3)
EFB 486	Ichthyology	(3)

Field Experience Elective

This elective is often taken at Cranberry Lake Biological Station, either during the post-freshman summer or subsequent summer. Other options for this requirement need approval of curriculum coordinator.

		Credits
EFB 202	Ecological Monitoring and Biodiversity Assessment	(3)
EFB 420	Internship in Environmental and Forest Biology	(1 - 5)
EFB 498	Research Problems in Environmental and Forest Biology	(1 - 5)
EFB 500	Forest Biology Field Trip	(1 - 3)

Bachelor of Science in Environmental Science

		Credits
EFB 303	Introductory Environmental Microbiology	(4)
EFB 307	Principles of Genetics	(3)
EFB 308	Principles of Genetics Laboratory	(1)
EFB 325	Cell Biology	(3)
EFB 326	Plant Evolution, Diversification and Conservation	(3)
EFB 336	Dendrology	(3)
EFB 337	Field Ethnobotany	(3)
EFB 342	Fungal Diversity and Ecology	(3)
EHS 350	Environmental Health Management	(3)

EFB 355	Invertebrate Zoology	(4)
EFB 384	Field Herpetology	(3)
EFB 385	Comparative Vertebrate Anatomy	(4)
EFB 453	Parasitology	(3)
ENS 498	Research Problem in Environmental Science	(1 - 5)
SRE 335	Renewable Energy	(3)
SRE 479	Life Cycle Assessment	(3)
APM 391	Introduction to Probability and Statistics	(3)

Bachelor of Science in Environmental Health

Water and Wastewater focus area		**Credits**
CIE 442	Treatment Processes in Environmental Engineering	(4)
EAR 401	Hydrogeology	(3)
EAR 420	Contaminant Hydrogeology	(3)
EFB 496	Topics in Environmental and Forest Biology	(1 – 3)
EFB 505	Microbial Ecology	(2)
ERE 275	Ecological Engineering	(3)
ERE 339	Fluid Mechanics	(4)
ERE 340	Engineering Hydrology and Hydraulics	(4)
ERE 440	Water and Wastewater Treatment	(3)
ERE 405	Sustainable Engineering	(3)
ERE 440	Water and Wastewater Treatment	(3)
EST 220	Urban Ecology	(3)
FCH 360	Physical Chemistry I	(3)
FCH 510	Environmental Chemistry I	(3)
FOR 487	Environmental Law and Policy	(3)
APM 391	Introduction to Probability and Statistics	(3)

Bachelor of Science in Biotechnology

		Credits
BTC 401	Molecular Biology Techniques	(4)
BTC 420	Internship in Biotechnology	(3)
BTC 499	Senior Project	(1)
EFB 210	Diversity of Life I	(3)
EFB 211	Diversity of Life II	(3)
EFB 303	Intro to Environmental Microbiology	(4)
EFB 307	Principles of Genetics	(3)
EFB 308	Principles of Genetics Lab	(1)
EFB 311	Principles of Evolution	(3)
EFB 320	General Ecology	(4)
EFB 325	Cell Biology	(3)
FCH 530	Biochemistry I	(3)
APM 391	Introduction to Probability and Statistics	(3)

3.1.4 Study Plan

Plan A

1st Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
PRPR 102 วจปส ๑๐๒	Regional Studies ภูมิภาคศึกษา	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 153 วททส ๑๕๓	Computer for Science Research and Presentation คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์	2 (2-0-4) ๒ (๒-๐-๔)
LAEN 180 ศศภอ ๑๘๐	English for Academic Purpose I ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๑	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 111 วททส ๑๑๑	Principles of Biology I หลักการทางชีววิทยา ๑	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 102 วททส ๑๐๒	General Biology Laboratory I ปฏิบัติการชีววิทยาทั่วไป ๑	1 (0-3-1) ๑ (๐-๓-๑)
SCPY 160 วทฟส ๑๖๐	General Physics Laboratory ปฏิบัติการฟิสิกส์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCCH 161 วทคม ๑๖๑	General Chemistry เคมีทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCCH 189 วทคม ๑๘๙	Chemistry Laboratory ปฏิบัติการเคมี	1 (0-3-1) ๑ (๐-๓-๑)
SCMA 174 วทคณ ๑๗๔	Calculus and System of Differential Equations แคลคูลัสและระบบสมการเชิงอนุพันธ์สามัญ	3 (3-0-6) ๓ (๓-๐-๖)
SCGI 103 วทศน ๑๐๓	Physics for future entrepreneurs ฟิสิกส์สำหรับผู้ประกอบการในอนาคต	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 106 วททส ๑๐๖	Orientation Seminar ปฐมนิเทศ	1 (0-3-1) ๑ (๐-๓-๑)
	Total	22

1st Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
PRPR 101 วจปส ๑๐๑	Population and Development ประชากรและการพัฒนา	2 (2-0-4) ๒ (๒-๐-๔)
LAEN 181 ศศภอ ๑๘๑	English for Academic Purpose II ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๒	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 113 วททส ๑๑๓	Principles of Biology II หลักการทางชีววิทยา ๒	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 104 วททส ๑๐๔	General Biology Laboratory II ปฏิบัติการชีววิทยาทั่วไป ๒	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 105 วททส ๑๐๕	Global Environment สิ่งแวดล้อมโลก	3 (3-0-6) ๓ (๓-๐-๖)
ENGE 105 สวศท ๑๐๕	Integrated Health and Environment บูรณาการสุขภาพและสิ่งแวดล้อม	3 (3-0-6) ๓ (๓-๐-๖)
SCCH 172 วทคม ๑๗๒	Organic Chemistry เคมีอินทรีย์	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 150 วททส ๑๕๐	Science Communication for Life Sciences การสื่อสารวิทยาศาสตร์เพื่อวิทยาศาสตร์ชีวภาพ	3 (3-0-6) ๓ (๓-๐-๖)
	Choose from Health and Recreation or Social Sciences and Humanities section	2
	Total	22

2nd Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 201* วททส ๒๐๑	General Zoology สัตววิทยาทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 202* วททส ๒๐๒	General Zoology Laboratory ปฏิบัติการสัตววิทยาทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
LAEN 380 ศศภอ ๓๘๐	Academic Presentations in English การนำเสนอผลงานเป็นภาษาอังกฤษ	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 220 วททส ๒๒๐	Principle of Water Chemistry หลักการทางเคมีของน้ำ	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 221 วททส ๒๒๑	Water Chemistry Laboratory ปฏิบัติการเคมีของน้ำ	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 203 วททส ๒๐๓	General Genetics พันธุศาสตร์ทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 204 วททส ๒๐๔	General Genetics Laboratory ปฏิบัติการพันธุศาสตร์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 205 วททส ๒๐๕	General Botany พฤกษศาสตร์ทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 206 วททส ๒๐๖	General Botany Laboratory ปฏิบัติการพฤกษศาสตร์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCBM 281 วทชพ ๒๘๑	Basic Biochemistry ชีวเคมีพื้นฐาน	3 (3-0-6) ๓ (๓-๐-๖)
SCBM 282 วทชพ ๒๘๒	Biochemistry Laboratory ปฏิบัติการชีวเคมี	1 (0-3-1) ๑ (๐-๓-๑)
	Total	22

*These courses are taught as modular courses.

2nd Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 207 วททส ๒๐๗	Basic Cell and Molecular Biology เซลล์และชีววิทยาระดับโมเลกุล	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 256 วททส ๒๕๖	Natural Products ผลิตภัณฑ์จากธรรมชาติ	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 208 วททส ๒๐๘	General Ecology นิเวศวิทยาทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 253 วททส ๒๕๓	Fundamentals to Finesse: Microbes for Quality Life พื้นฐานสู่พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 254 วททส ๒๕๔	Gardening งานสวน	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 210 วททส ๒๑๐	General Microbiology จุลชีววิทยาทั่วไป	3 (2-3-5) ๓ (๒-๓-๕)
	Choose from Social Sciences and Humanities or Health and Recreation sections	2
	Total	20

3rd Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 209* วททส ๒๐๙	Ecological Monitoring and Assessment of Bioresources การเฝ้าติดตามทางนิเวศและการตรวจสอบทรัพยากรชีวภาพ	4 (3-3-6) ๔ (๓-๓-๖)
SCBE 301 วททส ๓๐๑	Principles of Environmental Science หลักการวิทยาศาสตร์สิ่งแวดล้อม	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 302 วททส ๓๐๒	Biostatistics ชีวสถิติ	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 303 วททส ๓๐๓	Evolution วิวัฒนาการ	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 497 วททส ๔๙๗	Seminar in Bioresources and Environmental Biology สัมมนาทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	1 (0-3-1) ๑ (๐-๓-๑)
	รวม	14

*This course is taught as modular courses.

3rd Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 304 วททส ๓๐๔	Bioethics ชีวจริยธรรม	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 305 วททส ๓๐๕	Scientific Research and Presentation การวิจัยและการนำเสนอทางวิทยาศาสตร์	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 402 วททส ๔๐๒ SCBE 499 วททส ๔๙๙	Internship in Bioresources and Environmental Biology การฝึกงานทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม OR Independent Research Project in Bioresources and Environmental Biology โครงงานวิจัยอิสระทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	3 (0-9-3) ๓ (๐-๙-๓) 3 (0-9-3) ๓ (๐-๙-๓)
	Free electives	3
	รวม	9

4th Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
	Choose electives from student chosen Track	9
	รวม	9

4th Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
	Choose electives from student chosen Track	6
	Free electives**	3
	รวม	9

Plan B

1st Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
PRPR 102 วจปส ๑๐๒	Regional Studies ภูมิภาคศึกษา	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 153 วททส ๑๕๓	Computer for Science Research and Presentation คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์	2 (2-0-4) ๒ (๒-๐-๔)
LAEN 180 ศศภอ ๑๘๐	English for Academic Purpose I ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๑	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 111 วททส ๑๑๑	Principles of Biology I หลักการทางชีววิทยา ๑	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 102 วททส ๑๐๒	General Biology Laboratory I ปฏิบัติการชีววิทยาทั่วไป ๑	1 (0-3-1) ๑ (๐-๓-๑)
SCPY 160 วทฟส ๑๖๐	General Physics Laboratory ปฏิบัติการฟิสิกส์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCCH 161 วทคม ๑๖๑	General Chemistry เคมีทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCCH 189 วทคม ๑๘๙	Chemistry Laboratory ปฏิบัติการเคมี	1 (0-3-1) ๑ (๐-๓-๑)
SCMA 174 วทคณ ๑๗๔	Calculus and System of Differential Equations แคลคูลัสและระบบสมการเชิงอนุพันธ์สามัญ	3 (3-0-6) ๓ (๓-๐-๖)
SCGI 103 วทศน ๑๐๓	Physics for future entrepreneurs ฟิสิกส์สำหรับผู้ประกอบการในอนาคต	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 106 วททส ๑๐๖	Orientation Seminar ปฐมนิเทศ	1 (0-3-1) ๑ (๐-๓-๑)
	Total	22

1st Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
PRPR 101 วจปส ๑๐๑	Population and Development ประชากรและการพัฒนา	2 (2-0-4) ๒ (๒-๐-๔)
LAEN 181 ศศภอ ๑๘๑	English for Academic Purpose II ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๒	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 113 วททส ๑๑๓	Principles of Biology II หลักการทางชีววิทยา ๒	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 104 วททส ๑๐๔	General Biology Laboratory II ปฏิบัติการชีววิทยาทั่วไป ๒	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 105 วททส ๑๐๕	Global Environment สิ่งแวดล้อมโลก	3 (3-0-6) ๓ (๓-๐-๖)
ENGE 105 สวศท ๑๐๕	Integrated Health and Environment บูรณาการสุขภาพและสิ่งแวดล้อม	3 (3-0-6) ๓ (๓-๐-๖)
SCCH 172 วทคม ๑๗๒	Organic Chemistry เคมีอินทรีย์	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 150 วททส ๑๕๐	Science Communication for Life Sciences การสื่อสารวิทยาศาสตร์เพื่อวิทยาศาสตร์ชีวภาพ	3 (3-0-6) ๓ (๓-๐-๖)
	Choose from Health and Recreation or Social Sciences and Humanities section	2
	Total	22

2nd Year Semester 1

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 201* วททส ๒๐๑	General Zoology สัตววิทยาทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 202* วททส ๒๐๒	General Zoology Laboratory ปฏิบัติการสัตววิทยาทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
LAEN 380 ศศภอ ๓๘๐	Academic Presentations in English การนำเสนอผลงานเป็นภาษาอังกฤษ	2 (2-0-4) ๒ (๒-๐-๔)
SCBE 220 วททส ๒๒๐	Principle of Water Chemistry หลักการทางเคมีของน้ำ	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 221 วททส ๒๒๑	Water Chemistry Laboratory ปฏิบัติการเคมีของน้ำ	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 203 วททส ๒๐๓	General Genetics พันธุศาสตร์ทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 204 วททส ๒๐๔	General Genetics Laboratory ปฏิบัติการพันธุศาสตร์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCBE 205 วททส ๒๐๕	General Botany พฤกษศาสตร์ทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 206 วททส ๒๐๖	General Botany Laboratory ปฏิบัติการพฤกษศาสตร์ทั่วไป	1 (0-3-1) ๑ (๐-๓-๑)
SCBM 281 วทชพ ๒๘๑	Basic Biochemistry ชีวเคมีพื้นฐาน	3 (3-0-6) ๓ (๓-๐-๖)
SCBM 282 วทชพ ๒๘๒	Biochemistry Laboratory ปฏิบัติการชีวเคมี	1 (0-3-1) ๑ (๐-๓-๑)
	Total	22

*These courses are taught as modular courses.

2nd Year Semester 2

Course Code	Course Name	Credits (Theory-Practice-Self-study)
SCBE 207 วททส ๒๐๗	Basic Cell and Molecular Biology เซลล์และชีววิทยาระดับโมเลกุล	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 256 วททส ๒๕๖	Natural Products ผลิตภัณฑ์จากธรรมชาติ	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 208 วททส ๒๐๘	General Ecology นิเวศวิทยาทั่วไป	3 (3-0-6) ๓ (๓-๐-๖)
SCBE 253 วททส ๒๕๓	Fundamentals to Finesse: Microbes for Quality Life พื้นฐานสู่พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 254 วททส ๒๕๔	Gardening งานสวน	3 (2-3-5) ๓ (๒-๓-๕)
SCBE 210 วททส ๒๑๐	General Microbiology จุลชีววิทยาทั่วไป	3 (2-3-5) ๓ (๒-๓-๕)
	Choose from Social Sciences and Humanities or Health and Recreation sections	2
	Total	20

3rd and 4th Year Students (at SUNY-ESF)

Students, who are eligible, can choose their major at the State University of New York, College of Environmental Science and Forestry (SUNY-ESF). Please refer to Appendix 9 for detailed information, which is the MOUs between Mahidol University and SUNY-ESF (2014 and 2019). The courses on 4 majors at SUNY-ESF in equivalents to a BE program at Mahidol University are listed below.

Equivalent courses between Mahidol University and SUNY-ESF

Bachelor of Science in Environmental Biology at SUNY-ESF

3rd Year

Mahidol University			SUNY-ESF		
Course Code	Course Name	Credits	Course Code	Course Name	Credits
SCBE 209	Ecological Monitoring and Assessment of Bioresources	4	EFB 202 EFB 500	Ecological Monitoring and Biodiversity Assessment Forest Biology Field Trip	3 1
SCBE 301	Principles of Environmental Science	2	EFB 498	Research Problem in Environmental and Forest Biology (choose 2 out of 5 credits)	2
SCBE 302	Biostatistics	3	APM 391	Introduction to Probability and Statistics	3
SCBE 303	Evolution	3	EFB 311	Principles of Evolution	3
SCBE 304	Bioethics	2	EST 366	Attitudes, Values and the Environment	3
SCBE 305	Scientific Research and Presentation	3	EWP 220	Public Presentation Skills	3
SCBE 309	Plant Developmental Biology	3	EFB 427	Plant Developmental Biology	3
SCBE 390	Vertebrate Zoology	4	EFB 385	Comparative Vertebrate Anatomy	4

SCBE 497	Seminar in Bioresources and Environmental Biology	1	EWP 296	Special Topics in Writing, Literature, and Public Presentation Skills	1
	Free electives**	3		Free electives**	3
	Total	28		Total	28

4th Year

Mahidol University			SUNY-ESF		
Course Code	**Course Name**	**Credits**	**Course Code**	**Course Name**	**Credits**
SCBE 370	Invertebrate Zoology	4	EFB 355	Invertebrate Zoology	4
SCBE 414	Conservation biology: Asia Perspectives	3	EFB 413	Introduction to Conservation Biology	3
SCBE 451	Dendrology	3	EFB 336	Dendrology	3
SCBE 402 OR SCBE 499	Internship in Bioresources and Environmental Biology OR Independent Research Project in Bioresources and Environmental Biology	3 3	EFB 420 OR EFB 498	Internship in Environmental and Forest Biology OR Research Problems in Environmental and Forest Biology (choose 3 out of 5 credits)	3 3
	Free electives**	3		Free electives**	3
	Total	16			16

Note: ** For free electives, students can choose to study any courses offered at SUNY-ESF that are equivalent to courses offered at Mahidol University with approval of the advisor, however, the chosen courses shall not be contrary to the regulations of both universities. These are some of the selected courses, which are subjected to availability and to be offered in certain semester and academic year.

Bachelor of Science in Environmental Science at SUNY-ESF

3rd Year

Mahidol University			SUNY-ESF		
Course Code	**Course Name**	**Credits**	**Course Code**	**Course Name**	**Credits**
SCBE 209	Ecological Monitoring and Assessment of Bioresources	4	EFB 202 EFB 500	Ecological Monitoring and Biodiversity Assessment Forest Biology Field Trip	3 1
SCBE 222	Fundamental of Environmental Health and Toxiclogy	2	EHS 250	Foundations of Environmental Health	2
SCBE 301	Principles of Environmental Science	2	EFB 498	Research Problem in Environmental and Forest Biology (choose 2 out of 5 credits)	2
SCBE 302	Biostatistics	3	APM 391	Introduction to Probability and Statistics	3
SCBE 303	Evolution	3	EFB 311	Principles of Evolution	3
SCBE 304	Bioethics	2	EST 366	Attitudes, Values and the Environment	3
SCBE 305	Scientific Research and Presentation	3	EWP 220	Public Presentation Skills	3
SCBE 330	Environmental Microbiology	3	EFB 303	Introduction to Environmental Microbiology	3
SCBE 497	Seminar in Bioresources and Environmental Biology	1	EWP 296	Special Topics in Writing, Literature, and Public Presentation Skills	1
	Free electives**	3		Free electives**	3
	Total	26		Total	26

4th Year

Mahidol University			SUNY-ESF		
Course Code	**Course Name**	**Credits**	**Course Code**	**Course Name**	**Credits**
SCBE 319	Renewable Energy	3	SRE 335	Renewable Energy	3
SCBE 320	Occupational Health and Safety	3	EHS 440	Occupational Health and Safety	3
SCBE 401	Hazardous Waste Management	3	EHS 480	Hazardous Waste Management	3
SCBE 402 OR SCBE 499	Internship in Bioresources and Environmental Biology OR Independent Research Project in Bioresources and Environmental Biology	3 3	EFB 420 OR EFB 498	Internship in Environmental and Forest Biology OR Research Problem in Environmental and Forest Biology (choose 3 out of 5 credits)	3 3
	Free electives**	3		Free electives**	3
	Total	15			15

Note: ** For free electives, students can choose to study any courses offered at SUNY-ESF that are equivalent to courses offered at Mahidol University with approval of the advisor, however, the chosen courses shall not be contrary to the regulations of both universities. These are some of the selected courses, which are subjected to availability and to be offered in certain semester and academic year.

Bachelor of Science in Biotechnology at SUNY-ESF

3rd Year

Mahidol University			SUNY-ESF		
Course Code	Course Name	Credits	Course Code	Course Name	Credits
SCBE 209	Ecological Monitoring and Assessment of Bioresources	4	EFB 202 EFB 500	Ecological Monitoring and Biodiversity Assessment Forest Biology Field Trip	3 1
SCBE 301	Principles of Environmental Science	2	EFB 498	Research Problem in Environmental and Forest Biology (choose 2 out of 5 credits)	2
SCBE 302	Biostatistics	3	APM 391	Introduction to Probability and Statistics	3
SCBE 303	Evolution	3	EFB 311	Principles of Evolution	3
SCBE 304	Bioethics	2	EST 366	Attitudes, Values and the Environment	3
SCBE 305	Scientific Research and Presentation	3	EWP 220	Public Presentation Skills	3
SCBE 310	Plant Physiology	3	EFB 427	Plant Anatomy and Development	3
SCBE 330	Environmental Microbiology	3	EFB 303	Introduction to Environmental Microbiology	3
SCBE 313	Plant Molecular Genetics	3	BTC 425	Plant Biotechnology	3
	Free electives**	3		Free electives**	3
	Total	29		Total	29

4th Year

Mahidol University			SUNY-ESF		
Course Code	Course Name	Credits	Course Code	Course Name	Credits
SCBE 390	Vertebrate Zoology	4	EFB 385	Comparative Vertebrate Anatomy	4
SCBE 402	Internship in Bioresources and Environmental Biology	3	BTC 420	Internship in Biotechnology	3
SCBE 411	Molecular Biology Application	3	BTC 401	Molecular Biology Techniques	3
SCBE 497	Seminar in Bioresources and Environmental Biology	1	EWP 296	Special Topics in Writing, Literature, and Public Presentation Skills	1
SCBE 499	Independent Research Project in Bioresources and Environmental Biology	3	EFB 498	Research Problem in Environmental and Forest Biology (choose 3 out of 5 credits)	3
	Free electives**	3		Free electives**	3
	Total	17			17

Note: ** For free electives, students can choose to study any courses offered at SUNY-ESF that are equivalent to courses offered at Mahidol University with approval of the advisor, however, the chosen courses shall not be contrary to the regulations of both universities. These are some of the selected courses, which are subjected to availability and to be offered in certain semester and academic year.

Bachelor of Science in Environmental Health at SUNY-ESF

3rd Year

Mahidol University			SUNY-ESF		
Course Code	**Course Name**	**Credits**	**Course Code**	**Course Name**	**Credits**
SCBE 209	Ecological Monitoring and Assessment of Bioresources	4	EFB 202 EFB 500	Ecological Monitoring and Biodiversity Assessment Forest Biology Field Trip	3 1
SCBE 301	Principles of Environmental Science	2	EFB 498	Research Problem in Environmental and Forest Biology (choose 2 out of 5 credits)	2
SCBE 302	Biostatistics	3	APM 391	Introduction to Probability and Statistics	3
SCBE 303	Evolution	3	EFB 311	Principles of Evolution	3
SCBE 304	Bioethics	2	EST 366	Attitudes, Values and the Environment	3
SCBE 305	Scientific Research and Presentation	3	EWP 220	Public Presentation Skills	3
SCBE 307	Water Pollution Control and Management	3	ERE 440	Water and Wastewater Treatment	3
SCBE 497	Seminar in Bioresources and Environmental Biology	1	EWP 296	Special Topics in Writing, Literature, and Public Presentation Skills	1
	Free electives**	3		Free electives**	3
	Total	26		Total	26

4th Year

Mahidol University			SUNY-ESF		
Course Code	Course Name	Credits	Course Code	Course Name	Credits
SCBE 224	Urban Ecology	3	EST 220	Urban Ecology	3
SCBE 403	Sustainable Technology	3	ERE 405	Sustainable Engineering	3
SCBE 404	Water and Wastewater Treatment	3	ERE 440	Water and Wastewater Treatment	3
SCBE 417	Natural Resources and Environmental Management	3	EFB 496	Topics in Environmental and Forest Biology	3
SCBE 402 OR SCBE 499	Internship in Bioresources and Environmental Biology OR Independent Research Project in Bioresources and Environmental Biology	3 3	EFB 420 OR EFB 498	Internship in Environmental and Forest Biology OR Research Problem in Environmental and Forest Biology (choose 3 out of 5 credits)	3 3
	Free electives**	3		Free electives**	3
	Total	15			15

Note: ** For free electives, students can choose to study any courses offered at SUNY-ESF that are equivalent to courses offered at Mahidol University with approval of the advisor, however, the chosen courses shall not be contrary to the regulations of both universities. These are some of the selected courses, which are subjected to availability and to be offered in certain semester and academic year.

Plan for students who plan to apply for a professional license (optional)

According to the Article of Council of Science and Technology Professionals published in the Government Gazette volume 131, special part 195 D on 2nd October B.E. 2557 (A.D. 2014), Notification of the Ministry of Science and Technology published in the Government Gazette volume 132, special part 192 D on 20th August B.E. 2558 (A.D. 2015), and Notification of Councils of Science and Technology number 3/2561 issued on 25th September B.E. 2561 (A.D. 2018)

Practitioners in the fields of science and technology, according to the referred article and notification, are required to hold valid professional license to comply with the Professional Practice Standard in Science and Controlled Technology. To be a qualified specialist expert, one must hold no less than a Bachelor of Science and have taken sufficient credits of relevant subjects. The professional license holders need regular updates to keep up with new technology. The first license is valid for 3 years. After the first renewal, each subsequent license is valid for 5 years.

Fields of Specialty	Requirement
Health Impact Assessment	Taken no less than 3 credits in the specialized topic and no less than 12 credits in general environmental impacts on health such as - Global Environment SCBE105: 3(3-0-6) - Fundamentals of Environmental Health and Toxicology SCBE222: 2(2-0-4) - Toxicology in Public Health SCBE223: 3(3-0-6) - Biostatistics SCBE302: 3(3-0-6) - Environmental Risk Assessment SCBE318: 3(3-0-6) - Occupational Health and Safety SCBE320: 3(3-0-6) - Epidemiology and Disease Control SCBE321: 3(3-0-6) - Host-microbe Interactions SCBE332: 3(2-3-5)
Pollution control - Water pollution - Air pollution - Noise and vibration pollution	Taken no less than 6 credits in pollution control and other related subjects - Hazardous and Toxic Wastes SCBE317: 3(3-0-6) - Hazardous Waste Management SCBE401: 3(3-0-6) - Water Pollution Control and Management SCBE307: 3(2-3-5)

Fields of Specialty	Requirement
- Hazardous waste - Solid waste and sewage	- Air Quality Monitoring and Management SCBE322: 3(2-3-5) - Noise and Vibration SCBE323: 3(2-3-5) - Solid Waste and Sewage SCBE324: 3(2-3-5)
Culture and utilization of microorganisms	Holding no less than a Bachelor of Science in related fields - General Microbiology SCBE 210: 3(2-3-5) - Fundamental to Finesse: Microbes for Quality Life SCBE253: 3(2-3-5) - Host-microbe Interactions SCBE332: 3(2-3-5)

3.1.5 Curriculum Mapping shown in Appendix 4

3.1.6 Course Description

a. General Education (no less than 30 credits) credit (theory – lab/practice – self-study)

Social Sciences and Humanities

PRPR 101 Population and Development 2 (2-0-4)

วจปส ๑๐๑ ประชากรและการพัฒนา ๒ (๒-๐-๔)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Concepts and theories on population and development; relationships between population and development in terms of population; social and economic aspects; human resource development; education; poverty; migration; urbanization; locality; environment and resources; community participation; feminism and Greater Mekong Sub-region (GMS) development; analyzing and criticizing directions of development

แนวคิด ทฤษฎีประชากรและการพัฒนา ความสัมพันธ์ระหว่างประชากรและการพัฒนาในมิติทางประชากร สังคม และเศรษฐกิจ การพัฒนาทรัพยากรมนุษย์ การศึกษา ความยากจน การย้ายถิ่นและความเป็นเมือง ท้องถิ่น สิ่งแวดล้อมและทรัพยากรธรรมชาติ การมีส่วนร่วมของชุมชน สตรีนิยม การพัฒนาอนุภูมิภาคลุ่มน้ำโขง วิเคราะห์และวิพากษ์ แนวทางการพัฒนา

PRPR 102 Regional Studies 2 (2-0-4)
วจปส ๑๐๒ ภูมิภาคศึกษา ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Development theories; international relations theories; analysis of development and trends in economics of Asian countries; regional economic integration; Greater Mekong Sub-region (GMS); ASEAN community; ASEAN-China Free Trade Agreement (FTA); analysis of economic and socio-cultural impacts; commenting; discussing and presenting report

ทฤษฎีด้านการพัฒนา ทฎษฎีความสัมพันธ์ระหว่างประเทศ วิเคราะห์พัฒนาการและทิศทางการพัฒนาทางเศรษฐกิจและสังคมของประเทศในเอเชีย การรวมกลุ่มทางเศรษฐกิจของภูมิภาค อนุภูมิภาคลุ่มแม่น้ำโขง ประชาคมอาเซียน เขตการค้าเสรีอาเซียน-จีน การวิเคราะห์ผลกระทบที่เกิดขึ้นในด้านเศรษฐกิจ สังคม ประชากรและวัฒนธรรม วิพากษ์ อภิปราย และนำเสนอรายงาน

SCBM 103 Figurative Language for Everyday Life 1 (1-0-2)
วทชพ ๑๐๓ โวหารภาพพจน์สำหรับชีวิตประจำวัน ๑ (๑-๐-๒)
Prerequisite None
วิชาบังคับก่อน ไม่มี

The use of a phrase or word that has different meanings than its literal meanings or that convey meanings in fresh and unexpected ways; including metaphor; simile; euphemism; hyperbole; irony; metonymy; alliteration; anaphora; personification; apostrophe; assonance; litotes; understatement; onomatopoeia; oxymoron; paradox; synecdoche; and rhetorical question

วิธีใช้วลีหรือคำให้มีความหมายแตกต่างจากความหมายตามตัวอักษรหรือให้สื่อความหมายใหม่ในรูปแบบที่คาดไม่ถึง เช่น อุปมา ภาษาสละสลวย อติพจน์ การย้อนแย้งกัน นามนัย การสัมผัสอักษร การเขียนซ้ำคำ บุคลาธิสันฐาน การพูดถึงสิ่งไม่มีชีวิตว่าเป็นสิ่งมีชีวิต การกระทบสระ อุปนิเสธ คำกล่าวที่น้อยไปจากความจริง คำที่ออกเสียงเหมือนความหมาย ปฏิพจน์ ปฏิทรรศ์ อนุนามนัยและคำถามที่ไม่ต้องการคำตอบ

SHHU 125 Professional Code of Ethics 2 (2-0-4)
สมมน ๑๒๕ จรรยาบรรณวิชาชีพ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Meanings of ethics; meaning and components of profession; moral philosophical concepts and theories in professional ethics; code of professional ethics relevant to students; professional ethical issues

ความหมายและขอบเขตของจริยศาสตร์วิชาชีพ ความหมายต่างๆ ของจริยธรรม ความหมายและองค์ประกอบของวิชาชีพ แนวคิดและทฤษฎีจริยปรัชญาในจริยธรรมวิชาชีพ จรรยาบรรณวิชาชีพที่เกี่ยวข้องกับนักศึกษา ประเด็นจริยธรรมวิชาชีพ

SHHU 116 Comparative Culture 2 (2-0-4)
สมมน ๑๑๖ วัฒนธรรมเปรียบเทียบ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Comparison of material; cognitive; and normative dimensions between Thai; Western and other related cultures with emphasis on cross cultural understanding and appreciation of cultural diversity เปรียบเทียบมิติด้านวัตถุธรรม ความรู้คิด และบรรทัดฐานของวัฒนธรรมไทย วัฒนธรรมตะวันตก และวัฒนธรรมอื่นๆ ที่เกี่ยวข้อง เน้นความเข้าใจข้ามวัฒนธรรมและความวิจักษ์ในความหลากหลายทางวัฒนธรรม

Languages

LAEN 180 English for Academic Purpose I 2 (2-0-4)
ศศภอ ๑๘๐ ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๑ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Vocabulary, expressions, grammar, and contextualized social language; essential communicative skills in small groups; simulations in various university and academic situations; introduction to academic writing; and reading and listening from various sources

คำศัพท์วิชาการ สำนวน ไวยากรณ์ และภาษาที่ใช้บ่อยในปริบทสังคมวิชาการ ทักษะการสื่อสารที่จำเป็นในการสนทนากลุ่มย่อย การจำลองสถานการณ์ที่เกี่ยวข้องกับปริบทมหาวิทยาลัยและวิชาการ การเขียนเชิงวิชาการเบื้องต้น การอ่านและการฟังจากแหล่งข้อมูลต่าง ๆ

LAEN 181 English for Academic Purpose II 2 (2-0-4)
ศศภอ ๑๘๑ ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๒ ๒ (๒-๐-๔)
Prerequisite LAEN 180 English for Academic Purpose I

วิชาบังคับก่อน ศศภอ ๑๘๐ ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาการ ๑

Essential strategies for four language skills: reading and listening from various sources; speaking in academic contexts and essay-writing; including sub-skills i.e., grammar, academic vocabulary, and summary with a focus on academic English and issues that enhance student's world knowledge

กลยุทธ์ที่สำคัญในทักษะการใช้ภาษาทั้งสี่ การอ่านและการฟังตัวบททางวิชาการ การพูดในเชิงวิชาการและการเขียนระดับเรียงความ รวมทั้งทักษะย่อย คือ ไวยากรณ์ คำศัพท์วิชาการ การเขียนสรุป เน้นภาษาอังกฤษที่ใช้ในระดับอุดมศึกษา และเนื้อหาเกี่ยวกับสังคมโลก

LAEN 280 Science Fiction and Society 2 (2-0-4)
ศศภอ ๒๘๐ วรรณกรรมวิทยาศาสตร์กับสังคม ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

A study of literary fiction from detective to cyber punk short stories and novels to augment the awareness of significance and effects of science toward the society that humans live in

การศึกษาวรรณกรรมวิทยาศาสตร์ในรูปแบบเรื่องสั้น และนวนิยายเพื่อการตระหนักถึงความสำคัญและผลกระทบของวิทยาศาสตร์ที่มีต่อชุมชนและสังคมที่มนุษย์อาศัยอยู่ในฐานะสมาชิกคนหนึ่งของชุมชนและสังคมนั้น

LAEN 281 The Science of Speech Sounds 2 (2-0-4)
ศศภอ ๒๘๑ วิทยาศาสตร์ด้านเสียงพูด ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

The human speech sounds, including the articulatory, the physiology, the physics, the acoustics, the perception, and the application

เสียงพูดของมนุษย์ รวมทั้งด้านการเปล่งเสียง สรีระด้านเสียง ฟิสิกส์ กลศาสตร์ การรับรู้ และการประยุกต์ใช้

LAEN 282 Multilingualism and Multiculturalism 2 (2-0-4)
ศศภอ ๒๘๒ พหุภาษาและพหุวัฒนธรรม ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

The concepts of languages and cultures around the world, internationalization, and globalization; the universality and diversity in the multilingual and multicultural globe

มโนทัศน์เกี่ยวกับภาษาและวัฒนธรรมต่าง ๆ รอบโลก ความเป็นนานาชาติและโลกาภิวัตน์ สากลลักษณ์และความหลากหลายในโลกพหุภาษาและพหุวัฒนธรรม

LAEN 380 Academic Presentations in English 2 (2-0-4)
ศศภอ ๓๘๐ การนำเสนอผลงานเป็นภาษาอังกฤษ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Presentation skills in the students' fields of study using appropriate and accurate English; clear delivery of the message; interesting and effective language use; language for statistics description; presentation strategies and research skills that enhance life-long learning

การนำเสนอผลงานในสาขาวิชาต่างๆ โดยใช้ภาษาอังกฤษได้อย่างถูกต้องเหมาะสม การให้ข้อมูลอย่างชัดเจนน่าสนใจ และมีประสิทธิภาพ ภาษาที่ใช้ในการนำเสนอผลงาน การบรรยายข้อมูลทางสถิติ กลยุทธ์ในการนำเสนอ และทักษะการวิจัยซึ่งช่วยส่งเสริมการเรียนรู้ตลอดชีวิต

Science and Mathematics

SCBE 100 Wonder of Life 3(3-0-6)
วททส ๑๐๐ มหัศจรรย์แห่งชีวิต ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

The origin of life on earth; the composition of life and its organization; cell and its life; from breakfast to ATP; reproduce or die; a chip from the old block; adapt to evolve; we are the world; pollution not in my backyard

กำเนิดโลก องค์ประกอบและโครงสร้างของชีวิต เซลล์และชีวิต จากอาหารเช้าสู่เอทีพี สืบพันธุ์หรือสูญพันธุ์ ลูกไม้หล่นไม่ไกลต้น ปรับเพื่อเปลี่ยนโลก เราคือโลก มลพิษนอกบ้านของฉัน

SCBE 109 Human and its surroundings 2 (2-0-4)
วททส ๑๐๙ มนุษย์และสิ่งรอบตัว ๒ (๒-๐-๔)
Pre-requisite None
วิชาบังคับก่อน ไม่มี

Origin of life; the first life and its evolution; composition of life and its organization; cell and its life; from breakfast to carbondioxide; reproduction and fitness; adapt or otherwise extinct; we are the world; environment, its future, and ours

กำเนิดแห่งชีวิต ชีวิตแรกและวิวัฒนาการของมัน องค์ประกอบของชีวิตและการจัดระเบียบ เซลล์และชีวิตของเซลล์ จากอาหารเช้าสู่คาร์บอนไดออกไซด์ สืบพันธุ์และความเหมาะสมในการดำรงชีวิต การปรับตัวหรือการสูญพันธุ์ เราคือโลก สิ่งแวดล้อม อนาคตของมันและของเรา

SCBE 150 Science Communication for Life Sciences 3 (3-0-6)
วททส ๑๕๐ การสื่อสารวิทยาศาสตร์เพื่อวิทยาศาสตร์ชีวภาพ ๓ (๓–๐–๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Skills in science communication including compilation and in analysis of data based on scientific and statistic concepts for knowledge transfer; reliable national and international information database, teamwork skills; appropriate information technology for science communication for diverse target groups and scientists' ethics

ทักษะการสื่อสารทางวิทยาศาสตร์ รวมถึงการรวบรวมและวิเคราะห์ข้อมูลด้วยแนวคิดทางวิทยาศาสตร์และทางสถิติ เพื่อการถ่ายทอดความรู้ ฐานข้อมูลสารสนเทศทั้งในและต่างประเทศที่เชื่อถือได้ ทักษะการทำงานกลุ่ม ทักษะการใช้เทคโนโลยีสารสนเทศที่เหมาะสมในการสื่อสารความรู้ทางวิทยาศาสตร์สำหรับกลุ่มเป้าหมายที่หลากหลาย และจริยธรรมของนักวิทยาศาสตร์

SCBE 151 Plants and Civilizations 3 (2-2-5)
วททส ๑๕๑ พืชและอารยธรรม ๓ (๒-๒-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

An introduction to the Plant Kingdom, diversity of plants and classification; how plants are named; important plants in world history and scientific discoveries; survey and identify plants in local ceremonies; plants in everyday lives; economic plants, genetically modified plants and plant biotechnology; importance of plants to ecosystem and the future world; plant resource conservation.

ความรู้พื้นฐานเกี่ยวกับอาณาจักรพืช การจัดจำแนกพืชและความหลากหลายของพืช และการตั้งชื่อพืชขั้นแนะนำ พืชสำคัญในประวัติศาสตร์โลก และประวัติศาสตร์การค้นพบทางวิทยาศาสตร์ สำรวจและจำแนกพืชในพิธีกรรม

ท้องถิ่น พืชในชีวิตประจำวัน พืชเศรษฐกิจ พืชดัดแปลงพันธุกรรมและเทคโนโลยีชีวภาพของพืช ความสำคัญของพืชต่อระบบนิเวศและโลกอนาคต การอนุรักษ์พันธุกรรมพืช

SCBE 152 Natural Science Illustration 3 (1-4-4)
วททส ๑๕๒ นิทัศน์ทางวิทยาศาสตร์ธรรมชาติ ๓ (๑-๔-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Skills on illustrations and photography of specimens for data presentations in the natural science study, pictures editing using software

ทักษะการวาดและถ่ายภาพตัวอย่างเพื่อนำเสนอข้อมูลในการศึกษาวิทยาศาสตร์ธรรมชาติ การใช้ซอฟต์แวร์ตกแต่งภาพ

SCBE 153 Computer for Science Research and Presentation 2 (2-0-4)
วททส ๑๕๓ คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Skills on computer technologies; learning project-oriented research opportunities; working on computer networks and applications to locate, evaluate, and use electronic database information; create written documents and oral presentations; know how to build and search databases and perform system management to become independent users of information, computer technology and library resources.

ทักษะเกี่ยวกับเทคโนโลยีคอมพิวเตอร์ การเรียนรู้โอกาสการวิจัยเชิงโครงการ การทำงานบนเครือข่ายคอมพิวเตอร์และแอพพลิเคชันเพื่อค้นหาประเมินและการใช้ฐานข้อมูลอิเล็กทรอนิกส์ การสร้างเอกสารที่เป็นลายลักษณ์อักษรและการนำเสนอด้วยวาจา; รู้วิธีสร้างและค้นหาฐานข้อมูลและดำเนินการจัดการระบบเพื่อให้เป็นผู้ใช้ที่ข้อมูลเทคโนโลยีคอมพิวเตอร์และทรัพยากรห้องสมุดที่สามารถทำงานได้ด้วยตัวเอง

SCBE 253 Fundamental to Finesse: Microbes for quality life 3 (2-3-5)
วททส ๒๕๓ พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

The advancement of science and technology; survey, differentiate and evaluate products derived from various biological sources; the maximized utilization of natural resources for food, beverage, clothing, medicine, beauty, etiquette, and art particularly focusing on those derived from microbes to indulge the quality life

ความก้าวหน้าทางวิทยาศาสตร์และเทคโนโลยี สำรวจ จำแนกความแตกต่าง และประเมินผลิตภัณฑ์ทางชีวภาพต่างๆ การนำทรัพยากรธรรมชาติมาใช้ประโยชน์ต่างๆ ด้านอาหาร เครื่องดื่ม เสื้อผ้าอาภรณ์ ยารักษาโรค ความสวยงามและศิลปะ โดยมุ่งเน้นผลิตภัณฑ์ที่มาจากจุลินทรีย์เพื่อการดื่มด่ำชีวิตที่มีคุณภาพ

SCBE 254 Gardening 3 (2-3-5)
วททส ๒๕๔ งานสวน ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี
Indoor and outdoor plants; planting materials; plant care; garden design; DIY garden decor
พืชในร่มและกลางแจ้ง วัสดุปลูก การดูแลพืช การออกแบบสวน การตกแต่งสวนด้วยตนเอง

SCBE 255 Aesthetics for Fragrance and Flavor 3 (3-0-6)
วททส ๒๕๕ สุนทรียศาสตร์ของกลิ่นและรส ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี
Perceptions of fragrances and flavors; the smell of death; the taste of love; the odor and its chemistry; volatile chemicals; the distillation process; aromatherapy; essential oils; concoction and formulation; perfume and flavor; natural identical and their applications

การรับรู้กลิ่นและรส กลิ่นแห่งความตาย รสชาติแห่งรัก กลิ่นและเคมีแห่งกลิ่น สารระเหย กระบวนการกลั่น สุคนธบำบัด น้ำมันหอมระเหย ส่วนผสมและการปรุงสูตร น้ำหอมและสารปรุงแต่งรสชาติ สารเคมีเลียนแบบธรรมชาติและการใช้ประโยชน์

SCBE 256 Natural Products 3 (2-3-5)
วททส ๒๕๖ ผลิตภัณฑ์ธรรมชาติ ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Natural products that have been utilized by human; products of fragrances and flavors; products of food and drink; products of therapeutic purposes; products of medicinal purposes; natural identical and their applications; basic experiment on production and quality assessment of natural products

ผลิตภัณฑ์จากสิ่งมีชีวิตที่มนุษย์นำมาใช้ประโยชน์ เพื่อกลิ่นและรส เพื่ออาหารและเครื่องดื่ม เพื่อบำบัด เพื่อเป็นยา สารเคมีเลียนแบบธรรมชาติและการใช้ประโยชน์ การทดลองพื้นฐานในการผลิตและการประเมินคุณภาพผลิตภัณฑ์ธรรมชาติ

SCBE 325 Environmental Economics 2(2-0-4)
วททส ๓๒๕ เศรษฐศาสตร์สิ่งแวดล้อม ๒(๒-๐-๔)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Theory of externalities and market; microeconomic concepts to the study of environmental improvement; analytical tools; benefit-cost analysis; problems with environmental dimensions; criteria and strategies used in the development and implementation of environmental policies; theoretical and policy formulations with respect to environmental management; economic causes of environmental problems; environmental evaluation techniques; environmental policy instruments and their economic consequences; environmental policy decision making tools and modeling

ทฤษฎีปัจจัยภายนอกและการตลาด หลักการจุลเศรษฐศาสตร์ ที่ใช้ศึกษาเพื่อการพัฒนาทางสิ่งแวดล้อม เครื่องมือในการวิเคราะห์ การวิเคราะห์ประโยชน์และต้นทุน ปัญหาในมิติของสิ่งแวดล้อม เกณฑ์และวิธีที่ใช้ในการพัฒนาและนำนโยบายทางสิ่งแวดล้อมมาใช้ การกำหนดนโยบายและทฤษฎีที่เกี่ยวข้องกับการจัดการทางสิ่งแวดล้อม ต้นเหตุทางเศรษฐกิจที่ทำให้เกิดปัญหาทางสิ่งแวดล้อม เทคนิคการประเมินผลกระทบทางสิ่งแวดล้อม เครื่องมือนโยบายทางสิ่งแวดล้อมและผลกระทบทางเศรษฐกิจ เครื่องมือในการสร้างนโยบายเพื่อการตัดสินใจทางสิ่งแวดล้อมและระบบศึกษา

SCBM 101 Basic Information Literacy 1 (1-0-2)
วทชพ ๑๐๑ การเรียนรู้สารสนเทศพื้นฐาน ๑ (๑-๐-๒)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Discussions on the current status in information technology and IT devices in everyday use; using popular online tools such as E-mail and some social network tools with personal security; being

aware of related law affected; study on office software and cloud technology facilitating study and work; techniques in searching data from databases and the internet

อภิปรายความก้าวหน้าของเทคโนโลยีสารสนเทศและอุปกรณ์สื่อสารที่ใช้ในชีวิตประจำวัน การใช้สื่อสังคมออนไลน์ เช่น อีเมล์ ทวิตเตอร์ เฟสบุ๊ค และอื่น ๆ เพื่อการติดต่อสื่อสารทั้งในเรื่องงาน เรื่องส่วนตัวอย่างปลอดภัย ตระหนักถึงผลกระทบจากกฎหมายที่เกี่ยวข้องจากการประยุกต์ใช้ การใช้โปรแกรมสำนักงานและเทคโนโลยีคลาวด์ รวมถึงเทคนิคต่าง ๆ ในการสืบค้นฐานข้อมูลและอินเทอร์เน็ต เพื่อการศึกษาและการทำงาน

ENGE 105 Integrating Health and Environment 3(3-0-6)
สวศท ๑๐๕ บูรณาการสุขภาพและสิ่งแวดล้อม ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Concepts of “ health” and “ environment” , dimensions and levels of health and factors determining health and environment; the health system reform, strategic development of health and environment promotion, healthy public policy, health and environmental impact assessment; Integrative research for health and environment, indicators of well-beings; the information system for promoting health and environment, communication for health and environment; learning process for developing the quality of life, living for health and environment; self-sufficient economy, techniques for integrating health and environment, health, environment and occupations

แนวคิดสำหรับ “สุขภาพ” และ “สิ่งแวดล้อม” มิติและระดับของสุขภาพ และปัจจัยที่กำหนดสุขภาพและสิ่งแวดล้อมการปฏิรูประบบสุขภการพัฒนาเชิงยุทธศาสตร์สำหรับการเสริมสร้างสุขภาพและสิ่งแวดล้อม การประเมินผลกระทบทางสุขภาพและสิ่งแวดล้อม การวิจัยเชิงบูรณาการเพื่อสุขภาพ ตัวชี้วัดความอยู่ดีมีสุข ระบบสารสนเทศเพื่อเสริมสร้างสุขภาพและสิ่งแวดล้อม นโยบายสุขภาพสาธารณะ กระบวนการเรียนรู้เพื่อพัฒนาคุณภาพชีวิต การดำเนินชีวิตเพื่อสุขภาพและสิ่งแวดล้อม เศรษฐกิจพอเพียง เทคนิคการบูรณาการสุขภาพและสิ่งแวดล้อมความสัมพันธ์ระหว่างสุขภาพและสิ่งแวดล้อมกับอาชีพ

SCGI 103 Physics for future entrepreneurs 3(3-0-6)
วทศน ๑๐๓ ฟิสิกส์สำหรับผู้ประกอบการในอนาคต ๓ (๓-๐-๖)

Working principles of household appliances, cars and advanced technology instruments, physics concepts behind these devices, physics and safety, physics and environmental issues

หลักการทำงานของอุปกรณ์ไฟฟ้าในบ้าน รถยนต์ และอุปกรณ์ที่ใช้เทคโนโลยีสมัยใหม่ แนวคิดทางฟิสิกส์ที่เป็นพื้นฐานของอุปกรณ์เหล่านี้ ฟิสิกส์กับความปลอดภัย ฟิสิกส์กับประเด็นเกี่ยวกับสิ่งแวดล้อม

SCBC 207 Science in Social Media 2 (2-0-4)
วทชค ๒๐๗ วิทยาศาสตร์ในสื่อสังคม ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Viral content; health supplement advertisement; herbal remedies; antioxidants in cosmetics, foods, and drinks; skin care; plastic surgery; stem cells; exercise workout; weight loss; diet pills; practicing critical thinking skill; practicing information searching skill and information technology skill for working on group assignments and doing presentations in classroom

ข่าวที่แชร์อย่างแพร่หลายในสื่อสังคมออนไลน์ โฆษณาอาหารเสริม ยาสมุนไพร สารต้านอนุมูลอิสระในสินค้าอุปโภคบริโภค ผลิตภัณฑ์บำรุงผิว ศัลยกรรมตบแต่ง การใช้เซลล์ต้นกำเนิด การออกกำลังกายเพื่อลดน้ำหนัก ยาลดน้ำหนัก การฝึกทักษะการคิดวิเคราะห์ การฝึกทักษะการสืบค้นข้อมูลและทักษะด้านเทคโนโลยีสารสนเทศ เพื่อทำงานกลุ่มและนำเสนอในห้องเรียน

SCPA 203 Young Blood Detective 2 (2-0-4)
วทพธ ๒๐๓ ยอดนักสืบสายเลือดใหม่ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Team-based learning for the basic skills of detectives including observation, data searching and collection, planning, data analysis, amd knowledge synthesis; applying these skills in the circumstances such as exploration of evidences, investigation, lie detection, and case analysis

การรวมกลุ่มเพื่อฝึกทักษะพื้นฐานของนักสืบ ได้แก่ การสังเกตโดยใช้ประสาทสัมผัสทั้งห้า ทักษะการสืบค้นและรวบรวมข้อมูล การวางแผนวิเคราะห์ข้อมูล และการสังเคราะห์ความรู้ การประยุกต์ใช้ทักษะเหล่านี้ในสถานการณ์ต่างๆ เช่น ค้นหาหลักฐาน เฝ้าติดตามสืบ สอบเท็จ และวิเคราะห์คดี

Health and Recreation

SCPA 204 Common Diseases in Various Age Groups 2 (2-0-4)
วทพธ ๒๐๔ โรคทั่วไปในกลุ่มวัยต่าง ๆ ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Causes of diseases; signs and symptoms; initial diagnosis; awareness of common diseases in various age groups: newborns, pre-teens, teenagers, adults, the elderly

สาเหตุการเกิดโรค อาการและอาการแสดง การวินิจฉัยเบื้องต้น การตระหนักถึงโรคต่าง ๆ ในกลุ่มวัยเด็กแรกเกิด และเด็กอ่อน เด็กโต วัยรุ่น วัยทำงาน วัยสูงอายุ

SPGE 201 Basketball 2 (1-2-3)
วกศท ๒๐๑ บาสเกตบอล ๒ (๑-๒-๓)
Prerequisite None
วิชาบังคับก่อน ไม่มี

An application of sport science principles to basketball for heath and recreation; benefits, rules, regulations, and safety in basketball games; basic skills and physical movements in basketball such passed ball, dribbling ball, shooting and team strategies

การประยุกต์ใช้หลักวิทยาศาสตร์การกีฬาในบาสเกตบอล ประโยชน์ กติกา มารยาท การแต่งกาย และ ความปลอดภัยในการเล่น ทักษะพื้นฐานในการเคลื่อนที่ และ การรับบอล ส่งบอล การเลี้ยงลูก การยิงประตู และการเล่นทีม ในกีฬาบาสเกตบอล

SPGE 202 Arts of Self-defense for Health and Recreation 2 (1-2-3)
วกศท ๒๐๒ ศิลปะการต่อสู้ป้องกันตัว ๒ (๑-๒-๓)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Sport science principles and their application to the arts of self-defense for health and recreation; usefulness, definition, safety, basic skills, such as rolls and somersaults, punch, immobilization, attacks and self-defense

หลักวิทยาศาสตร์การกีฬาและการประยุกต์ใช้ใน ศิลปะการต่อสู้ป้องกันตัว ประโยชน์ ความหมาย ความปลอดภัย ทักษะเบื้องต้นในการต่อสู้ป้องกันตัว เช่น การล้ม การม้วนตัวด้านหน้า-หลัง การเตะ การต่อย การทุ่ม การควบคุมและการแก้ไขจากการถูกควบคุม

SPGE 203 Bike for Health and Recreation 2 (1-2-3)
วกศท ๒๐๓ จักรยานเพื่อสุขภาพและนันทนาการ ๒ (๑-๒-๓)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Sport science principles and their application to bike riding, physical and mental fitness preparations for bike riders, bicycle and accessories maintenance, benefits, basic principles, bike skills, safety, rules and regulations and manner in riding in the bike lane, tour around MU by bike for recreations and health

เพื่อพัฒนารายวิชาให้มีความเหมาะสมและสามารถนำไปประยุกต์ใช้ปฏิบัติในชีวิตประจำวัน เพื่อให้เกิดประโยชน์ในการเสริมสร้างสุขภาพทางกาย ใจ อารมณ์และสังคมที่ดี ช่วยคลายความเครียดจากการเรียนวิชาการอื่นๆ และเป็นทางเลือกในการดำเนินชีวิตประจำวันอย่างเหมาะสม ส่งเสริมการลดการใช้พลังงานสิ้นเปลืองและลดการสร้างมลภาวะที่เป็นอันตรายต่อสุขภาพและสิ่งแวดล้อม

SCPM 203 General Principles of Drug and Herbal Usage 2 (2-0-4)
วทภส ๒๐๓ หลักการทั่วไปของการใช้ยาและสมุนไพร ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Definitions of drugs, herbs, and toxicants; dosage forms; drug labeling and reading; routes of drug administration; basic principles of pharmacology for drugs and herbal medicine; drugs used in special population; herbal plants; drugs used in animals; herbal medicine in the health promotion and cosmetics; adverse drug reactions; safety and toxicity of drugs and herbs

ความหมายของยา สมุนไพรและสารพิษ รูปแบบยา การอ่านฉลากยา วิถีการให้ยา หลักการพื้นฐานทางเภสัชวิทยาของยาและยาสมุนไพร การใช้ยาในประชากรกลุ่มพิเศษ พืชสมุนไพร การใช้ยาในสัตว์ สมุนไพรในการรักษาโรคและความงาม อาการไม่พึงประสงค์ ความปลอดภัยและความเป็นพิษจากยาและสมุนไพร

SCPS 101 Health and Wellness 2 (2-0-4)
วทสร ๑๐๑ สุขภาพเพื่อการพัฒนาคุณภาพชีวิต ๒ (๒-๐-๔)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Physical and spiritual factors affecting health and wellness; physical fitness and health; nutrition; physical activity; stress management; disease awareness and prevention

ปัจจัยทางกายและใจที่มีผลต่อสุขภาพและคุณภาพชีวิต สมรรถภาพทางกายและสุขภาพ โภชนาการ การออกกำลังกาย วิธีการจัดการความเครียด การระวังและการป้องกันการเกิดโรค

b) Specific Courses (90 credits)

1. Core Courses (34 credits) credit (theory – lab/practice – self-study)

SCBE 111 Principles of Biology 1 3 (3-0-6)
วททส ๑๑๑ หลักการทางชีววิทยา ๑ ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic biology and fields of biology; data mining with ICT literacy from scientific database; presentation and communication in biology; types of chemicals in living things; major types of cells and tissues; growth and metabolic processes of cells; growth and survival of living things; cell division; genetics; pattern of inheritance; molecular genetics; recombinant DNA technology; evolution; ecology; environmental biology and conservation

ชีววิทยาพื้นฐานและสาขาวิชาทางชีววิทยา การสืบค้นข้อมูลสารสนเทศน์จากฐานข้อมูลทางวิทยาศาสตร์ การนำเสนอและสื่อสารข้อมูลทางชีววิทยา ชนิดของสารเคมีในสิ่งมีชีวิต ชนิดหลักของเซลล์และเนื้อเยื่อ การเจริญเติบโตและเมตาโบลิซึมของเซลล์ การเจริญเติบโตและการมีชีวิต การแบ่งเซลล์ พันธุศาสตร์ แบบแผนการถ่ายทอดลักษณะทางพันธุกรรม พันธุศาสตร์ระดับโมเลกุล เทคโนโลยีดีเอ็นเอรีคอมบิแนนท์ วิวัฒนาการ นิเวศวิทยา ชีววิทยาสภาวะแวดล้อมและการอนุรักษ์

SCBE 102 General Biology Laboratory 1 1 (0-3-1)
วททส ๑๐๒ ปฏิบัติการชีววิทยาทั่วไป ๑ ๑ (๐-๓-๑)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic experiments in biology including microscope; movement of molecules; cells and organelles; plant tissues; animal tissues; cell division; population genetics; behavioral biology; ecology and environmental biology

การทดลองพื้นฐานทางชีววิทยา ได้แก่ กล้องจุลทรรศน์ การเคลื่อนที่ของโมเลกุล เซลล์และออแกเนลล์ เนื้อเยื่อพืช เนื้อเยื่อสัตว์ การแบ่งเซลล์ พันธุศาสตร์ประชากร ชีววิทยาพฤติกรรม นิเวศวิทยาและชีววิทยาสภาวะแวดล้อม

SCBE 113 Principles of Biology 2 3 (3-0-6)
วททส ๑๑๓ หลักการทางชีววิทยา ๒ ๓ (๓-๐-๖)
Prerequisite SCBE111 Principles of Biology 1

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑

Diversity of life; classification and taxonomy; data mining with ICT literacy from scientific database; presentation and communication in biology; virus and sub-cellular organisms; prokaryotic organisms; evolutionary junction; protists; fungi; plants; animals; physiology of animals; digestive system; respiratory system; circulatory system; excretory system; reproductive system and developmental biology; locomotive system; nervous and endocrine system

ความหลากหลายของสิ่งมีชีวิต การจำแนกและอนุกรมวิธาน การสืบค้นข้อมูลสารสนเทศน์จากฐานข้อมูลทางวิทยาศาสตร์ การนำเสนอและสื่อสารข้อมูลทางชีววิทยา ไวรัสและสิ่งมีชีวิตที่เล็กกว่าเซลล์ โปรคาริโอต วิวัฒนาการของโปรติสท์ รา พืช และ สัตว์ สรีรวิทยาของสัตว์ ระบบย่อยอาหาร ระบบหายใจ ระบบหมุนเวียน ระบบขับถ่าย ระบบสืบพันธุ์ พัฒนาการของสิ่งมีชีวิต ระบบการเคลื่อนที่ ระบบประสาท และ ระบบต่อมไร้ท่อ

SCBE 104 General Biology Laboratory 2 1 (0-3-1)
วททส ๑๐๔ ปฏิบัติการชีววิทยาทั่วไป ๒ ๑ (๐-๓-๑)

Prerequisite SCBE102 General Biology Laboratory 1
วิชาบังคับก่อน วททส ๑๐๒ ปฏิบัติการชีววิทยาทั่วไป ๑

Basic experiments in biology including diversity of prokaryotes; diversity of protists, fungi, and plants; diversity of invertebrates and vertebrates; physiology of animals: the circulatory system; physiology of the reproductive system and developmental biology; the nervous system and sensory organs

การทดลองทางชีววิทยา ได้แก่ ความหลากหลายของโปรคาริโอต ความหลากหลายของโปรติสท์ รา พืช สัตว์ไม่มีกระดูกสันหลังและสัตว์มีกระดูกสันหลัง สรีรวิทยาของสัตว์ ระบบหมุนเวียน ระบบสืบพันธุ์ ชีววิทยาการเจริญ ระบบประสาทและอวัยวะรับสัมผัส

SCBE 105 Global Environment 3 (3-0-6)
วททส ๑๐๕ สิ่งแวดล้อมโลก ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

An overview of the global environmental issues, the relationship between human society development and the use of natural resources from the past to present, the strategies of resource uses by human in the different periods of history; focusing on the population growth and societal development and its pressures on physical and biological resources; energy usage from past to

present and the future; causes and socio-economic implications of climate change, pollution, and the loss of biodiversity; interactions among physical, chemical, and biological components of the environment; pollution and degradation of the environment related to human activities and their impact on biodiversity and sustainability

สรุปภาพรวมของปัญหาสิ่งแวดล้อมระดับโลก ความสัมพันธ์ระหว่างการพัฒนาสังคมมนุษย์และการใช้ทรัพยากรธรรมชาติตั้งแต่อดีตจนถึงปัจจุบัน กลยุทธ์ของการใช้ทรัพยากรโดยมนุษย์ในแต่ละช่วงของเวลาในประวัติศาสตร์ จุดเน้นหนักอยู่ที่การเติบโตของประชากรมนุษย์และการพัฒนาการของสังคมมนุษย์และความกดดันที่มีต่อทรัพยากรทางกายภาพและชีวภาพ การใช้พลังงานตั้งแต่อดีตจนถึงปัจจุบันและอนาคต สาเหตุและผลกระทบทางเศรษฐกิจและสังคมของการเปลี่ยนแปลงสภาพภูมิอากาศ มลพิษและการสูญเสียความหลากหลายทางชีวภาพ ความสัมพันธ์ระหว่างส่วนประกอบทางด้านกายภาพ เคมีและชีวภาพของสิ่งแวดล้อม มลพิษและความเสื่อมโทรมของสภาพแวดล้อมที่เกี่ยวข้องกับกิจกรรมของมนุษย์และผลกระทบต่อความหลากหลายทางชีวภาพและความยั่งยืนของสภาวะแวดล้อมตามธรรมชาติ

SCBE 106 Orientation Seminar 1 (0-3-1)
วททส ๑๐๖ ปฐมนิเทศ ๑ (๐-๓-๑)
Prerequisite None
วิชาบังคับก่อน ไม่มี
A curriculum overview, lecture rooms/laboratories/staff, group activities
ภาพรวมของหลักสูตร สถานที่ที่ใช้ในการศึกษา ห้องปฏิบัติการ และบุคลากร กิจกรรมกลุ่ม

SCBE 220 Principle of Water Chemistry 3 (3-0-6)
วททส ๒๒๐ หลักการทางเคมีของน้ำ ๓ (๓-๐-๖)
Prerequisite SCCH 161 General Chemistry
วิชาบังคับก่อน วทคม ๑๖๑ เคมีทั่วไป

Basic knowledge of chemical analysis in water and wastewater quality, water chemical ion concentration calculation; fundamental knowledge for analytical chemistry of water quality and efficiency in water and wastewater analysis, chemical equilibria, qualitative and quantitative analysis of water quality parameters by conventional titration and biochemical methods; techniques in chemical analysis for important parameters in water and wastewater treatment
หลักการขั้นพื้นฐานในการวิเคราะห์คุณภาพน้ำและน้ำเสียทางเคมี การคำนวณความเข้มข้นทางเคมีของไอออนของน้ำ ความรู้พื้นฐานทางเคมีวิเคราะห์ในการวัดคุณภาพน้ำและประสิทธิภาพในการวิเคราะห์น้ำและน้ำเสีย สมดุลทางเคมีการ

วิเคราะห์เชิงคุณภาพและเชิงปริมาณของปัจจัยชี้วัดคุณภาพน้ำ พื้นฐานการไตเตรทแบบธรรมดาและวิธีการทางชีวเคมี เทคนิคในการวิเคราะห์ทางเคมีสำหรับพารามิเตอร์ที่สำคัญในการบำบัดน้ำและน้ำเสีย

SCBE 221 Water Chemistry Laboratory 1 (0-3-1)
วททส ๒๒๑ หลักการทางเคมีของน้ำ ๑ (๐-๓-๑)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Water and wastewater chemistry in action, quantitative analysis, method of pH measurements, an application of Beers Law and colorimetric analysis, measurement of absorption spectrum, preparation of buffer solution, biochemical oxygen demand, chemical oxygen demand, phosphate, nitrate and ammonia measurement in water and wastewater

การปฏิบัติการเคมีของน้ำและน้ำเสีย การวิเคราะห์ในเชิงปริมาณ วิธีการวัดค่าความเป็นกรด-ด่าง การใช้กฎเบียร์และการวิเคราะห์สี การวัดสเปกตรัมการดูดกลืนแสง การเตรียมสารละลายบัฟเฟอร์ การหาค่าความต้องการออกซิเจนทางชีวเคมี การหาความต้องการออกซิเจนทางเคมี การวัดฟอสเฟต ไนเตรต และแอมโมเนียของน้ำและน้ำเสีย

SCBE 301 Principles of Environmental Science 2 (2-0-4)
วททส ๓๐๑ หลักการวิทยาศาสตร์สิ่งแวดล้อม ๒ (๒-๐-๔)

Prerequisite SCBE 111 Principles of Biology I
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑

The physical, chemical, and biological processes shaping up the natural world; details of how nature is affected by human and solutions to these environmental problems; air, water and soil pollution, human population explosion, natural resource and energy management; environmental science involving biology, chemistry, geology, and other sciences; environmental science dealing with the ideas and diverse methods in sciences to help solve problems with sustainability

ความสัมพันธ์ระหว่างสิ่งมีชีวิตและสิ่งแวดล้อมทางกายภาพ เคมี และชีววิทยา ช่วยสร้างโลกให้เป็นเช่นปัจจุบัน รายละเอียดของวิชาครอบคลุมผลของการกระทำของมนุษย์ที่มีต่อสภาวะแวดล้อมและการแก้ไข กิจกรรมที่มนุษย์กระทำและผลกระทบที่มีต่อระบบต่างทางชีววิทยา ปัญหาของประชากรและการเกิดภาวะมลพิษและความเสื่อมโทรมสภาพของสิ่งแวดล้อม วิทยาศาสตร์สิ่งแวดล้อมเกี่ยวข้องกับ วิทยาศาสตร์ชีวภาพ เคมีและธรณีวิทยา วิทยาศาสตร์ประยุกต์อื่นๆ วิทยาศาสตร์สิ่งแวดล้อมใช้ปรัชญาและความรู้และวิธีการทางวิทยาศาสตร์อันหลากหลาย เพื่อแก้ไขปัญหาสภาวะแวดล้อมอย่างยั่งยืน

SCCH 161 General Chemistry 3 (3-0-6)

วทคม ๑๖๑ เคมีทั่วไป ๓ (๓-๐-๖)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Atomic structure, chemical bonding, gases and the kinetic molecular theory of gases, phase equilibria; solutions and colloids, chemical thermodynamics; chemical kinetics, ionic equilibria, electrochemistry

โครงสร้างของอะตอม พันธะเคมี แก๊สและทฤษฎีจลน์โมเลกุลของแก๊ส สมดุลระหว่างวัฏภาคสารละลายและคอลลอยด์ อุณหพลศาสตร์เคมี จลนพลศาสตร์เคมี สมดุลของไอออน ไฟฟ้าเคมี

SCCH 172 Organic Chemistry 3 (3-0-6)

วทคม ๑๗๒ เคมีอินทรีย์ ๓ (๓-๐-๖)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Molecular structure and classification of organic compound; reactions of organic compounds; nomenclature and stereochemistry; synthesis and reactions of alkanes, cycloalkanes, alkenes, alkynes, aromatic hydrocarbons, halides, phenols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acids derivatives, amines

โครงสร้างโมเลกุลและการจำแนกสารอินทรีย์ ปฏิกิริยาของสารประกอบอินทรีย์ การเรียกชื่อ และสเตอริโอเคมี การสังเคราะห์ปฏิกิริยาแอลเคน ไซโคลแอลเคน แอลคีน แอลไคน์ อะโรมาติกไฮโดรคาร์บอน สารเฮไลด์ แอลกอฮอล์ ฟีนอล อีเทอร์ อัลดีไฮด์ คีโตน กรดคาร์บอกซิลิก อนุพันธ์กรดคาร์บอกซิลิก แอมีน

SCCH 189 Chemistry Laboratory 1 (0-3-1)

วทคม ๑๘๙ ปฏิบัติการเคมี ๑ (๐-๓-๑)

Prerequisite SCCH 161 General Chemistry

วิชาบังคับก่อน วทคม ๑๖๑ เคมีทั่วไป

Experiments of general chemistry and basic organic chemistry including the scientific errors and significant numbers; the preparation of solutions and titrations, rate of reaction, chemical equilibria; the quantitative analysis using spectroscopy, solubility classification; the use of models to study stereochemistry of organic substances, reactions of hydrocarbons, alcohols, phenols, aldehydes, ketones, carboxylic acids, derivatives, and amines

การทดลองเคมีทั่วไปและเคมีอินทรีย์เบื้องต้น ได้แก่ ความคลาดเคลื่อนและเลขนัยสำคัญการเตรียมสารละลายและการไทเทรต กฎอัตราของปฏิกิริยา สมดุลเคมีการวิเคราะห์เชิงปริมาณโดยเทคนิคทางแสง การจำแนกสารอินทรีย์ตามการละลาย การใช้แบบจำลองศึกษาสเตอริโอเคมีของสารอินทรีย์ ปฏิกิริยาของไฮโดรคาร์บอน แอลกอฮอล์ ฟีนอล แอลดีไฮด์ คีโตน กรดคาร์บอกซิลก์ อนุพันธ์ของกรดคาร์บอกซิลิกและเอมีน

SCPY 160 General Physics Laboratory 1 (0-3-1)
วทฟส ๑๖๐ ปฏิบัติการฟิสิกส์ทั่วไป ๑ (๐-๓-๑)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic physics experiments relating to mechanics, thermodynamics, physical optics, electromagnetism special theory of relativity quantum mechanics, atomic physics, nuclear physics

การทดลองฟิสิกส์พื้นฐานที่เกี่ยวข้องกับ กลศาสตร์ เทอร์โมไดนามิกส์ แสงเชิงกายภาพ แม่เหล็กไฟฟ้า ทฤษฎีสัมพัทธภาพพิเศษ กลศาสตร์ควอนตัม ฟิสิกส์นิวเคลียร์ ฟิสิกส์ของอนุภาค

SCMA 174 Calculus and Systems of Ordinary Differential Equations 3 (3-0-6)
วทคณ ๑๗๔ แคลคูลัสและระบบสมการเชิงอนุพันธ์สามัญ ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Review of calculus, chain rule and derivatives of inverse functions, derivatives of trigonometric, inverse trigonometric, exponential and logarithmic functions, implicit differentiation and related rates; applications of derivatives, antiderivatives, definite and indefinite integrals; fundamental theorems of calculus, techniques of integration, applications of integration; systems of ordinary differential equations, direction fields and phase portraits; matrix representation, stationary solutions, solutions by eigenvalue method, applications of systems of ordinary differential equations.

การทบทวนแคลคูลัสหลักเกณฑ์ลูกโซ่และอนุพันธ์ของฟังกช์นผกผัน อนุพันธ์ของฟังก์ชันตรีโกณมิติ ฟังก์ชันตรีโกณมิติผกผัน ฟังก์ชั่นเชิงกำลังและฟังก์ชั่นลอการิทึม การหาอนุพันธ์โดยปริยายและอัตราสัมพัทธ์ การประยุกต์อนุพัทธ์ปฏิยานุพันธ์ ปริพันธ์จำกัดเขตและไม่จำกัดเขต ทฤษฎีบทหลักมูลของแคลคูลัส เทคนิคการหาปริพันธ์ การประยุกต์การหาปริพันธ์ ระบบสมการเชิงอนุพันธ์สามัญสนามทิศทางและรูปเฟส ตัวแทนเมทริกซ์ ผลเฉลยนิ่ง ผลเฉลยโดยวิธิค่าลักษณะเฉพาะ การประยุกต์ ระบบสมการเชิงอนุพันธ์สามัญ

2. Major required courses (41 credits)

SCBE 201 General Zoology 3 (3-0-6)

วททส ๒๐๑ สัตววิทยาทั่วไป ๓ (๓-๐-๖)

Prerequisites SCBE 111 Principles of Biology I

SCBE 113 Principles of Biology II

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑

วททส ๑๑๓ หลักการทางชีววิทยา ๒

Morphology, physiology, taxonomy, ecology and evolution of Protozoa, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthopoda, Echinodermata, and Chordata

สัณฐานวิทยา สรีรวิทยา อนุกรมวิธาน นิเวศวิทยา และวิวัฒนาการของโพรโตซัว พอริเฟอรา ไนดาเรีย แพลทิเฮลมินทิส นีมาโทดา แอนเนลิดา มอลลัสกา อาร์โทรโพดา เอ็กไคโนเดอร์มาตา และคอร์ดาตา

SCBE 202 General Zoology Laboratory 1 (0-3-1)

วททส ๒๐๒ ปฏิบัติการสัตววิทยาทั่วไป ๑ (๐-๓-๑)

Prerequisites SCBE 102 General Biology Laboratory I

SCBE 104 General Biology Laboratory II

วิชาบังคับก่อน วททส ๑๐๒ ปฏิบัติการชีววิทยาทั่วไป ๑

วททส ๑๐๔ ปฏิบัติการชีววิทยาทั่วไป ๒

Laboratory in morphology, physiology, and taxonomy of Protozoa, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthopoda, Echinodermata, and Chordata

ปฏิบัติการด้านสัณฐานวิทยา สรีรวิทยา และอนุกรมวิธาน ของโพรโตซัว พอริเฟอรา ไนดาเรีย แพลทิเฮลมินทิส นีมาโทดา แอนเนลิดา มอลลัสกา อาร์โทรโพดา เอ็กไคโนเดอร์มาตา และคอร์ดาตา

SCBE 203 General Genetics 3 (3-0-6)

วททส ๒๐๓ พันธุศาสตร์ทั่วไป ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑

Principles of inheritance; gene and environment interaction; quantitative genetics; associative inheritance; variations of chromosomes; structure of chromosomes; mutation and DNA repair;

biochemical and immunological genetics; microbial genetics; extrachromosomal inheritance; gene regulations; molecular genetic analysis; population genetics and speciation

หลักการถ่ายทอดทางพันธุกรรม การกระทำร่วมกันระหว่างยีนและสิ่งแวดล้อม พันธุศาสตร์เชิงปริมาณ การถ่ายทอดทางพันธุกรรมแบบเชื่อมโยง การแปรผันของโครโมโซม โครงสร้างของสารพันธุกรรม การกลายและซ่อมแซมสารพันธุกรรม พันธุศาสตร์เชิงชีวเคมีและเชิงอิมมูโน พันธุศาสตร์จุลชีพ การถ่ายทอดพันธุกรรมนอกโครโมโซม การกำกับการทำงานของยีน การวิเคราะห์พันธุศาสตร์ระดับโมเลกุล พันธุศาสตร์เชิงประชากรและการเกิดสปีชีส์ใหม่

SCBE 204 General Genetics Laboratory 1 (0-3-1)
วททส ๒๐๔ ปฏิบัติการพันธุศาสตร์ทั่วไป ๑ (๐-๓-๑)
Prerequisite SCBE 102 General Biology Laboratory I
วิชาบังคับก่อน วททส ๑๐๒ ปฏิบัติการชีววิทยาทั่วไป ๑

Laboratory practices in genetic inheritance in Drosophila; quantitative genetics; cytogenetics; bacterial genetics; yeast genetics; and population genetics

ปฏิบัติการการถ่ายทอดพันธุกรรมของแมลงหวี่ พันธุศาสตร์เชิงปริมาณ เซลล์พันธุศาสตร์ การถ่ายทอดยีนในแบคทีเรีย พันธุศาสตร์ของยีสต์ และพันธุศาสตร์เชิงประชากร

SCBE 205 General Botany 3 (3-0-6)
วททส ๒๐๕ พฤกษศาสตร์ทั่วไป ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic concept and application of plant science related to other disciplines; biodiversity, evolution, anatomy, morphology, taxonomy, ecology, physiology, genetics and molecular biology

หลักการเบื้องต้นของวิชาพฤกษศาสตร์และการประยุกต์ใช้ในการศึกษาวิจัยของวิทยาศาสตร์สาขาอื่นๆ ที่เกี่ยวข้อง ความหลากหลายและวิวัฒนาการ กายวิภาค สัณฐานวิทยา อนุกรมวิธาน นิเวศวิทยา สรีรวิทยา พันธุศาสตร์และชีววิทยาโมเลกุลพืช

SCBE 206 General Botany Laboratory 1 (0-3-1)
วททส ๒๐๖ ปฏิบัติการพฤกษศาสตร์ทั่วไป ๑ (๐-๓-๑)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic laboratory in plant sciences, characterization of various plant characteristics; biodiversity, evolution, anatomy, morphology, taxonomy, ecology, physiology, genetics and molecular biology

ปฏิบัติการเบื้องต้นทางพฤกษศาสตร์ ศึกษาลักษณะต่างๆ ของพืช ความหลากหลายทางชีวภาพ วิวัฒนาการ กายวิภาค สัณฐานวิทยา อนุกรมวิธาน นิเวศวิทยา สรีรวิทยา พันธุศาสตร์ และชีววิทยาโมเลกุลของพืช

SCBE 207 Basic Cell and Molecular Biology 3 (3-0-6)
วททส ๒๐๗ เซลล์และชีววิทยาระดับโมเลกุล ๓ (๓-๐-๖)
Prerequisites SCBE 111 Principles of Biology I
SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑
วททส ๑๑๓ หลักการทางชีววิทยา ๒

Cell structures, functions, cell action, concepts in basic molecular biology, protein targeting and vesicular trafficking, cell signaling and cell communication, cell response, cell cycle and cell differentiation, cell death, DNA mutation and DNA repair, immune, cancer

โครงสร้าง หน้าที่ และการทำงานของเซลล์ แนวคิดทางชีววิทยาระดับโมเลกุลพื้นฐาน การส่งทอดโปรตีนและการขนส่ง การส่งสัญญาณภายในเซลล์และการติดต่อสื่อสารระหว่างเซลล์ การตอบสนองของเซลล์ วัฏจักรของเซลล์และการเปลี่ยนแปลงไปทำหน้าที่เฉพาะของเซลล์ การตายของเซลล์ การกลายพันธุ์และการซ่อมแซมสารพันธุกรรมของเซลล์ กาสร้างภูมิคุ้มกัน การเกิดมะเร็ง

SCBE 208 General Ecology 3 (3-0-6)
วททส ๒๐๘ นิเวศวิทยาทั่วไป ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Minimum ecological literacy on ecology of individual (autecology) to population, community, landscape, the ecosystem and applied ecology; integrating basic ecological concepts with outdoor laboratory using the place-based education approach

ความรู้พื้นฐานเกี่ยวกับนิเวศวิทยาระดับตัวตน ประชากร ชุมชน ภูมินิเวศ ระบบนิเวศ และนิเวศวิทยาประยุกต์ บูรณาการความคิดรวบยอดทางนิเวศวิทยาระดับพื้นฐานเข้ากับบทปฏิบัติการนอกห้องเรียนโดยใช้การศึกษาที่ใช้พื้นที่เป็นตัวตั้ง

SCBE 209 Ecological Monitoring and Assessment of Bioresources 4 (3-1-6)
วททส ๒๐๙ การเฝ้าติดตามทางนิเวศและการตรวจสอบทรัพยากรชีวภาพ ๔ (๓-๑-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Field visit for hand-on monitoring and assessment of bioresources in the Kanchanaburi province

การฝึกปฏิบัติตรวจสอบและประเมินทรัพยากรทางชีวภาพของจังหวัดกาญจนบุรี

SCBE 210 General Microbiology 3 (2-3-5)
วททส ๒๑๐ จุลชีววิทยาทั่วไป ๓ (๒-๓-๕)

Prerequisites SCBE 111 and SCBE 113
วิชาบังคับก่อน วททส ๑๑๑ และ วททส ๑๑๓

Biochemistry of cell and cell structure; dynamics of microbial growth and its requirement; an identification and classification of microorganisms; sub-cellular organisms and infectious particles; bacteria and archaea; eukaryotic microorganisms; host-microbe interactions; immune responses; epidemiology; antimicrobial medications; infections and diseases; microbial ecology; environmental microbiology; food microbiology; industrial microbiology and biotechnology; Basic skill in microbiology laboratory

ชีวเคมีของเซลล์และโครงสร้างเซลล์ พลศาสตร์ของการเจริญและสิ่งที่ต้องการเพื่อการเติบโตของจุลินทรีย์ การจัดจำแนกชนิดของจุลินทรีย์ สิ่งมีชีวิตที่เล็กกว่าระดับเซลล์และอนุภาคก่อโรค แบคทีเรียและอาร์เคีย ยูแคริโอต ปฏิสัมพันธ์ระหว่างโฮสและจุลินทรีย์ การตอบสนองทางภูมิคุ้มกัน ระบาดวิทยา ยาต้านเชื้อจุลินทรีย์ โรคและการติดเชื้อ นิเวศวิทยาของจุลินทรีย์ จุลชีววิทยาสิ่งแวดล้อม จุลชีววิทยาอาหาร จุลชีววิทยาอุตสาหกรรมและเทคโนโลยีชีวภาพ ปฏิบัติการทางจุลชีววิทยาเบื้องต้น

SCBM 281 Biochemistry 3 (3-0-3)
วทชพ ๒๘๑ ชีวเคมี ๓ (๓-๐-๓)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Structures and functions of biomolecules; protein folding, protein functions, bio-catalysis, enzyme kinetics, citric acid cycle, electron transport and oxidative phosphorylation; anabolism and catabolism of biomolecules in normal and some important pathological stages; regulations of

metabolic pathways, flow of genetic information, gene regulation, and molecular techniques with medical applications

โครงสร้างและหน้าที่ของชีวโมเลกุล การม้วนตัวของโปรตีนโครงสร้างและหน้าที่ของโปรตีน ตัวเร่งชีวภาพ จลนศาสตร์ของเอนไซม์ วัฏจักรกรดซิตริก การส่งผ่านอีเลคตรอนและออกซีเดทีฟ-ฟอสฟอรีเลชั่น การสร้างและการสลายชีวโมเลกุลต่างๆในภาวะปกติและตัวอย่างภาวะการเกิดโรคที่สำคัญ การควบคุมกระบวนการเมแทบอลิซึมในสิ่งมีชีวิตการจัดเรียงรหัสพันธุกรรมและการถ่ายทอด การแสดงออกของจีโนมและการควบคุมการแสดงออกของยีน เทคนิคทางอณูชีววิทยาที่เกี่ยวข้องกับการประยุกต์ทางการแพทย์

SCBM 282 Biochemistry Laboratory 1 (0-3-2)
วทชพ ๒๘๒ ปฏิบัติการชีวเคมี ๑ (๐-๓-๒)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Determination of LDH enzyme activity by the spectrophotometric method, determination of cholesterol in lipoproteins, DNA isolation and PCR amplification followed by an analysis of DNA by gel electrophoresis technique; structures and functions of biomolecules, protein folding, protein functions, bio-catalysis, enzyme kinetics, TCA cycle, electron transport and oxidative phosphorylation; anabolism and catabolism of biomolecules in normal and pathological stages, regulation of metabolic pathways, flow of genetic information, gene regulation, and molecular techniques with medical applications, starvation

การวัดการทำงานของเอนไซม์ LDH โดยวิธีการดูดกลืนแสง การวัดโคลเลสเตอรัลในไลโปโปรตีน การแยกดีเอ็นเอและปฏิกริยาพีซีอาร์พร้อมการวิเคราะห์โดยกระแสไฟฟ้าโครงสร้างและหน้าที่ของชีวโมเลกุล การม้วนตัวของโปรตีนโครงสร้างและหน้าที่ของโปรตีน ตัวเร่งชีวภาพ จนลศาสตร์ของเอนไซม์ วัฏจักรกรดซิตริก การถ่ายทอดอีเลคตรอน การสร้างเอทีพีในไมโตคอนเดรีย การสร้างและการสลายชีวโมเลกุลต่างๆในภาวะปกติและภาวะการเกิดโรค การควบคุมขบวนการเมแทบอลิซึมในสิ่งมีชีวิต รหัสพันธุกรรมและการถ่ายทอด การจัดเรียงและการแสดงออกของยีโนม เทคนิคทางอณูชีววิทยาที่เกี่ยวข้องกับการประยุกต์ทางการแพทย์ การอดอาหาร

SCBE 302 Biostatistics 3 (3-0-6)
วททส ๓๐๒ ชีวสถิติ ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic statistics, probability distribution, sampling, sample size, estimation of population; hypothesis and hypothesis testing, z – test, t – test, analysis of variance, ANOVA, One–way ANOVA, multiple comparisons, chi-square-test; regression, simple linear regression, multiple regression, linear correlation, using statistical analysis

สถิติพื้นฐาน ความน่าจะเป็นและการแจกแจง การสุ่มตัวอย่าง ขนาดของตัวอย่าง และการประมาณค่าของประชากร สมมติฐานและการทดสอบสมมติฐาน การทดสอบแบบ z – test การทดสอบแบบ t – test การวิเคราะห์วาเรียนซ์ การวิเคราะห์วาเรียนซ์แบบทิศทางเดียว การตรวจสอบความแตกต่างของค่าเฉลี่ย การทดสอบแบบไคสแควร์ การวิเคราะห์การถดถอย การถดถอยเชิงเส้นอย่างง่าย สหสัมพันธ์เส้นตรง การใช้โปรแกรมทางสถิติวิเคราะห์ข้อมูล

SCBE 303 Evolution 3 (3-0-6)
วททส ๓๐๓ วิวัฒนาการ ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑

Evolutionary changes in living things; origins of biomolecules, prokaryotes and eukaryotes; anagenesis and cladogenesis; species and speciation; competition mechanism; patterns of selection including altruism; evolutionary factors involved in structural change of population; an analysis of molecular evolution

กระบวนการเปลี่ยนแปลงของสิ่งมีชีวิตชนิดต่างๆ กำเนิดของชีวโมเลกุล เซลล์โพรคาริโอตและยูคาริโอต อะนาเจเนซิสและแคลโดเจเนซิส การเกิดสปีชีส์ใหม่ กลไกการแข่งขัน
รูปแบบและระดับของการคัดเลือกรวมทั้งอัลทรูอิสซึม ปัจจัยทางวิวัฒนาการที่เปลี่ยนแปลง โครงสร้างของประชากร การวิเคราะห์วิวัฒนาการระดับโมเลกุล

SCBE 304 Bioethics 2 (2-0-4)
วททส ๓๐๔ ชีวจริยธรรม ๒ (๒-๐-๔)

Prerequisite None
วิชาบังคับก่อน ไม่มี

An analysis of the development of biological, medical, and environmental sciences; examples and existing problems; the use of animal and human subjects in research and their solution

การวิเคราะห์พัฒนาการทางสาขาวิชาวิทยาศาสตร์ชีวภาพ วิทยาศาสตร์การแพทย์และวิทยาศาสตร์สิ่งแวดล้อม ตัวอย่างและปัญหาที่เกิดขึ้นจริง การวิจัยที่ใช้มนุษย์และสิ่งมีชีวิต และการแก้ปัญหาเหล่านั้น

SCBE 305 Scientific Research and Presentation 1 (0-3-1)

วททส ๓๐๕ การวิจัยและการนำเสนอทางวิทยาศาสตร์ ๑ (๐-๓-๑)

Prerequisite None

วิชาบังคับก่อน ไม่มี

The research projects in topics related to bioresources and environmental biology; significance and originality, using appropriate scientific methodology under the supervision of advisors; the presentation of research outcomes using an appropriate and efficient methods at the end of the research period

การทำโครงการวิจัยในหัวข้อที่เกี่ยวข้องกับทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม มีความสำคัญและความริเริ่มใหม่ และใช้กระบวนการทางวิทยาศาสตร์ที่เหมาะสม ภายใต้การควบคุมของอาจารย์ที่ปรึกษา ผลการวิจัยจะต้องถูกนำเสนอด้วยวิธีการที่เหมาะสมและมีประสิทธิภาพเมื่อสิ้นสุดระยะเวลาดำเนินการวิจัย

SCBE 497 Seminar in Bioresources and Environmental Biology 1 (0-3-1)

วททส ๔๙๗ สัมมนาทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม ๑ (๐-๓-๑)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Practice on literature review of various topics of current interests in the field of bioresources and environmental biology; data analysis and discussion on the research, development of professional skill in scientific presentation

การฝึกรวบรวมและรายงานผลการวิจัยต่างๆ เกี่ยวกับทรัพยาการชีวภาพและสิ่งแวดล้อมที่น่าสนใจ และเป็นปัจจุบัน การวิเคราะห์และวิจารณ์ผลการวิจัย และการนำเสนอผลงานวิจัยอย่างมืออาชีพ

SCBE 402 Internship in Bioresources and Environmental Biology 3 (0-9-3)

วททส ๔๐๒ การฝึกงานทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม ๓ (๐-๙-๓)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Specific problems or training in the field under the guidance of the advisors

ปัญหาพิเศษหรือการฝึกงานที่นักศึกษาสนใจ ภายใต้การควบคุมและแนะนำของอาจารย์ที่ปรึกษา

SCBE 499 Independent Research Project in Bioresources and Environmental Biology 3 (0-9-3)

วททส ๔๙๙ โครงงานวิจัยอิสระทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม ๓ (๐-๙-๓)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Specific problems or training in the field under the guidance of the advisors

ปัญหาพิเศษหรือการฝึกงานที่นักศึกษาสนใจ ภายใต้การควบคุมและแนะนำของอาจารย์ที่ปรึกษา

3. Major Elective Courses (15 credits)

SCBE 222 Fundamentals of Environmental Health and Toxicology 2 (2-0-4)

วททส 222 หลักการพื้นฐานทางอนามัยสิ่งแวดล้อมและพิษวิทยา ๒ (๒-๐-๔)

Prerequisite None

วิชาบังคับก่อน ไม่มี

General concepts of environmental health; fundamental of environmental toxicology; exposure assessment; toxicology; epidemiology; risk assessment and analysis; measuring and analysis of pollutants in the environment; environmental pollutants effects on human health

หลักการทั่วไปของอนามัยสิ่งแวดล้อม พื้นฐานพิษวิทยาสภาวะแวดล้อม การประเมินการได้รับสาร พิษวิทยาระบาดวิทยา การประเมินและการวิเคราะห์ความเสี่ยง การวัดและการวิเคราะห์สารก่อมลพิษในสภาวะแวดล้อม ผลกระทบของมลพิษต่อสุขภาพของมนุษย์

SCBE 223 Toxicology in Public Health 3 (3-0-6)

วททส ๒๒๓ พิษวิทยาทางสาธารณสุข ๓ (๓-๐-๖)

Pre-requisite: SCBE111, SCBE113

Basic concepts of toxicology; investigation of effects of environmental agents on public health; distribution of toxic substances, cellular penetration; metabolic conversion; elimination of toxic agents; interaction of foreign chemicals with biological systems; application of concepts in toxicology to implement prevention of morbidity; morality resulting from environmental exposures to toxic substances through case study

หลักการพื้นฐานทางพิษวิทยา การศึกษาผลกระทบของสารในสิ่งแวดล้อมต่อสุขภาพ การกระจายตัวของสารพิษ การแทรกซึมเข้าภายในเซลล์ การเปลี่ยนรูปของศาลทางเมตาโบลิซึม กระบวนการกำจัดสารพิษ ปฏิสัมพันธ์ของสารเคมี

แปลกปลอมและระบบทั้งชีวภาพ การนำหลักการทางพิษวิทยามาใช้เพื่อการป้องกันการสูญเสียชีวิต จริยธรรมจากการศึกษากรณีที่ได้รับสารพิษจากสิ่งแวดล้อม

SCBE 224 Urban Ecology 3 (3-0-6)
วททส ๒๒๔ นิเวศวิทยาชุมชนเมือง ๓ (๓-๐-๖)

City ecosystems perspective; role and importance of science, engineering; urban design and planning professions; community participation in creating livable communities, environmental equity and law

มุมมองของระบบนิเวศของเมือง บทบาทและความสำคัญของวิทยาศาสตร์และวิศวกรรมศาสตร์ วิชาชีพการออกแบบและการวางผังเมือง การมีส่วนร่วมของชุมชนในการสร้างชุมชนที่น่าอยู่ ความยุติธรรมและกฎหมายทางสิ่งแวดล้อม

SCBE 306 Marine Biology 4 (3-2-7)
วททส ๓๐๖ ชีววิทยาทางทะเล ๔ (๓-๒-๗)
Prerequisites SCBE 201 General Zoology
SCBE 202 General Zoology Laboratory
วิชาบังคับก่อน วททส ๒๐๑ สัตววิทยาทั่วไป
วททส ๒๐๒ ปฏิบัติการสัตววิทยาทั่วไป

Natural history of marine organisms (exclusive of protozoa and insects); types of the environment in the ocean, leading to shallow tropical seas; the relationship between biological distributions and the physical and chemical environment; the effects of environmental change; life cycles of marine animals; planktons and food chains affecting population changes and the field survey; the application of ecological techniques to local problems; field survey and laboratory exercises

สิ่งมีชีวิตในทะเล (ยกเว้นโพรโทซัว และแมลง) รูปแบบของสิ่งแวดล้อมในมหาสมุทรที่ทำให้เกิดการตื้นเขินในทะเลเขตร้อน ความสัมพันธ์ระหว่างการกระจายตัวทางชีววิทยากับสิ่งแวดล้อมทางกายภาพและทางเคมี ผลกระทบของการเปลี่ยนแปลงสิ่งแวดล้อมวัฏจักรของสิ่งมีชีวิต แพลงก์ตอนและห่วงโซ่อาหารที่มีผลต่อการเปลี่ยนแปลงประชากรและการสำรวจภาคสนาม วิธีการทางนิเวศวิทยาเพื่อแก้ปัญหาที่เกิดขึ้นในท้องถิ่น การสำรวจภาคสนามและทำปฏิบัติการ

SCBE 307 Water Pollution Control and Management 3 (2-3-5)
วททส ๓๐๗ การควบคุมและจัดการมลพิษทางน้ำ ๓ (๒-๓-๕)

Prerequisite SCBE 301 Principles of Environmental Science
วิชาบังคับก่อน วททส ๓๐๑ หลักการวิทยาศาสตร์สิ่งแวดล้อม

Nature, distribution and ecological effects of pollutants in air, soil and water; methods of detection and remediation of environmental pollutants; ecological implications of pollution problems from a variety of sources; causes and problems of pollution in the environment including water, soil and sediment, and air; effects of pollutants on human and other organisms; practice on basic techniques in water pollution control and management

การกระจายตัวทางธรรมชาติและผลทางนิเวศวิทยาของสารมลพิษในอากาศ ดิน และน้ำ วิธีการตรวจสอบสารมลพิษและการบำบัดฟื้นฟูสภาพแวดล้อมที่ปนเปื้อนด้วยมลพิษ ปัญหาสิ่งแวดล้อมจากหลายๆ แหล่ง ต้นเหตุและปัญหามลพิษในสิ่งแวดล้อมทั้งในน้ำ ในดิน และในอากาศ ผลของมลพิษต่อมนุษย์และสิ่งมีชีวิตอื่นๆ และการฝึกปฏิบัติการเบื้องต้นเกี่ยวกับการควบคุมและจัดการมลพิษทางน้ำ

SCBE 308 Developmental Biology 3 (3-0-6)
วททส ๓๐๘ ชีววิทยาการเจริญ ๓ (๓-๐-๖)

Prerequisite SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๓ หลักการทางชีววิทยา ๒

Concepts of development; gene and development; determination and differentiation; polarity and pattern formation; stages in development; cellular and morphological changes in principal stages of normal and abnormal development; metamorphosis; regeneration; apoptosis and aging

แนวคิดกระบวนการการเจริญยีนและการเจริญการกำหนดและเปลี่ยนสภาพ การเกิดขั้วและการสร้างแบบรูป ขั้นตอนในกระบวนการการเจริญ การเปลี่ยนแปลงของเซลล์และรูปร่างในการเจริญตามปกติและที่ผิดปกติ เมทามอร์โฟซิส การเจริญทดแทน การเสื่อมสภาพของและการแก่

SCBE 309 Plant Developmental Biology 3 (3-0-6)
วททส ๓๐๙ ชีววิทยาการพัฒนาการของพืช ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Basic principles of plant development, the development of model plants and factors regulating the development

หลักการพื้นฐานของการพัฒนาการของพืช การพัฒนาการของพืชต้นแบบ และปัจจัยที่ควบคุมการพัฒนาการ

SCBE 310 Plant Physiology 3 (2-3-5)
วททส ๓๑๐ สรีรวิทยาของพืช ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Organ systems in plants; nutrient and water transport; the effect of nutrient and plant growth regulators; photosynthesis, respiration, metabolism and energy transfer in plants; plants stress responses; signal transduction in plants; basic techniques in plant tissue culture and hydroponics

ระบบอวัยวะของพืช การลำเลียงน้ำ แร่ธาตุ และสารอาหารในพืช หน้าที่ของแร่ธาตุและสารเร่งเจริญ กระบวนการสังเคราะห์ด้วยแสง การหายใจ เมตาโบลิซึมและการถ่ายทอดพลังงาน การปรับตัวของพืชภายใต้สภาวะเครียด การส่งสัญญาณในพืช ปฏิบัติการเพาะเลี้ยงเนื้อเยื่อพืชและไฮโดรโพนิกส์เบื้องต้น

SCBE 311 Principles of Animal Physiology 4 (3-2-7)
วททส ๓๑๑ หลักสรีรวิทยาของสัตว์ ๔ (๓-๒-๗)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Comparative physiology of the organ systems in animals, invertebrates and vertebrates including human, metabolism, mechanism of homeostasis; laboratory exercises in animal physiology

การทำงานของระบบอวัยวะต่างๆ ของคนและสัตว์ ตลอดจนเมแทบอลิซึมและกลไกการปรับตัวให้อยู่ในสภาวะสมดุล และการทำปฏิบัติการทางด้านสรีรวิทยาของสัตว์

SCBE 313 Plant Molecular Genetics 3 (3-0-6)
วททส ๓๑๓ พันธุศาสตร์ระดับโมเลกุลของพืช ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Principles of plant molecular genetics; the use of statistic method to analyze quantitative traits and calculate heredity; molecular structure and functions of genetic materials; the distribution and behavior of genes in populations; biochemistry and molecular genetics; the nature of genes, an introduction to gene function, protein synthesis, and modification

หลักการทางพันธุศาสตร์ระดับโมเลกุลของพืช การใช้วิธีทางสถิติในการวิเคราะห์และตรวจสอบลักษณะทางกรรมพันธุ์ โครงสร้างและหน้าที่ของสารพันธุกรรม การกระจายตัวและการแสดงออกของยีนในระดับประชากร ชีวเคมีและอณูพันธุศาสตร์ โครงสร้าง หน้าที่ และคุณสมบัติของยีนในระดับโมเลกุล การควบคุมการสังเคราะห์โปรตีนและการดัดแปลงโปรตีนหลังการสังเคราะห์

SCBE 314 Insect Physiology 3 (3-0-6)
วททส ๓๑๔ สรีรวิทยาแมลง ๓ (๓-๐-๖)
Prerequisite SCBE 372 Basic Entomology
วิชาบังคับก่อน วททส ๓๗๒ กีฏวิทยาพื้นฐาน

Structure and function of the insect organ systems: the digestive system, the excretory system, the respiratory system, the nervous system and sense organs, the endocrine system, the reproductive system; the metabolism, growth and metamorphosis, locomotion, behavior, and response to insecticide

โครงสร้างและหน้าที่การทำงานของระบบอวัยวะแมลง ได้แก่ ระบบย่อยอาหาร ระบบหมุนเวียนเลือด ระบบขับถ่าย ระบบหายใจ ระบบประสาทและอวัยวะรับสัมผัส ระบบต่อมไร้ท่อ ระบบสืบพันธุ์ ตลอดจนเมแทบอลิซึม การเจริญเติบโตและเปลี่ยนแปลงรูปร่าง การเคลื่อนไหว พฤติกรรม และการตอบสนองต่อสารกำจัดแมลง

SCBE 315 Coevolution 2 (2-0-4)
วททส ๓๑๕ วิวัฒนาการร่วม ๒ (๒-๐-๔)
Prerequisite SCBE 303 Evolution
วิชาบังคับก่อน วททส ๓๐๓ วิวัฒนาการ

Coevolution of plants and animals, animals of the same and different species in the ecosystem; factors involved and components of coevolution with an emphasis on plants and herbivores, predators and preys; defense mechanism; roles of coevolution in the population structure

ความสัมพันธ์แบบต่างๆ ระหว่างพืชกับสัตว์ สัตว์กับสัตว์สปีชีส์เดียวกัน และต่างสปีชีส์ในระบบนิเวศ ปัจจัยที่เกี่ยวข้อง และส่วนประกอบของวิวัฒนาการร่วม โดยเน้นในแง่ระหว่างพืชกับสัตว์กินพืช และระหว่างผู้ล่ากับเหยื่อ กลไกการป้องกันตัวเองของสิ่งมีชีวิต บทบาทของวิวัฒนาการร่วมต่อโครงสร้างของประชากร

SCBE 316 Biological Microtechnique 3 (2-3-5)
วททส ๓๑๖ ชีววิทยาไมโครเทคนิค ๓ (๒-๓-๕)
Prerequisite None

วิชาบังคับก่อน ไม่มี

Theory and practice of preparing plants and animals for microscopic examination; general routines of the preparation of tissue such as fixation and dehydration, sectioning with microtome and staining of sections, microanatomy and chemical composition of some tissues

ทฤษฎีและปฏิบัติการเกี่ยวกับขั้นตอนการเตรียมตัวอย่างพืชและสัตว์ เพื่อศึกษารายละเอียดด้วยกล้องจุลทรรศน์ วิธีการเตรียมตัวอย่างพืชและสัตว์ การดอง การเอาน้ำออกจากเนื้อเยื่อ การตัดเนื้อเยื่อบางด้วยเครื่องไมโครโทม การย้อมสีเนื้อเยื่อที่ตัดแล้ว รายละเอียดเกี่ยวกับจุลกายวิภาคและองค์ประกอบทางเคมีของเนื้อเยื่อบางชนิด

SCBE 317 Hazardous and Toxic Wastes 3 (3-0-6)
วททส ๓๑๗ ของเสียอันตรายและเป็นพิษ ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Toxic waste, municipal waste, biomedical waste, hazardous waste, e-waste; requirements for solid waste management, sampling and characterization of solid waste; an analysis of hazardous waste constituents, health and environmental issues related to toxic and hazardous waste management; waste reduction at source, collection techniques, materials and resource recovery, recycling, optimization of solid waste treatment and disposal techniques, composting, incineration techniques, refuse derived fuels, disposal practices, integrated waste management

ขยะพิษ, ขยะชุมชน, ขยะจากโรงพยาบาล, ขยะอันตราย, ขยะอิเล็กทรอนิกส์, ข้อกำหนดในการจัดการขยะ, การสุ่มตัวอย่างและการจำแนกลักษณะของขยะ, การวิเคราะห์องค์ประกอบขยะอันตราย, สุขภาพและปัญหาสิ่งแวดล้อมที่เกี่ยวข้องกับการจัดการขยะพิษและอันตราย, การลดขยะจากแหล่งกำเนิด เทคนิคการจัดเก็บขยะ การกู้คืนวัสดุและทรัพยากรที่มีค่า การรีไซเคิล การเพิ่มประสิทธิภาพของการบำบัดและการกำจัดขยะมูลฝอยโดยการทำปุ๋ยหมัก เทคนิคการเผาขยะให้เป็นเชื้อเพลิงเพื่อการกำจัดขยะ การปฏิบัติในการกำจัดการจัดการขยะแบบบูรณาการ

SCBE 318 Environmental Risk Assessment 3 (3-0-6)
วททส ๓๑๘ การประเมินความเสี่ยงด้านสิ่งแวดล้อม ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

A survey of risk assessment; environmental health regulations, decision-making, basic components and applications of environmental health risk assessment; exposure assessment; hazard identification; dose-response evaluation and risk management

การสำรวจการประเมินความเสี่ยง การควบคุมสุขภาพสิ่งแวดล้อม การตัดสินใจ องค์ประกอบพื้นฐานและการประยุกต์ใช้การประเมินความเสี่ยงด้านสุขภาพสิ่งแวดล้อม

SCBE 319 Renewable Energy 3 (3-0-6)
วททส ๓๑๙ พลังงานทดแทน ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

The energy systems and renewable energy resources, scientific examination of the energy field; an emphasis on alternative energy sources, technology and application; societal present needs and future energy demands, conventional energy sources and systems examination; fossil fuels, nuclear energy, alternative or renewable energy sources, solar, biomass (conversions), wind power, geothermal, and hydro, energy conservation methods

ระบบพลังงานและทรัพยากรพลังงานทดแทน การตรวจสอบทางวิทยาศาสตร์ของแหล่งพลังงาน แหล่งพลังงานทางเลือกเทคโนโลยีและการประยุกต์ความต้องการทางสังคมปัจจุบันและความต้องการพลังงานในอนาคตการตรวจสอบแหล่งพลังงานทั่วไปและการตรวจสอบระบบเชื้อเพลิงฟอสซิลพลังงานนิวเคลียร์แหล่งพลังงานทางเลือก พลังงานแสงอาทิตย์พลังงานชีวมวล (แปลง) พลังงานลม พลังงานความร้อนใต้พิภพ และพลังน้ำ วิธีการอนุรักษ์พลังงาน

SCBE 320 Occupational Health and Safety 3 (3-0-6)
วททส ๓๒๐ อาชีวอนามัยและความปลอดภัย ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Workplace occupational health and safety; safe work practices in offices, industry and construction; how to identify and prevent or correct problems associated with occupational safety and health in various situations; implementation of safe healthy practices at work and at home
สุขภาพและความปลอดภัยในที่ทำงาน การปฏิบัติงานอย่างปลอดภัยในที่ทำงาน ในอุตสาหกรรมและงานก่อสร้าง การระบุและการป้องกันรวมถึงการแก้ไขปัญหาที่เกี่ยวข้องกับสุขภาพและความปลอดภัยในที่ทำงาน การนำระเบียบความปลอดภัยทางสุขภาพมาปฏิบัติในที่ทำงานและที่บ้าน

SCBE 321 Epidemiology and Disease Control 3 (3-0-6)
วททส ๓๒๑ ระบาดวิทยาและการควบคุมโรค ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Principles and methods of epidemiology; disease pyramid; infectious and chronic diseases; vector-borne disease and transmission; vector control; vertical transmission and horizontal transmission; data mining with ICT literacy from scientific database; presentation and communication in epidemiology; statistical analysis; evolution and ecology of pathogens; disease control and case studies

หลักการและวิธีศึกษาระบาดวิทยา ปิรามิดของโรค โรคติดต่อและโรคเรื้อรัง โรคที่มีพาหะและการกระจายตัวของโรค การควบคุมพาหะ การแพร่แนวดิ่งและแนวระนาบ การสืบค้นข้อมูลจากฐานข้อมูลทางวิทยาศาสตร์ การนำเสนอและการสื่สารทางระบาดวิทยา การวิเคราะห์ทางสถิติ วิวัฒนาการและนิเวศวิทยาของเชื้อก่อโรค การควบคุมโรคและกรณีศึกษา

SCBE 322 Air Quality Monitoring and Management 3 (2-3-5)
วททส ๓๒๒ การจัดการและการตรวจวัดมลพิษทางอากาศ ๓ (๒-๓-๕)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Air pollution and its control; theoretical and practical aspects of industrial air pollution control and monitoring; processes and devices used in the area air pollution control; filtration and separation; chemical and mechanical methods of air purification; absorption; adsorption; precipitation; technologies and protocols used for air pollution monitoring

มลพิษทางอากาศและการควบคุม การศึกษาทฤษฎีและปฏิบัติในการควบคุมและตรวจสอบมลพิษทางอากาศในอุตสาหกรรม กระบวนการและอุปกรณ์ที่ใช้ในการควบคุมมลพิษทางอากาศ การกรองและการแยก วิธีการทางเคมีและเชิงกล ที่ใช้ในการฟอกอากาศ การดูดกลืนสาร การดูดจับสาร การตกตะกอน และเทคโนโลยีที่เกี่ยวข้องในการตรวจวัดมลพิษทางอากาศ

SCBE 323 Noise and Vibration 3(2-3-5)
วททส ๓๒๓ เสียงและการสั่นสะเทือน ๓(๒-๓-๕)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Noise and vibration monitoring; noise and vibration hazard; sources and health effects of noise and vibration; noise monitoring and evaluation; noise and vibration exposure levels; interpretation and analysis of noise monitoring results; implementation of hearing conservation program

การตรวจวัดเสียงและการสั่นสะเทือน อันตรายของเสียงและการสั่นสะเทือน ที่มาและผลกระทบทางสุขภาพของเสียงและการสั่นสะเทือน การประเมินผลและการตรวจวัดเสียง ระดับการได้รับเสียงและการสั่นสะเทือน การประมวลผลและการวิเคราะห์ผลการตรวจสอบค่าการศึกษาทางเสียง การนำโปรแกรมการรักษาการได้ยินมาใช้

SCBE 324 Solid Waste and Sewage 3(2-3-5)
วททส ๓๒๔ สิ่งปฏิกูลและน้ำเสีย ๓(๒-๓-๕)
Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒
Solid waste policy; types and amounts of wastes; solid waste treatment and management; technical design of waste systems; source separation; waste collection and transport; landfilling; incineration; biochemical conversion methods; excursion to solid waste treatment and recycling facilities; sewage sludge; hazardous wastes.
นโยบายเกี่ยวกับสิ่งปฏิกูล ชนิดและปริมาณของของเสีย การบำบัดในการจัดการสิ่งปฏิกูล การออกแบบทางเทคนิคของระบบจัดการของเสีย การแยกแหล่งที่มา การเก็บและการขนส่ง การนำไปฝังดิน การนำไปเผา การนำไปเปลี่ยนรูปทางชีวเคมี การเยี่ยมชมสถานที่บำบัดสิ่งปฏิกูลและสถานที่รีไซเคิล กากตะกอนของเสีย ของเสียอันตราย

SCBE 330 Environmental Microbiology 3 (3-0-6)
วททส ๓๓๐ จุลชีววิทยาสิ่งแวดล้อม ๓ (๓-๐-๖)
Prerequisite SCBE 253 Fundamentals to Finesse: Microbes for Quality Life
วิชาบังคับก่อน วททส ๒๕๓ พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ
The relationship between microbes and environment; microbe activities, roles and impacts of microbes in environment, applications of microbes in bioremediation
ความสัมพันธ์ของจุลินทรีย์กับสิ่งแวดล้อม กิจกรรมต่างๆ ของจุลินทรีย์ ความสำคัญของจุลินทรีย์ต่อสิ่งแวดล้อมและผลกระทบ การนำจุลินทรีย์มาประยุกต์ใช้ในการรักษาสภาพสิ่งแวดล้อม

SCBE 331 Industrial Microbiology 3 (2-3-5)
วททส ๓๓๑ จุลชีววิทยาทางอุตสาหกรรม ๓ (๒-๓-๕)
Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒
Industrial utilization of microbes; products from microbes, types of microbes used in industry, introduction to fermentation technology; laboratory experiment in industrial microbiology

การใช้ประโยชน์จากจุลินทรีย์ในระดับอุตสาหกรรม ผลิตภัณฑ์ต่างๆ จากจุลินทรีย์ จุลินทรีย์ชนิดต่างๆ ที่ใช้ประโยชน์ในทางอุตสาหกรรม; เทคโนโลยีการหมักเบื้องต้น การทำปฏิบัติการทางจุลชีววิทยาอุตสาหกรรม

SCBE 332 Host-microbe Interactions 3 (2-3-5)
วททส ๓๓๒ ปฏิสัมพันธ์ระหว่างโฮสต์และจุลินทรีย์ ๓ (๒-๓-๕)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Biodiversity of microbes and their interactions with their hosts; various types of interactions including mutualism, commensalism, parasitism; molecular aspects of host and microbes of importance with implications in ecological aspects; implication and exploitation of the interactions in agriculture, medicine, and public health; laboratory exercises

ความหลากหลายทางชีวภาพของจุลินทรีย์ ปฏิสัมพันธ์ระหว่างโฮสต์และจุลินทรีย์ในระบบต่างๆ ความสัมพันธ์แบบพึ่งพาและแบบปรสิต ปฏิสัมพันธ์ระหว่างโฮสต์และจุลินทรีย์ในระดับโมเลกุล การศึกษาเชิงนิเวศวิทยา ศึกษาตัวอย่างจากทางการเกษตร ทางการแพทย์และสาธารณสุข การทำปฏิบัติการ

SCBE 333 Plant Virology 3 (3-0-6)
วททส ๓๓๓ ไวรัสวิทยาพืช ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Biology of virus, diversity of virus, major groups of virus that cause diseases, research and application

ชีววิทยาของไวรัส ความหลากหลายของไวรัส กลุ่มไวรัสที่ก่อให้เกิดโรคที่สำคัญ งานวิจัยและการประยุกต์

SCBE 334 Biology of Plankton 3 (2-3-5)
วททส ๓๓๔ ชีววิทยาของแพลงตอน ๓ (๒-๓-๕)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Cellular organization and basic molecular biology of planktons including algae, protozoa and insect larvae; taxonomy and life history of different groups of planktons, Isolation, and plankton aquaculture; the role of plankton in the food web structure and the ecological environment; an application of plankton to agriculture, industry, medicine and scientific research

โครงสร้างระดับเซลล์และอณูชีววิทยาเบื้องต้นของแพลงก์ตอน การจัดจำแนกในเชิงอนุกรมวิธาน วิถีชีวิตของแพลงก์ตอนในกลุ่มต่างๆ การแยกและการเพาะเลี้ยงแพลงก์ตอนในห้องปฏิบัติการ บทบาทของแพลงก์ตอนที่มีต่อห่วงโซ่อาหาร สิ่งแวดล้อม และระบบนิเวศ รวมไปถึงการนำแพลงก์ตอนไปประยุกต์ใช้ในเชิงอุตสาหกรรม การเกษตร และในการวิจัยทางการแพทย์และวิทยาศาสตร์

SCBE 335 Fungal Diversity and Ecology 3 (3-0-6)
วททส ๓๓๕ ความหลากหลายและนิเวศวิทยาของเห็ดรา ๓ (๓-๐-๖)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Biology of fungi and mushroom; diversity and their role in the ecosystem
ชีววิทยาของเห็ดและรา ความหลากหลาย และบทบาทในระบบนิเวศ

SCBE 336 Mycorrhizal Ecology 3 (2-3-5)
วททส ๓๓๖ นิเวศวิทยาของไมคอร์ไรซา ๓ (๒-๓-๕)

Prerequisite SCBE 253 Fundamentals to Finesse: Microbes for Quality Life
วิชาบังคับก่อน วททส ๒๕๓ พื้นฐานสู่ความอภิเชษฐ์: จุลินทรีย์เพื่อชีวิตที่มีคุณภาพ

Relationships between mycorrhizal fungi and plants; the role in the plant nutrient uptake and function in the plant community dynamics; methodological approaches used in mycorrhizal research; applications of mycorrhiza in agriculture and environmental conservation; laboratory exercises

ความสัมพันธ์ระหว่างไมคอร์ไรซาและพืช: บทบาทในการช่วยพืชดูดซับอาหาร และหน้าที่ในการเปลี่ยนแปลงกลุ่มประชากรพืช วิธีการในการศึกษาวิจัยไมคอร์ไรซา การนำไมคอร์ไรซามาประยุกต์ใช้ในทางเกษตรกรรมและการรักษาสภาพสิ่งแวดล้อม การทำปฏิบัติการ

SCBE 350 Diversity of Plants 3 (2-3-5)
วททส ๓๕๐ ความหลากหลายของพืช ๓ (๒-๓-๕)

Prerequisite None
วิชาบังคับก่อน ไม่มี

A comparative study on structures and reproductive organs of non-vascular and vascular plants; classification, identification, and nomenclature of plants; specimen preparations

ศึกษาเปรียบเทียบโครงสร้างและการสืบพันธุ์ของพืชไม่มีท่อลำเลียงและพืชมีท่อลำเลียง ประวัติความเป็นมาของพฤกษอนุกรมวิธาน การจำแนกพืช การระบุพืช การตั้งชื่อพืช วิวัฒนาการของพืช การจัดทำตัวอย่างพรรณไม้แห้ง ลักษณะของพืชกลุ่มต่างๆ

SCBE 351 Tropical Plants and Gardens 3 (2-3-5)
วททส ๓๕๑ พืชเขตร้อนและสวน ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Tropical ornamental plants including flowering plants, cut-flower plants, foliage plants, trees, bonsai, and others; styles of garden in the past and present time and principles of landscape gardening; gardening laboratory

ไม้ประดับเขตร้อน ทั้งไม้ดอก ไม้ตัดดอก ไม้ใบ ไม้ต้น บอนไซ และอื่นๆ รูปแบบของสวนในอดีตและปัจจุบัน หลักการจัดสวนเบื้องต้น ปฏิบัติการจัดสวน

SCBE 352 Orchid Biology 3 (2-3-5)
วททส ๓๕๒ ชีววิทยาของกล้วยไม้ ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Theory and practice in orchid biology including orchid ecology and distribution, anatomy, morphology, taxonomy, physiology, cultivation, hybridization, and an application for a complete cycle of orchid conservation

ทฤษฎีและการฝึกปฏิบัติการเกี่ยวกับชีววิทยาของกล้วยไม้ รวมถึงนิเวศวิทยาและการกระจายพันธุ์ กายวิภาคศาสตร์ สัณฐานวิทยา อนุกรมวิธาน สรีรวิทยา การปลูกเลี้ยง การผสมพันธุ์กล้วยไม้ และการประยุกต์เพื่อการอนุรักษ์กล้วยไม้อย่างครบวงจร

SCBE 450 Flowering Plants: Diversity, Evolution, and Systematics 3 (2-3-5)
วททส ๔๕๐ พืชดอก: ความหลากหลาย วิวัฒนาการ และซิสเตมาติกส์ ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

History and systematics of flowering plants based on current phylogenetic study; an identification key construction and usage; diagnostic characters of each flowering plant group

ประวัติความเป็นมาของพฤกษอนุกรมวิธาน การจำแนกพืช การระบุพืช การตั้งชื่อพืช วิวัฒนาการของพืช การจัดทำตัวอย่างพรรณไม้แห้ง ลักษณะของพืชกลุ่มต่างๆ

SCBE 451 Dendrology 3 (2-3-5)
วททส ๔๕๑ รุกขวิทยา ๓ (๒-๓-๕)
Prerequisite SCBE 205 General Botany
SCBE 206 General Botany Laboratory
วิชาบังคับก่อน วททส ๒๐๕ พฤกษศาสตร์ทั่วไป
วททส ๒๐๖ ปฏิบัติการพฤกษศาสตร์ทั่วไป

Technical terms relevant to morphology and taxonomy of trees; classification of trees and forest ecology in Thailand and Southeast Asia; examples of trees with economic significance and conservation; Tree farming; field tip and excursion

ศัพท์พฤกษศาสตร์เกี่ยวกับสัณฐานวิทยาและอนุกรมวิธานของไม้ยืนต้น การตั้งชื่อ การจำแนก ชีวนิเวศป่าไม้ป่าของประเทศไทยและภูมิภาคเอเชียอาคเนย์ ไม้ยืนต้นเอกลักษณ์ ภูมิศาสตร์ทางกายภาพและการกระจายพันธุ์ของไม้ยืนต้น วงศ์ไม้มีค่าทางเศรษฐกิจ วงศ์ไม้หายากใกล้สูญพันธุ์ การปลูกสร้างสวนป่าไม้เศรษฐกิจ มีปฏิบัติการ และปฏิบัติงานภาคสนาม

SCBE 452 Flora of Thailand 3 (3-0-6)
วททส ๔๕๒ พรรณพฤกษชาติประเทศไทย ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

History, current status of scientific plant collection and prospects of the flora of Thailand project; The need for further collecting of plants in Thailand; the need for international collaboration on the project

ประวัติศาสตร์ สถานะปัจจุบันในการเก็บตัวอย่างพืชทางวิทยาศาสตร์ และอนาคตของโครงการพรรณพฤกษชาติประเทศไทย ความต้องการเก็บตัวอย่างพืชในประเทศไทยต่อจากนี้ไป ความต้องการความร่วมมือกับนานาชาติในโครงการฯ

SCBE 370 Invertebrate Zoology 4 (3-2-7)
วททส ๓๗๐ วิทยาสัตว์ไม่มีกระดูกสันหลัง ๔ (๓-๒-๗)
Prerequisite None

วิชาบังคับก่อน ไม่มี

Morphology, physiology, and taxonomy of invertebrates from protozoa to cellmates; phylogenetic relationships; ecology and behavior; demonstration and laboratory exercises

สัณฐานวิทยาภายนอกและภายใน สรีรวิทยาของอวัยวะและระบบอวัยวะต่างๆ การจัดจำแนกสัตว์ไม่มีกระดูกสันหลังจากสิ่งมีชีวิตเซลล์เดียวถึงสัตว์ที่มีช่องลำตัวแท้จริง ความสัมพันธ์ทางด้านสายพันธุ์ นิเวศวิทยา และพฤติกรรม ทำปฏิบัติการ

SCBE 371 Parasitology 4 (3-2-7)
วททส ๓๗๑ ปรสิตวิทยา ๔ (๓-๒-๗)

Prerequisite None
วิชาบังคับก่อน ไม่มี

Biology and life cycles of parasites of man and some domestic animals; host-parasite relationship; immunology of parasitic diseases; basic problems in the control and diagnosis of parasitic infection in Thailand and around the world; laboratory exercises

ชีววิทยาและวัฏจักรชีวิตของปรสิตทั้งของคนและสัตว์ ความสัมพันธ์ระหว่างปรสิตและโฮสต์ ภูมิคุ้มกันต่อโรคปรสิต ปัญหาพื้นฐานในการควบคุมและวินิจฉัยโรคที่เกิดจากปรสิตที่สำคัญในประเทศไทยและทั่วโลก ทำปฏิบัติการ

SCBE 372 Basic Entomology 4 (3-2-7)
วททส ๓๗๒ กีฏวิทยาพื้นฐาน ๔ (๓-๒-๗)

Prerequisite SCBE 208 General Ecology
วิชาบังคับก่อน วททส ๒๐๘ นิเวศวิทยาทั่วไป

Insect anatomy, morphology, physiology, reproduction, development and metamorphosis; taxonomy and nomenclature of insects; theorem of human-insect relationship, and other arthropods; laboratory exercises collection and preservation of insect specimens, dissection and field survey

กายวิภาคศาสตร์ สัณฐานวิทยา สรีรวิทยา การสืบพันธุ์ การเจริญเติบโตและการเปลี่ยนแปลงรูปร่างของแมลง การจัดจำพวกแมลง อนุกรมวิธานและการตั้งชื่อ ทฤษฎีความสัมพันธ์ระหว่างแมลงกับมนุษย์ และสัตว์ขาป้องชนิดอื่น ปฏิบัติการเกี่ยวกับการเก็บรักษาแมลง การผ่าตัดและการสำรวจภาคสนาม

SCBE 373 Vector Biology 4 (3-2-7)
วททส ๓๗๓ ชีววิทยาของพาหะนำโรค ๔ (๓-๒-๗)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Morphology, physiology, genetics, life cycles and ecology of insects and snail vector-borne diseases of medical and economic importance; biological and environmental factors of infection rate and epidemiology; laboratory exercises

สัณฐานวิทยา สรีรวิทยา พันธุศาสตร์ วัฏจักรชีวิต และนิเวศวิทยาประชากรของพาหะนำโรคเมืองร้อนที่มีความสำคัญทางการแพทย์และทางเศรษฐกิจ กลไกทางชีววิทยาและอิทธิพลของสิ่งแวดล้อมต่อการติดเชื้อของพาหะของโรค และระบาดวิทยา ทำปฏิบัติการ

SCBE 374 Aquatic Entomology 4 (3-2-7)
วททส ๓๗๔ กีฏวิทยาสัตว์น้ำ ๔ (๓-๒-๗)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Aquatic insect biology; classification; morphology and physiology; adaptation; roles in the ecosystem; field survey and laboratory exercises

ชีววิทยาของแมลงน้ำ การจัดจำแนก สัณฐานวิทยาและสรีรวิทยา การปรับตัว และบทบาทในระบบนิเวศ การสำรวจในภาคสนามและการทำปฏิบัติการ

SCBE 375 Acarology 4 (3-2-7)
วททส ๓๗๕ ชีววิทยาของเห็บและไร ๔ (๓-๒-๗)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Biology of tick and mite with an emphasis on theory and experiment on tick; systematics and evolution of tick and mite; veterinary significance of tick and mite; economics, epidemiology and ecology of tick and mite; tick-borne diseases; forensic acarology

ชีววิทยาของเห็บและไรมุ่งเน้นทฤษฎีและปฏิบัติการเกี่ยวกับเห็บ การจัดหมวดหมู่ของเห็บและไร รวมถึงวิวัฒนาการของสิ่งมีชีวิตทั้ง 2 กลุ่มนี้ ความสำคัญของเห็บและไรทางการแพทย์และสัตวแพทย์ ความเกี่ยวข้องของเห็บและไรกับเศรษฐศาสตร์ ระบาดวิทยาและทางนิเวศวิทยา โรคที่เกิดจากเห็บ และนิติวิทยาของเห็บและไร

SCBE 390 Vertebrate Zoology 4 (3-2-7)
วททส ๓๙๐ วิทยาสัตว์มีกระดูกสันหลัง ๔ (๓-๒-๗)
Prerequisite None

วิชาบังคับก่อน ไม่มี

Morphology, physiology, behavior, taxonomy and the classification of various vertebrate groups; comparative anatomy in relation to the evolution of the vertebrates; demonstration, laboratory exercises and field trips

สัณฐานวิทยา สรีรวิทยา พฤติกรรม การจัดจำแนกสัตว์มีกระดูกสันหลัง กายวิภาคศาสตร์เปรียบเทียบในเชิงความสัมพันธ์ทางวิวัฒนาการของสัตว์มีกระดูกสันหลัง สาธิต ทำปฏิบัติการ และออกภาคสนามเพื่อดูตัวอย่างสัตว์ตามธรรมชาติ

SCBE 391 Ichthyology 4 (3-2-7)
วททส ๓๙๑ มีนวิทยา ๔ (๓-๒-๗)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Fish biology; classification; morphology and physiology; adaptation; roles in the ecosystem; demonstration, laboratory exercises and field trips

ชีววิทยาของปลา การจัดจำแนก สัณฐานวิทยาและสรีรวิทยา การปรับตัว และบทบาทในระบบนิเวศ สาธิต ทำปฏิบัติการ และออกภาคสนาม

SCBE 392 Herpetology 4 (3-2-7)
วททส ๓๙๒ ชีววิทยาสัตว์ครึ่งบกครึ่งน้ำและเลื้อยคลาน ๔ (๓-๒-๗)
Prerequisites SCBE 201 General Zoology
SCBE 202 General Zoology Laboratory
วิชาบังคับก่อน วททส ๒๐๑ สัตววิทยาทั่วไป
วททส ๒๐๒ ปฏิบัติการสัตววิทยาทั่วไป

Fish biology; classification; morphology and physiology; adaptation; roles in the ecosystem; demonstration, laboratory exercises and field trips

ชีววิทยาของสัตว์ครึ่งบกครึ่งน้ำและเลื้อยคลาน การจัดจำแนก สัณฐานวิทยาและสรีรวิทยา การปรับตัว และบทบาทในระบบนิเวศ สาธิต ทำปฏิบัติการ และออกภาคสนาม

SCBE 393 Ornithology 4 (3-2-7)
วททส ๓๙๓ ปักษีวิทยา ๔ (๓-๒-๗)
Prerequisite None

วิชาบังคับก่อน ไม่มี

Origins and evolution of birds, classification and taxonomy of birds, bird physiology, habitats and ecology, vocalizations and territoriality, behaviour, the breeding systems, census methods, conservation, migration and field trip

กำเนิดและวิวัฒนาการของนก อนุกรมวิธานและการจำแนกชนิดนก สรีรวิทยาของนก นิเวศวิทยาของนก การส่งเสียงร้องของนกและการสร้างอาณาเขต พฤติกรรม การผสมพันธุ์ การสำรวจประชากร การอนุรักษ์ การอพยพ การศึกษาภาคสนาม

SCBE 394 Mammal Diversity 4 (3-2-7)
วททส ๓๙๔ ความหลากหลายของสัตว์เลี้ยงลูกด้วยนม ๔ (๓-๒-๗)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Biology of mammals; classification; morphology and physiology; adaptation; roles in the ecosystem; field trips

ชีววิทยาของสัตว์เลี้ยงลูกด้วยนม การจัดจำแนก สัณฐานวิทยาและสรีรวิทยา การปรับตัว และบทบาทในระบบนิเวศ การศึกษาในภาคสนาม

SCBE 401 Hazardous Waste Management 3 (3-0-6)
วททส ๔๐๑ การจัดการของเสียอันตราย ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Basic concept of hazardous waste management including household hazardous waste management, infectious waste management, and electronic waste management; hazardous waste characteristics including sources and categories of hazardous waste; current issues in hazardous waste disposal; emerging technologies for the control of hazardous wastes

แนวคิดพื้นฐานการจัดการขยะอันตรายรวมถึงการจัดการขยะอันตรายจากชุมชน การจัดการขยะติดเชื้อ และการจัดการขยะอิเล็กทรอนิกส์ ลักษณะเฉพาะของขยะอันตรายรวมถึงแหล่งที่มาและประเภทของขยะอันตราย ปัญหาการกำจัดขยะอันตราย เทคโนโลยีใหม่ๆ ที่ใช้ในการควบคุมขยะอันตราย

SCBE 402 Internship in Bioresources and Environmental Biology 3 (0-9-3)
วททส ๔๐๒ การฝึกงานทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม ๓ (๐-๙-๓)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Full- or part-time employment, volunteer work with an agency, research institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational and professional goals

การทำงานเต็มเวลาหรือครึ่งเวลาหรืองานอาสาสมัครกับหน่วยงานราชการ สถาบันวิจัย คลินิก กลุ่มวิชาชีพธุรกิจ หรือบุคคลที่เกี่ยวข้องในกิจกรรมที่สอดคล้องกับเป้าหมายทางการศึกษาและอาชีพของนักศึกษา

SCBE 403 Sustainable Technology 3 (3-0-6)
วททส ๔๐๓ เทคโนโลยีที่ยั่งยืน ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Developing solutions to societal and environmental problems in a changing world; changing climate; fuel depletion; regional water shortages; evaluation of system sustainability using a multidisciplinary framework; sustainability metrics, including energy evaluation and life cycle assessment

การพัฒนาแนวทางแก้ไขปัญหาสังคมและสิ่งแวดล้อมในโลกที่กำลังเปลี่ยนแปลง อากาศกำลังเปลี่ยนแปลง การหมดไปของเชื้อเพลิง การขาดแคลนน้ำในระดับภูมิภาค การประเมินความยั่งยืนของระบบโดยใช้กรอบสหวิชาชีพ ตัวชี้วัดความยั่งยืนรวมถึงการประเมินพลังงานและการประเมินวัฏจักรชีวิต

SCBE 404 Water and Wastewater Treatment 3 (3-0-6)
วททส ๔๐๔ การบำบัดน้ำและน้ำเสีย ๓ (๓-๐-๖)

Prerequisite SCBE 111 Principles of Biology I, SCBE 113 Principles of Biology II
วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑, วททส ๑๑๓ หลักการทางชีววิทยา ๒

Design principles; practice of unit operations; processes for water and wastewater treatment; engineering and technology concepts; design procedures for water and wastewater treatment

หลักการออกแบบ การฝึกปฏิบัติการทำงานในระบบปฏิบัติการ กระบวนการบำบัดน้ำและน้ำเสีย แนวคิดทางวิศวกรรมและเทคโนโลยี ขั้นตอนการออกแบบระบบบำบัดน้ำและน้ำเสีย

SCBE 410 Environmental and Biodiversity Education: Theories and Practices 3 (3-0-6)
วททส ๔๑๐ การสื่อสารทางสิ่งแวดล้อมและความหลากหลายทางชีวภาพศึกษา: ทฤษฎีและปฏิบัติ ๓ (๓-๐-๖)

Prerequisite None

วิชาบังคับก่อน ไม่มี

History, goals, and objectives of environmental education; theoretical foundations of learning and development; human-nature relationships; types of environmental education practices and related concepts, monitoring and evaluation, critical review of selected examples; hands-on experience

ประวัติศาสตร์ เป้าหมาย และวัตถุประสงค์ของสิ่งแวดล้อมศึกษา พื้นฐานทางทฤษฎีของการเรียนรู้และการพัฒนาความสัมพันธ์ระหว่างมนุษย์กับธรรมชาติ รูปแบบของสิ่งแวดล้อมศึกษา และแนวคิดที่เกี่ยวข้อง การติดตามและประเมินผล การศึกษาเชิงลึกและวิพากษ์กรณีศึกษาสิ่งแวดล้อมศึกษาที่น่าสนใจ ประสบการณ์โดยการทดลองทำโดยตรง นักศึกษาต้องมีส่วนร่วมในกระบวนการเรียนรู้สูง

SCBE 411 Molecular Biology Applications 3 (3-0-6)

วททส ๔๑๑ การประยุกต์ชีววิทยาระดับโมเลกุล ๓ (๓-๐-๖)

Prerequisite None

วิชาบังคับก่อน ไม่มี

The methodology to biological researches; current topics in biological research focusing on the methodology aiming to answer specific questions; current scientific literature

การประยุกต์นำชีววิทยาระดับโมเลกุลมาใช้ในการทดลอง วิธีการทดลองทางชีววิทยา หัวข้อทันสมัยในการทดลองเพื่อตอบปัญหาทางวิทยาศาสตร์ได้อย่างถูกต้อง ตัวอย่างและวิเคราะห์ตัวอย่างการทดลองตามความสนใจของนักศึกษา

SCBE 412 Biological Control 3 (3-0-6)

วททส ๔๑๒ การควบคุมโดยชีววิธี ๓ (๓-๐-๖)

Prerequisites SCBE 111 Principles of Biology I
SCBE 113 Principles of Biology II

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑
วททส ๑๑๓ หลักการทางชีววิทยา ๒

Approaches and procedures in biological control to manage important pests in agriculture and public health; history and examples will be given along with the application and commercialization of biological control agents

แนะนำแนวทางและขั้นตอนการควบคุมโดยชีววิธี ในการกำจัดศัตรูทางการเกษตรและทางการแพทย์ ประวัติและตัวอย่างของการผลิตชีวปัจจัยเพื่อการประยุกต์และการค้า

SCBE 413 Integrated Pest Management 3 (3-0-6)
วททส ๔๑๓ การจัดการแมลงศัตรูแบบบูรณาการ ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Principles of integrated pest control, environment, ecology, and economics in the management of pests; theories and concepts of the integrated pest management with monitoring techniques and the application of biotechnology current application of precision management, bioinformatic technology, green and organic technology, application of recombinant DNA technology, and simulation modeling

หลักการจัดการแมลงศัตรูแบบบูรณาการ สิ่งแวดล้อม นิเวศวิทยา และเศรษฐศาตร์ ทฤษฎีและแนวคิดการจัดการแมลงศัตรูแบบบูรณาการ การประยุกต์เทคโนโลยีชีวภาพในการจัดการแมลงศัตรู การประยุกต์ปัจจุบันในการจัดการโดยใช้เทคโนโลยีคอมพิวเตอร์และชีวสารสนเทศ เทคโนโลยีการใช้พืชและสารอินทรีย์ การประยุกต์ใช้เทคโนโลยีดีเอนเอรีคอมบิแนนต์ และแบบจำลองสภาพการณ์จริง

SCBE 414 Conservation Biology: Asia Perspectives 3 (3-0-6)
วททส ๔๑๔ ชีววิทยาเชิงอนุรักษ์ : มุมมองภูมิภาคเอเชีย ๓ (๓-๐-๖)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Conservation biology and biological diversity; threats to biological diversity; conservation at the population and species levels; conserving biological community; the role of local communities on conservation; laws, policies, and Institutions for conservation; research issue needs in conservation biology

ชีววิทยาเชิงอนุรักษ์และความหลากหลายทางชีวภาพ ภัยคุกคามที่มีต่อความหลากหลายทางชีวภาพ การอนุรักษ์ในระดับประชากรและสปีชีส์ การอนุรักษ์ในระดับชุมชนของสิ่งมีชีวิต การอนุรักษ์โดยชุมชนท้องถิ่น กฎหมาย นโยบาย สถาบันเกี่ยวกับการอนุรักษ์ ประเด็นการวิจัยที่ยังมีความต้องการในการอนุรักษ์ความหลากหลายทางชีวภาพ

SCBE 415 Biodiversity Sciences 3 (3-0-6)
วททส ๔๑๕ วิทยาศาสตร์ชีวนานาพันธุ์ ๓ (๓-๐-๖)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Definition, scope and constraints of biodiversity science; genetic diversity, species diversity, wild taxa, ecosystem diversity, values and uses of biodiversity; loss of biodiversity, conservation of biodiversity; biodiversity and biotechnology, and the management of plant biodiversity

ความหลากหลายทางชีวภาพในสายวิทยาศาสตร์ ความหลากหลายทางพันธุศาสตร์ ความหลากหลายของสปีชีส์ สัตว์ป่า ระบบทางนิเวศ คุณค่าและการใช้ประโยชน์ของความหลากหลายทางชีวภาพ การสูญเสียความหลากหลายทางชีวภาพ การอนุรักษ์ความหลากหลายทางชีวภาพ ความหลากหลายทางชีวภาพและเทคโนโลยีชีวภาพ และการจัดการความหลากหลายทางชีวภาพของพืช

SCBE 416 In vitro Propagation for Plant Resource Conservation 3 (1-6-4)
วททส ๔๑๖ การขยายพันธุ์ในสภาพปลอดเชื้อเพื่อการอนุรักษ์ทรัพยากรพืช ๓ (๑-๖-๔)

Prerequisite None

วิชาบังคับก่อน ไม่มี

Principles of plant in vitro propagation for plant resource conservation, effect of nutrient agar and plant growth regulators in in vitro propagation and applications; basic in vitro culture inoculation, sub-culturing, and transplantation; laboratory exercises

หลักการขยายพันธุ์พืชในสภาพปลอดเชื้อเพื่อการอนุรักษ์ทรัพยากรพืช ตั้งแต่พื้นฐานถึงการนำไปประยุกต์ใช้ อิทธิพลของสูตรอาหารและสารควบคุมการเจริญเติบโตต่อการขยายพันธุ์และปรับปรุงพันธุ์ พืชในสภาพปลอดเชื้อ เทคนิคการย้ายต้นกล้าจากสภาวะปลอดเชื้อออกสู่ธรรมชาติ การทำปฏิบัติการ

SCBE 417 Natural Resources and Environmental Management 3 (3-0-6)
วททส ๔๑๗ การจัดการทรัพยากรธรรมชาติและสิ่งแวดล้อม ๓ (๓-๐-๖)

Prerequisites SCBE 111 Principles of Biology I
SCBE 102 General Biology Laboratory I

วิชาบังคับก่อน วททส ๑๑๑ หลักการทางชีววิทยา ๑
วททส ๑๐๒ ปฏิบัติการชีววิทยาทั่วไป ๑

Essential concepts related to natural resources, environment, and its management; connection with sustainable development and environmental impact assessment; relevant disciplinary approaches from the natural sciences, social sciences, and humanities; interactions with noted theorists and practitioners

แนวคิดสำคัญเกี่ยวกับทรัพยากรธรรมชาติ สิ่งแวดล้อมและการจัดการ ความเชื่อมโยงกับการพัฒนาที่ยั่งยืน และการประเมินผลกระทบทางสิ่งแวดล้อม แนวทางการศึกษาจากวิชาการสาขาต่างๆ ที่เกี่ยวข้อง ทั้งด้านวิทยาศาสตร์ธรรมชาติ สังคมศาสตร์ และมนุษยศาสตร์ นักศึกษาจะได้มีโอกาสรับฟัง พูดคุย และแลกเปลี่ยนความคิดเห็นกับนักทฤษฎีและนักปฏิบัติที่สำคัญในสาขา นักศึกษาต้องมีส่วนร่วมในกระบวนการเรียนรู้สูง

SCBE 418 Economic Botany 3 (2-3-5)
วททส ๔๑๘ พฤกษศาสตร์เศรษฐกิจ ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Examples of economic plants; Uses of plans in the past and today; Laboratory practice on identification, utilization and field trips

ตัวอย่างพืชเศรษฐกิจที่สำคัญ การนำมาใช้ประโยชน์ในอดีตและปัจจุบัน ปฏิบัติการจัดจำแนก การนำพืชไปใช้ประโยชน์ และการศึกษาในภาคสนาม

SCBE 419 Organismic Ecology to Eco-complexity 3 (2-3-5)
วททส ๔๑๙ นิเวศวิทยาระดับตัวตนสู่ความซับซ้อนทางนิเวศวิทยา ๓ (๒-๓-๕)
Prerequisite None
วิชาบังคับก่อน ไม่มี

Organismal ecology, population ecology, community ecology, ecosystem ecology and applied ecology; ecological survey and field study

นิเวศวิทยาระดับตัวตน ในมิติของ วิวัฒนาการ พฤติกรรม และ สรีรวิทยา นิเวศวิทยาระดับประชากร การปฏิสัมพันธ์ระหว่างประชากร นิเวศวิทยาชุมชน นิเวศวิทยาระบบนิเวศ และ นิเวศวิทยาประยุกต์ การสำรวจทางนิเวศวิทยาและการศึกษาในภาคสนาม

SCBE 420 Biogeography and Paleontology 3 (3-0-6)
วททส ๔๒๐ ชีวภูมิศาสตร์และบรรพชีววิทยา ๓ (๓-๐-๖)
Prerequisites None
วิชาบังคับก่อน ไม่มี

Causes and effects, processes of changes in geology and geography affecting biological phenomena from past to present and future including effects of human activities both directly and indirectly

ศึกษาความเป็นมา การเปลี่ยนแปลง สาเหตุและกระบวนการเปลี่ยนแปลงทางภูมิศาสตร์ ที่มีผลกระทบทางชีววิทยา ตั้งแต่อดีต ถึงปัจจุบัน รวมถึงเหตุปัจจัยที่มาจากมนุษย์ ทั้งทางตรงและทางอ้อม

Elective courses offered by State University of New York, College of Environmental Science and Forestry

APM 391 Introduction to Probability and Statistics (3)

Three hours of lecture per week. Introduction to concepts and methods of statistics as applied to problems in environmental science and forestry. Topics include inference (confidence intervals and hypothesis testing), sampling distributions, descriptive statistics, exploratory data analysis, comparison of population means and proportions, categorical data analysis, regression and correlation, and nonparametric methods. Fall or Spring.

BTC 401 Molecular Biology Techniques (4)

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisite(s): EFB 307, 308, 325, or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

BTC 420 Internship in Biotechnology (1 - 5)

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational and professional goals. The extent of the internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student and submitted to the sponsoring faculty member and on an evaluation of the student's performance written by the site supervisor to the sponsoring faculty member. Fall, Spring, Summer.

Prerequisite: Consent of a faculty sponsor.

BTC 499 Senior Project Synthesis (1)

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

CIE 442 Treatment Processes in Environmental Engineering (4)

Fundamental engineering concepts and principles used for the design and operation of water and wastewater treatment systems. Estimating water demand and wastewater flows in the urban water use cycle. Significance of government regulations and standards.

PREREQ: (CIE 327 OR MAE 341) AND CIE 341

EAR 401 Hydrogeology (3)

Fundamentals of groundwater hydraulics. Aquifer flow systems analysis and evaluation. Groundwater-surfacewater relationships. Groundwater chemistry. Additional work required of graduate students.

PREREQ: EAR 101 OR EAR 110 OR EAR 203 OR (EAR 104 AND EAR 105)

EAR 420 Contaminant Hydrogeology (3)

Fundamentals of solute transport, major classes of groundwater contamination, remediation strategies, natural attenuation characterization, fingerprinting of contaminant types. Additional work required of graduate students.

PREREQ: CHE 106 AND (PHY 211 OR EAR 401)

EFB 202 Ecological Monitoring and Biodiversity Assessment (3)

Forty-five hours of lecture, laboratory and field instruction per week for three weeks. An introduction to the biodiversity of northeastern North American terrestrial, wetland, and aquatic communities with a focus on vascular plants and invertebrate and vertebrate animals. Incorporates practical field exercises designed to acquaint the student with problem solving. Summer, Cranberry Lake Biological Station.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.

Prerequisite(s): One year of introductory biology.

EFB 211 Diversity of Life II (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on microbes, protistans and animals. Spring.

Prerequisite(s): EFB 101 and 102 or equivalent year of introductory Biology.

EFB 303 Introductory Environmental Microbiology (4)

Three hours of lecture and three hours of laboratory per week. An introduction to the biology of microorganisms and viruses and a study of their interactions with other microbes and macroorganisms. Fall.

EFB 307 Principles of Genetics (3)

Three hours of lecture and discussion per week. A general course covering concepts of genetics and evolution basic to upper-division biology and biochemistry courses. Includes the inheritance and analysis of Mendelian and quantitative traits, the chemical nature of the gene and its action, genetic engineering, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Fall.

EFB 308 Principles of Genetics Laboratory (1)

Three hours of auto-tutorial laboratory per week. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian traits and changes in populations caused by major 151 forces in evolution or by breeding procedures.

Numerical methods for characterizing quantitative traits and for testing hypotheses are introduced. Fall.

Co-requisite: EFB 307.

EFB 311 Principles of Evolution (3)

Three hours of lecture or discussion per week. An introduction to the fundamental processes driving evolution (genetic drift, gene flow, mutation, sexual selection, and natural selection), the evolution of life-histories, trade-offs, and phenotypic plasticity. Macroevolutionary concepts covered include speciation, extinction, co-evolution, and the reconstruction of phylogenies. Spring.

Prerequisites: EFB 307 and EFB 320, or equivalents.

EFB 320 General Ecology (4)

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

EFB 325 Cell Biology (3)

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring. Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

EFB 326 Diversity of Plants (3)

Two hours of lecture and one three-hour laboratory per week. An evolutionary survey of plants from unicellular prokaryotes to multicellular eukaryotes. Coverage includes the algae, fungi, bryophytes, lower vascular plants, ferns, gymnosperms and angiosperms. Spring.

EFB 327 Adirondack Flora (3)

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification of vascular plants and recognition of ecological characteristics of major plant species and communities of the Adirondack Mountain region. Satisfies elective field study requirement in Environmental and Forest Biology. Appropriate for upper and lower division undergraduate students seeking instruction in plant identification and ecology. Summer, Cranberry Lake Biological Station.

Prerequisite: General botany or general biology.

EFB 336 Dendrology (3)

Two hours of lecture per week and one three-hour laboratory/field trip. Field study, identification, natural history and elementary silvics of important forest trees of North America. Fall.

EFB 337 Field Ethnobotany (3)

Two hours of lecture per week and six to eight hours of field work and discussion each day for two weeks. A field-based introduction to the identification and traditional cultural uses of plants in the Adirondack region for food, medicine and fiber. Topics include plant identification, traditional ecological knowledge and use of ecological and ethnobotanical methods. Satisfies elective field course requirement in programs offered by Department of Environmental and Forest Biology. Cranberry Lake Biological Station. Summer. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

Prerequisite: EFB 226 General Botany or equivalent.

ERE 340 Engineering Hydrology and Hydraulics (4)

Three hours of lecture and lab per week. Covers watershed hydrology and analysis of rainfall, evapotranspiration, infiltration, and runoff processes as well as hydraulic processes involved with pipe networks, open-channels with flow controls, and groundwater systems. Spring.

Prerequisites: Fluid mechanics. Note: Credit will not be granted for both ERE 340 and ERE 540

EFB 342 Fungal Diversity and Ecology (3)

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course designed to provide an introduction to the collection,

identification and ecology of fungi and fungal-like organisms. Included in the course are Oomycetes (Kingdom Straminipila) and Myxomycetes (Kingdom Protista), as well as the more familiar groups of Kingdom Fungi. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General biology or general botany.

EFB 351 Forest Entomology (3)

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on insect pests of forested ecosystems. Designed for students in Environmental Biology, Forest Health and Forest Resources Management. Fall, even years.

Note: Credit will not be granted for both EFB 351 and EFB 551.

EFB 352 Entomology (3)

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern U.S. Designed for students in Environmental Biology and Forest Health. Fall, odd years.

Note: Credit will not be granted for both EFB 352 and EFB 552.

EFB 355 Invertebrate Zoology (4)

Three hours of lecture and three hours of laboratory per week. Structure, function, classification and evolution of invertebrates. Emphasis on functional biology and ecological interactions. Spring.

EFB 384 Field Herpetology (3)

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification, natural history, ecology, and conservation of amphibians and reptiles of the Adirondack region. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General biology or general zoology.

EFB 385 Comparative Vertebrate Anatomy (4)

Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns and phylogenetic relationships in vertebrates. Spring.

EFB 388 Ecology of Adirondack Fishes (3)

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course in the identification of fish and recognition of ecological characteristics of major fish species and communities of Adirondack waters. Satisfies a component of the field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General zoology or general biology.

EFB 420 Internship in Environmental and Forest Biology (1 - 5)

Full- or part-time engagement as volunteer or employee in professional experience having environmental biology focus. Tenure at outside institution under guidance of external supervisor, but with EFB-based faculty sponsor. Requires initial study plan outlining educational goals, plus record of activities and supervisor's assessment of student's performance upon completion. Grading satisfactory/ Unsatisfactory. Fall, Spring, Summer.

Prerequisite(s): Permission of Instructor.

EFB 427 Plant Anatomy and Development (3)

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant anatomy by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves hands-on activities using current techniques. Fall.

Prerequisite: one-year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

EFB 428 Mycorrhizal Ecology (3)

Two hours of combined lecture/discussion and 3 hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake, and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Fall, even years.
Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

EFB 435 Flowering Plants: Diversity, Evolution, and Systematics (3)

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globallydistributed families with particular focus on flora of the Northeastern U.S. Fall
Prerequisite(s): General Biology I and II or equivalent and at least junior standing.

EFB 440 Mycology (3)

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall.
Note: Credit will not be granted for both EFB 440 and EFB 640.

EFB 446 Ecology of Mosses (3)

Two hours of lecture and one three-hour laboratory or field trip per week. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring.
Note: Credit will not be granted for both EFB 446 and EFB 646.

EFB 453 Parasitology (3)

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Spring. Prerequisite(s): One year of Introductory Biology, Ecology.
Note: Credit will not be granted for both EFB 453 and EFB 653.

EFB 462 Animal Physiology: Environmental and Ecological (3)

Three hours of lecture, discussion and/or exercises per week. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size and physiological constraints on animal life history. Fall.

Note: Credit will not be granted for both EFB 462 and EFB 662.

EFB 482 Ornithology (4)

Three hours of lecture and discussion, three hours of laboratory/field trip per week and additional mandatory field trips. Students become familiar with all aspects of birds: taxonomy, structure, function, ecology, population dynamics, conservation and identification. Emphasizes identification of the birds of the eastern United States by sight, and the common species by sound. Exposure to birds worldwide. Fall.

Prerequisite: General biology and general ecology.

EFB 483 Mammal Diversity (4)

Three hours of classroom instruction and three hours of laboratory per week. Describes the evolutionary development, ecology and diversity of mammals world-wide and within New York State. Laboratory exercises and discussions complement lectures, providing hands-on experience in identification, adaptive morphology, and techniques in field mammalogy. Spring.

Prerequisites: Junior standing in EFB.

EFB 485 Herpetology (3)

Two hours of lecture and three hours of laboratory per week. An introduction to the structure, function, ecology, 156 behavior, development and distribution of amphibians and reptiles as they relate to the systematics of the various groups. Fall.

EFB 486 Ichthyology (3)

Two hours of lecture and three hours of laboratory per week. An introduction to the anatomy, physiology, ecology, behavior and taxonomy of fishes. Spring.

EFB 496 Topics in Environmental and Forest Biology (1 - 3)

Experimental, interdisciplinary or special coursework in biology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit. Fall, Spring, Maymester or Summer. For sections taught during Maymester or summer session, appropriate tuition and fees apply in addition to travel and lodging costs.

EFB 498 Research Problems in Environmental and Forest Biology (1 - 5)

Independent research by advanced undergraduate student in topic related to environmental biology, conducted at SUNY-ESF or outside institution. EFB-based faculty member serves as student's research sponsor; EFB-based faculty member or scientist at outside institution serves as research supervisor. Final written report to academic sponsor serves as basis for grade. Fall, Spring, Summer.

EFB 500 Forest Biology Field Trip (1 - 3)

A five- to 10-day trip to: 1) agencies engaged in biological research, management and administration; or 2) regions or areas of unusual biological interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Fall or Spring.

EFB 505 Microbial Ecology (2)

Two hours of lecture/discussion per week. An in-depth survey of contemporary topics in microbial ecology including carbon, nitrogen and sulfur cycling, microbial degradation of recalcitrant compounds, frost control, and utilization of wood-based feedstocks as carbon sources for bioconversion to bioenergy, biofuels, and biomaterials. Spring.
Prerequisite: EFB 303 or similar microbiology course is recommended.

EFB 530 Plant Physiology (3)

Three hours of lecture per week. Internal processes and conditions in higher plants with emphasis on physiological and biochemical concepts. For students majoring in the biological sciences. Spring.

Prerequisites: EFB 325, EFB 326. Note: EFB 531 also required for plant sciences concentration students.

EFB 554 Aquatic Entomology (3)

Two hours of lecture, three hours of laboratory/field work per week and a weekend field trip. An introduction to the identification, life histories and ecology of aquatic insects, with emphasis on genera found in the Northeastern United States. Includes a consideration of the functional role of insects in aquatic systems, and current avenues of research. Intended for seniors and graduate students pursuing interests in entomology, fisheries and wildlife, forestry, limnology and general ecology. Fall. Prerequisite: One course in entomology or permission of instructor.

EFB 570 Insect Physiology (3)

Two hours of lecture and three hours of laboratory per week. Study of the life processes in insects; introduction to modern physiological instrumentation and laboratory methods. Spring.

EHS 350 Environmental Health Management (3)

Three 50 minute lectures per week. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and environmental safety. Spring

Prerequisites: EHS 250 and EWP 190 or the equivalent. Note: credit will not be granted for both EHS 350 and EHS 550.

ENS 498 Research Problems in Environmental Science (1 - 5)

Independent research in topics in environmental science for undergraduate students. Selection of subject area determined by the student in conjunction with an appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Fall, Spring and/or Summer.

Prerequisite(s): Consent of instructor.

ERE 275 Ecological Engineering (3)

Two hours of lecture and one hour of group instruction per week. Theory and practice of ecological engineering with strong focus on sustainability and design, monitoring, and construction of ecosystems and the built environment. Key concepts, empirical models, and case studies, including applications of water/wastewater treatment, air resources and solid waste management. Spring
Prerequisites: one semester of calculus, biology, and chemistry. ERE students only or by permission of instructor.

ERE 339 Fluid Mechanics (4)

Three hours of lecture per week plus one lab session. An introduction to fluid mechanics within the context of civil and environmental engineering. This includes hydrostatics, Bernoulli's Equation, control volume analysis, drag, dynamic similitude, pipe flow, and open channel flow with some brief coverage of hydraulic machines and flow in porous media. Fall.
Prerequisites: APM206 and GNE172 or equivalents

EFB 340 Forest and Shade Tree Pathology (3)

Two hours of lecture per week and three hours of auto-tutorial laboratory. Major diseases of forest, shade and ornamental trees; and deterioration of forest products, with emphasis on disease identification, principles of disease 152 development, effects of disease on the host, and practical control measures. Spring.

ERE 405 Sustainable Engineering (3)

Three hours of lecture/discussion per week. Will explore and attempt to develop solutions to societal and environmental problems in a changing world that is facing climate change, premium fuel depletion, and regional water shortages. Evaluation of system sustainability using a multidisciplinary framework. Introduction to sustainability metrics, including emergy evaluation and life cycle assessment. Application of emergy evaluation. Spring.

ERE 440 Water and Wastewater Treatment (3)

Three hours of lecture per week. Two laboratory exercises and one field trip replace three regular class meeting times. Design principles and practice of unit operations and processes for water and wastewater treatment. Study of the engineering concepts and design procedures for water and wastewater treatment. Spring.

Prerequisite(s): ERE275 Ecological Engineering; ERE 339 Fluid Mechanics Note: Credit will not be granted for both ERE 440 and ERE 640.

EST 220 Urban Ecology (3)

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

FCH 360 Physical Chemistry I (3)

Three hours of lecture per week. An introduction to the properties of gases and liquids, the laws of thermodynamics, phases, phase transitions, solutions and colligative properties, electrochemistry, and reaction equilibria. Fall.

Prerequisite(s): MAT 295 and 296, and PHY 211 and 212, or their equivalents.

FCH 510 Environmental Chemistry I (3)

Three hours of lecture per week. Introduction to the processes that control chemical behavior in aquatic environments, including precipitation, dissolution, gas exchange, acid-base, oxidation-reduction, complexation and adsorption reactions. Emphasis will be on explanation and prediction of chemical behavior. Examples will be from the areas of fresh and marine waters, groundwater, wastewater, and geo-chemistry. Spring.

Prerequisites: An introductory course in physical chemistry is required.

FCH 530 Biochemistry I (3)

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids,

proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. This course requires critical review of current topics in Biochemistry not required in FCH 430. Fall

Prerequisite: FCH150, FCH151, FCH221, FCH223 or equivalents.

FOR 487 Environmental Law and Policy (3)

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Fall.

Prerequisite: Junior or Senior standing. Note: Credit will not be granted for both FOR 487 and FOR 687.

SRE 335 Renewable Energy (3)

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy generation and supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of technological, economic and environmental impacts. Spring

Prerequisites: PHY 211, EFB 200, SRE 225 or equivalent one semester of introductory physics. FCH 110 and FCH 111, or equivalent one semester of introductory chemistry with lab. SRE 325 or instructor permission. Note- Credits will not be granted for SRE 335 and 535 (both undergraduate and graduate versions of the same course)

SRE 479 Life Cycle Assessment (3)

Three hours of lecture per week. Life cycle assessment (LCA) is a tool used across fields to determine the cradle-to-grave environmental impacts of products and systems. The course will cover how to perform an LCA and how to evaluate LCA results. Students will conduct in groups a full life cycle assessment with a literature review, sensitivity analysis, and uncertainty analysis using available data and impact assessment methods. Spring.

Prerequisites:A college-level statistics course, junior or senior standing, or instructorpermission

Description of selected courses in Environmental Health (2+2) program

ESF 200 Information Literacy (1)

Three hours of lecture/discussion per week for five weeks. Introductory course for students of all levels and all curricula to the basic research process for information retrieval and management. Emphasis on electronic bibliographic and Internet research tools. Fall and Spring.

EHS 250 Foundations of Environmental Health (2)

One hour of lecture/discussion per week. Introduction to environmental health concepts. Course will introduce students to environmental risk, epidemiology, toxicology, policy, and regulation; agents of disease and human health risks including vector-borne pathogens, toxic metals, pesticides, and radiation. Course will also cover applications of environmental health with a focus on water and air quality, food safety, waste management and occupational health. Fall

Prerequisites: One year each of Biology with lab (EFB 101 and 102, EFB 103 and 104), General Chemistry with lab (FCH 150 and 151, FCH 152 and 153) and Calculus (APM 105 and 106).

EHS 360 Environmental Sampling Methods (3)

Two 50 minute lectures and one 3 hour lab per week. Overview of different methods used for sampling air and water quality, soils, environmental microbes, and non-chemical environmental stressors (i.e. radiation, temperature, stress, noise) with an emphasis on their impact on human health. Spring

Credit will not be granted for both EHS 360 and EHS 560. Pre-requisites: EHS 250, FCH 150, and 152 or equivalents. Co- or pre-requisite: APM 391.

EFB 400 Toxic Health Hazards (3)

Three hours of lecture per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Fall.

Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

ENS 132 Orientation Seminar: Environmental Science (1)

One hour of lecture or discussion each week. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options within the Environmental Science program. Fall.

FST 102 - Food Fights: Contemporary Food Issues

Public Health, Food Studies and Nutrition

3 credit(s) At least 1x fall or spring

Introduction to key issues of the contemporary food system. Explores various social, political, economic, and environmental dimensions of food production, distribution, and consumption with a focus on the United States.

(Syracuse University)

EFB 360 Epidemiology (3)

Three hours of lecture/discussion per week. Introduction to the study of disease in populations and factors influencing disease occurrence. Case studies explore population measures of disease, clinical measures and causation. Emphasizes quantitative approaches, study design, ethics, intervention and implementation. Spring.

Prerequisite(s): One year of Introductory Biology, one Statistics course or equivalent by permission.

EHS 320 Disease Prevention (3)

Two 50 minute lectures per week. History of infectious diseases, control measures, new and emerging diseases, prediction and monitoring of known and infectious diseases. Examination of the intersections of public and environmental health, disease control and prevention, and historical and emerging diseases, and tracking and prediction of outbreaks. Spring.

Prerequisites: EHS 250 and EFB 303. Note: Credit will not be granted for both EHS 520 and EHS 320

EHS 350 Environmental Health Management (3)

Three 50 minute lectures per week. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and environmental safety. Spring

Prerequisites: EHS 250 and EWP 190 or the equivalent. Note: credit will not be granted for both EHS 350 and EHS 550.

EHS 420 Professional Internship in Environmental Health (1 - 5)

40 hours of work with the sponsor per credit. Full or part time position as an employee or volunteer in a profession setting with an environmental health focus. Internship will be structured in collaboration between ESF faculty advisor and on-site supervisor. Requires a plan outlining learning goals and objectives, weekly record of activities, supervisors assessment and final report by student. Fall, Spring, Summer

EHS 480 Hazardous Waste Management (3)

Two 80 minute lectures per week. In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. Fall.

Credit will not be granted for both EHS 680 and EHS 480 Pre and co-requisite(s): Pre or co-requisite of EHS250 and prerequisite of one year of Organic Chemistry (FCH 221/222 and 223/224 or equivalent)

ENS 470 Environmental Risk Assessment (3)

Three hours of lecture per week. Identification of environmental hazards to human and other life forms; application of statistical tools and methods required for quantifying risk and their applicability and limitations; regulatory requirements governing risk assessment reporting; and

effective public communication of environmental risks. Fall.

Prerequisite: APM 106, APM 391, EFB 103, FCH 152

FCH 399 Introduction to Atmospheric Sciences (3)

Three hours of lecture and discussions per week. Atmospheric composition, mass and structure; solar radiation and the global energy budget; atmospheric moisture budget, cloud and precipitation; photolysis, gas-phase oxidation, aqueous chemistry, and gas-to-particle conversion; physical and chemical mechanisms driving environment phenomena such as acid rain, the greenhouse effect, the ozone hole, remote and urban air pollution, and haze. Prerequisite(s): General physics I, 1 year each of general chemistry and calculus. Co-requisite(s): General physics II.

EHS 440 Occupational Health and Safety (3)

Three 50 minute lectures per week. In-depth examination of workplace environmental health issues. Topics include safety issues, ergonomics, fire protection, hazardous materials, and terrorism preparedness. Overview of legislation of these issues, as well as managing in workplace. Spring

Credit will not be granted for both EHS 640 and EHS 440. Pre or co-requisite of EHS 250 and pre or co requisite of EHS 350 or equivalent.

ENS 494 Environmental Science Capstone (1)

1 hour of lecture/discussion per week. Support and instruction for completion and presentation of the senior synthesis project for Environmental Science. Topics include research skills and literature review, data analysis, scientific writing including editing, and oral presentation. Research or internship must be nearly or fully completed.

Description of selected courses in Biotechnology (2+2) program

BTC 132 Orientation Seminar (1)

One hour of lecture or discussion per week. Occasional tour of laboratories or field trips. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options to facilitate transition of students into the program and assist them in making informed decisions on course selection and future career directions. Fall.

BTC 401 Molecular Biology Techniques (4)

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisite(s): EFB 307, 308, 325, or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.

Prerequisite(s): One year of introductory biology.

EFB 320 General Ecology (4)

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

BTC 498 Research Problems in Biotechnology (1 - 9)

Laboratory research experience with research time agreed upon by student and instructor. Independent research experience covering biotechnological topics. Specific topics determined through consultation between student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Grading determined by the instructor and could include, but not required, evaluation of skills learned, data obtained, and laboratory notebook record keeping. A final written report is required. Fall or Spring.
Prerequisite: Permission of instructor.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.
Prerequisite(s): One year of introductory biology.

BTC 497 Research Design and Professional Development (1)

One hour of discussion or seminar each week covering the scientific method, professional ethics and responsibilities of the practicing scientist. Employment opportunities, future career choices, safety considerations, and use of the scientific literature are covered. Students will select a research topic and prepare a proposal, which may be applied to BTC 498 or BTC 420. Spring.
Pre- or co-requisite: Biotechnology major or permission of instructor.

EFB 325 Cell Biology (3)

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring.
Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

BTC 420 Internship in Biotechnology (1 - 5)

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional

group, business, or individual involved in activities consistent with the student's educational and professional goals. The extent of the internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student and submitted to the sponsoring faculty member and on an evaluation of the student's performance written by the site supervisor to the sponsoring faculty member. Fall, Spring, Summer.
Prerequisite: Consent of a faculty sponsor.

FCH 530 Biochemistry I (3)

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. This course requires critical review of current topics in Biochemistry not required in FCH 430. Fall
Prerequisite: FCH150, FCH151, FCH221, FCH223 or equivalents.

FCH 532 Biochemistry II (3)

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis. This course requires critical review of current topics in Biochemistry not required in FCH 432. Spring
Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH530 or equivalents.

BTC 499 Senior Project Synthesis (1)

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

Description of selected courses in Biotechnology (3+1) program

BTC 132 Orientation Seminar (1)

One hour of lecture or discussion per week. Occasional tour of laboratories or field trips. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options to facilitate transition of students into the program and assist them in making informed decisions on course selection and future career directions. Fall.

BTC 401 Molecular Biology Techniques (4)

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisite(s): EFB 307, 308, 325, or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.

Prerequisite(s): One year of introductory biology.

EFB 320 General Ecology (4)

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

FCH 530 Biochemistry I (3)

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. This course requires critical review of current topics in Biochemistry not required in FCH 430. Fall

Prerequisite: FCH150, FCH151, FCH221, FCH223 or equivalents.

BTC 498 Research Problems in Biotechnology (1 - 9)

Laboratory research experience with research time agreed upon by student and instructor. Independent research experience covering biotechnological topics. Specific topics determined through consultation between student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Grading determined by the instructor and could include, but not required, evaluation of skills learned, data obtained, and laboratory notebook record keeping. A final written report is required. Fall or Spring.

Prerequisite: Permission of instructor.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.

Prerequisite(s): One year of introductory biology.

BTC 497 Research Design and Professional Development (1)

One hour of discussion or seminar each week covering the scientific method, professional ethics and responsibilities of the practicing scientist. Employment opportunities, future career choices, safety considerations, and use of the scientific literature are covered. Students will select a research topic and prepare a proposal, which may be applied to BTC 498 or BTC 420. Spring.

Pre- or co-requisite: Biotechnology major or permission of instructor.

EFB 325 Cell Biology (3)

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring.

Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

FCH 532 Biochemistry II (3)

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis. This course requires critical review of current topics in Biochemistry not required in FCH 432. Spring

Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH530 or equivalents.

BTC 499 Senior Project Synthesis (1)

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

3.2 Name, Surname, Identification Number, Academic Position, and Educational Qualifications of the Instructors Responsible for the Program

3.2.1 Instructors Responsible for the Program

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
1	Mr. Prayad Pokethitiyook 3-7498-0000x-xxx	Assoc Prof	- Ph.D. (Chemical Engineering), University of Melbourne, Australia, 1999 - M.S. (Environmental Science and Engineering), Virginia Polytechnic Institute and State University, USA, 1989 - M.Sc. (Environmental Biology), Mahidol University, 1981 - B.Sc. (Biology), Mahidol University, 1978	Yongpisanphop J, Babel S, Kurisu F, Kruatrachue M, **Pokethitiyook P.** (2019). Isolation and characterization of Pb-resistant plant growth promoting endophytic bacteria and their role in Pb accumulation by fast-growing trees. *Environmental Technology* 9:1-28.
2	Mr. Patompong Johns Saengwilai 1-1014-0053x-xxx	Asst Prof	- Ph.D. (Plant Biology), Pennsylvania State University, USA, 2013 - B.Sc. (Biology), Mahidol University, 2007	Meeinkuirt, W., Phusantisampan, T., **Saengwilai, P.** (2018). Root system architecture influencing cadmium accumulation in rice (Oryza sativa L.). *International journal of phytoremediation*, 21, 19-26.
3	Mr. Puey Ounjai 3-1020-0197x-xxx	Asst Prof	- Ph.D. (Molecular Genetics and Genetic Engineering), Mahidol University, 2007 - B.Sc. Biotechnology King Mongkut Institute of Technology Ladkrabang, 2001	Samranwanich T, Boonthaworn K, Singhakaew S, **Ounjai P** (2019) Time-Restricted Inquiry-Based Learning Promotes Student Active Engagement in Undergraduate Zoology Laboratory. *Journal of Microbiology and Biology Education.* https://doi.org/10.1128/jmbe.v20i1.1571

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
4	Miss Prinpida Sonthiphand 3-1005-0155x-xxx	Lecturer	- Ph.D. (Biology), University of Waterloo, Canada, 2014 - M.Sc. (Environmental Management), Chulalongkorn University, 2009 - B.Sc. (Biochemistry), Chulalongkorn University, 2005	Tiralerdpanich P, **Sonthiphand P**, Luepromchai E, Pinyakong O, Pokethitiyook P. (2018) Potential microbial consortium involved in the biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Mar Pollut Bull*.;133:595-605. doi: 10.1016/j.marpolbul.2018.06.015.
5	Miss Alyssa Stewart 5-9080-0000x-xxx	Lecturer	- Ph.D. (Biology), University of Maryland at College Park, USA, 2015 - B.S. (Biology), University of North Carolina at Chapel Hill, USA, 2007	**Stewart AB,** Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. *Biotropica*, 50:98-105.
6	Mr. Pahol Kosiyachinda 3-1022-0061x-xxx	Lecturer	- Ph.D. (Plant Pathology) Cornell University, USA: 2002 - B.Sc. (Biology), Mahidol University, 1996	Pheungtheun, P., Senarat, S., Poonprasert, P., Kanchanareka, T., Kettratad, J., **Kosiyachinda, P**. (2018) Ovarian histology of *Trypauchen vagina* (Bloch & Schneider, 1801) during breeding season from Samut Songkhram Province. *KKU Sci. J*: 46(3) 462-468.

3.2.2 The Regular Instructors

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.1	Mr. Prayad Pokethitiyook 3-7498-0000x-xxx	Assoc Prof	- Ph.D. (Chemical Engineering), University of Melbourne, Australia, 1999 - M.S. (Environmental Science and Engineering), Virginia Polytechnic Institute and State University, USA, 1989 - M.Sc. (Environmental Biology), Mahidol University, 1981 - B.Sc. (Biology), Mahidol University, 1978	Yongpisanphop J, Babel S, Kurisu F, Kruatrachue M, **Pokethitiyook P.** (2019). Isolation and characterization of Pb-resistant plant growth promoting endophytic bacteria and their role in Pb accumulation by fast-growing trees. *Environmental Technology* 9:1-28.
3.2.2.2	Mr. Sompoad Srikosamatara 3-7098-0004x-xxx	Assoc Prof	- Ph.D (Zoology) University of Florida, USA: 1987 - วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2523 - วท.บ. (ชีววิทยา) มหาวิทยาลัยมหิดล: 2520	Prayong, N., & Srikosamatara, S. (2017). Cutting trees in a secondary forest to increase gaur Bos gaurus numbers in Khao Phaeng Ma Reforestation area, Nakhon Ratchasima Province, Thailand. Conservation Evidence, 14, 5-9.
3.2.2.3	Arunee Ahantarig 3-1012-0150x-xxx	Assoc Prof	- Ph.D. (Plant Science) Chiba University, Japan: 1995 -วท.ม. (เกษตรศาสตร์) มหาวิทยาลัยเกษตรศาสตร์: 2531 -วท.บ. (เกษตรศาสตร์) มหาวิทยาลัยเกษตรศาสตร์: 2527	Trinachartvanit, W., Maneewong, S., Kaenkan, W., Usananan, P., Baimai, V., & Ahantarig, A. (2018). Coxiella-like bacteria in fowl ticks from Thailand. Parasites & vectors, 11(1), 670.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.4	Miss Theeraporn Puntheeranurak 5-1012-0009x-xxx	Assoc Prof	-ปร.ด. (พันธุศาสตร์ระดับโมเลกุลและพันธุวิศวกรรม) มหาวิทยาลัยมหิดล: 2546 -วท.บ. (ชีววิทยา) มหาวิทยาลัยเกษตรศาสตร์: 2541	Udomrat, S., Kumkate, S., Puntheeranurak, T., & Osotchan, T. (2018). Poly-L-lysine modified ITO surface for enhanced cell growth. Materials Today: Proceedings, 5(5), 11083-11088.
3.2.2.5	Mr. Philip D. Round 1-0512-54110-xxxx	Assoc Prof	B.Sc (Zoology) University of Aberdeen, UK: 1974	Irving, G. J., Round, P. D., Savini, T., Lynam, A. J., & Gale, G. A. (2018). Collapse of a tropical forest bird assemblage surrounding a hydroelectric reservoir. Global Ecology and Conservation, 16, e00472.
3.2.2.6	Miss Supeecha Kumkate 3-6501-0057x-xxx	Asst Prof	- Ph.D. (Biology) University of York, UK, 2004 -วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2542 - วท.บ. (จุลชีววิทยา), จุฬาลงกรณ์มหาวิทยาลัย, 2538	Udomrat, S., Kumkate, S., Puntheeranurak, T., & Osotchan, T. (2018). Poly-L-lysine modified ITO surface for enhanced cell growth. Materials Today: Proceedings, 5(5), 11083-11088.
3.2.2.7	Miss Wachareeporn Trinachartvanit 3-7298-0010x-xxx	Asst Prof	-Ph.D. (Ecology Ethology and Evolution) University of Illinois at Urbana-Champaign, USA: 2004 -วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2538 -วท.บ. (ชีววิทยา) มหาวิทยาลัยมหิดล: 2535	Trinachartvanit, W., Maneewong, S., Kaenkan, W., Usananan, P., Baimai, V., & Ahantarig, A. (2018). Coxiella-like bacteria in fowl ticks from Thailand. Parasites & vectors, 11(1), 670.
3.2.2.8	Miss Jenjit Khudamrongsawat 3-2399-0004x-xxx	Asst Prof	-Ph.D. (Biology) University of Alabama, USA: 2007 -M.Sc. (Plant Science)	Techachoochert, S., Gale, G. A., Khudamrongsawat, J., & Round, P. D. (2018). Habitat Association and

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			University of California, USA: 2002 -B.Sc. (Biological Science) Rochester Institute of Technology: 2000	Conservation Status of the Endangered Giant Nuthatch (Sitta magna) in Thailand. Tropical Conservation Science, 11, 1940082918798332.
3.2.2.9	Mrs. Surang Chankhamhaengdecha 3-2103-0096x-xxx	Asst Prof	-ปร.ด. (เทคโนโลยีชีวภาพ) มหาวิทยาลัยมหิดล: 2547 -วท.ม. (เทคโนโลยีชีวภาพ) มหาวิทยาลัยมหิดล: 2542 -วท.บ. (จุลชีววิทยา) มหาวิทยาลัยบูรพา: 2540	Dowdell, P., Chankhamhaengdecha, S., Panbangred, W., Janvilisri, T., & Aroonnual, A. (2019). Probiotic Activity of Enterococcus faecium and Lactococcus lactis Isolated from Thai Fermented Sausages and Their Protective Effect Against Clostridium difficile. Probiotics and Antimicrobial Proteins, 1-8.
3.2.2.10	Mr. Metha Meetam 3-1022-0082x-xxx	Asst Prof	- Ph.D. (Horticulture) Purdue University, USA, 2006 - B.A.(Biology) Washington University, USA, 1999	Charoonnart, P., Worakajit, N., Zedler, J. A., Meetam, M., Robinson, C., & Saksmerprome, V. (2019). Generation of microalga Chlamydomonas reinhardtii expressing shrimp antiviral dsRNA without supplementation of antibiotics. Scientific reports, 9(1), 3164.
3.2.2.11	Mr. Puey Ounjai 3-1020-0197x-xxx	Asst Prof	- Ph.D. (Molecular Genetics and Genetic Engineering), Mahidol University, 2007 - B.Sc. Biotechnology King Mongkut Institute of Technology Ladkrabang, 2001	Samranwanich T, Boonthaworn K, Singhakaew S, **Ounjai P** (2019) Time-Restricted Inquiry-Based Learning Promotes Student Active Engagement in Undergraduate Zoology Laboratory. *Journal of Microbiology and Biology Education.* https://doi.org/10.1128/jmbe.v20i1.1571

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.12	Mr. Patompong Johns Saengwilai 1-1014-0053x-xxx	Asst Prof	- Ph.D. (Plant Biology), Pennsylvania State University, USA, 2013 - B.Sc. (Biology), Mahidol University, 2007	Meeinkuirt, W., Phusantisampan, T., **Saengwilai, P.** (2018). Root system architecture influencing cadmium accumulation in rice (Oryza sativa L.). *International journal of phytoremediation*, 21, 19-26.
3.2.2.13	Mr. Ekgachai Jeratthitikul 1-5499-0000x-xxx	Asst Prof	- D.Sc (Biological Science) Kyoto University, Japan, 2013 - M.Sc. (Biological Science) Kyoto University, Japan, 2009 - วท.บ. (สัตววิทยา), จุฬาลงกรณ์มหาวิทยาลัย, 2550	Jeratthitikul, E., Phuangphong, S., Sutcharit, C., Prasankok, P., Kongim, B., & Panha, S. (2019). Integrative taxonomy reveals phenotypic plasticity in the freshwater mussel Contradens contradens (Bivalvia: Unionidae) in Thailand, with a description of a new species. Systematics and Biodiversity, 1-14.
3.2.2.14	Miss Chalita Kongrit 3-1019-0038x-xxx	Lecturer	- ปร.ด. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2553 - วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2545	Khudamrongsawat, J., Nakchamnan, K., Laithong, P., & Kongrit, C. (2018). Abnormal Repetitive Behaviours of Confiscated Slow Loris (Nycticebus spp.) in Thailand. Folia Primatologica, 89(3-4), 216-223.
3.2.2.15	Mrs. Thitinun Sumranwanich 3-6204-0023x-xxx	Lecturer	- Ph.D. (Horticulture) Pennsylvania State University, USA, 2003 - - วท.บ. (ชีววิทยา), มหาวิทยาลัยเชียงใหม่, 2539	Kampeera, J., Pasakon, P., Karuwan, C., Arunrut, N., Sappat, A., Sirithammajak, S., Dechokiattawan, N., Sumranwanich, T., Chaivisuthangkura, P., Ounjai, P. and Chankhamhaengdecha, S. (2019). Point-of-Care Rapid Detection of Vibrio parahaemolyticus in Seafood using Loop-Mediated Isothermal Amplification and Graphene-based Screen-Printed Electrochemical Sensor. Biosensors and Bioelectronics.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.16	Mr. Nuttaphon Onparn 3-1002-0032x-xxx	Lecturer	- Ph.D. (Biological Sciences) University of Exeter, UK, 2004 - M.S. (Ecosystems Analysis and Governance) University of Warwick, UK, 1999 - วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2541	Manawatthana, S., Laosinchai, P., Onparn, N., Brockelman, W. Y., & Round, P. D. (2017). Phylogeography of bulbuls in the genus Iole (Aves: Pycnonotidae). Biological Journal of the Linnean Society, 120(4), 931-944.
3.2.2.17	Mr. Pahol Kosiyachinda 3-1022-0061x-xxx	Lecturer	- Ph.D. (Plant Pathology) Cornell University, USA: 2002 - B.Sc. (Biology), Mahidol University, 1996	Pheungtheun, P., Senarat, S., Poonprasert, P., Kanchanareka, T., Kettratad, J., **Kosiyachinda, P**. (2018) Ovarian histology of *Trypauchen vagina* (Bloch & Schneider, 1801) during breeding season from Samut Songkhram Province. *KKU Sci. J*: 46(3) 462-468.
3.2.2.18	Mr. Siravit Sitprija 3-1014-0318x-xxx	Lecturer	- Ph.D. (Animal Physiology) Chulalongkorn University, 2009 - M.Sc. (Industrial microbiology) Chulalongkorn University, 1999 - B.Sc. (Biology) Kasetsart University, 2538	Sitprija, V., & Sitprija, S. (2019). Marine toxins and nephrotoxicity: mechanism of injury. Toxicon.161:44-49.
3.2.2.19	Miss Prinpida Sonthiphand 3-1005-0155x-xxx	Lecturer	- Ph.D. (Biology), University of Waterloo, Canada, 2014 - M.Sc. (Environmental	Tiralerdpanich P, **Sonthiphand P**, Luepromchai E, Pinyakong O, Pokethitiyook P. (2018) Potential microbial consortium involved in the

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Management), Chulalongkorn University, 2009 - B.Sc. (Biochemistry), Chulalongkorn University, 2005	biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Mar Pollut Bull*.;133:595-605. doi: 10.1016/j.marpolbul.2018.06.015.
3.2.2.20	Mr. Phurt Harnvoravongchai 1-1014-0116x-xxx	Lecturer	- Ph.D. Eng. (Bioengineering) Tokyo Institute of Technology, Japan, 2015 - M. Eng (Bioengineering) Tokyo Institute of Technology, Japan, 2012	Harnvoravongchai, P., Chankhamhaengdecha, S., Ounjai, P., Singhakaew, S., Boonthaworn, K., & Janvilisri, T. (2018). Antimicrobial Effect of Asiatic Acid Against Clostridium difficile Is Associated With Disruption of Membrane Permeability. Frontiers in microbiology, 9.
3.2.2.21	Mr. Warut Siriwut 1-7199-0015x-xxx	Lecturer	- ปร.ด. (ชีววิทยา) จุฬาลงกรณ์มหาวิทยาลัย, 2556 - วท.บ. (ชีววิทยา) มหาวิทยาลัยขอนแก่น, 2540	Siriwut, W., Edgecombe, G. D., Sutcharit, C., Tongkerd, P., & Panha, S. (2018). Systematic revision and phylogenetic reassessment of the centipede genera Rhysida Wood, 1862 and Alluropus Silvestri, 1912 (Chilopoda: Scolopendromorpha) in Southeast Asia, with further discussion of the subfamily Otostigminae. Invertebrate Systematics, 32(5), 1005-1049.
3.2.2.22	Miss Parinda Thayanukul 1-1014-0010x-xxx	Lecturer	- Ph.D., (Environmental engineering), The University of Tokyo, Japan, 2012 - M. E. (Environmental engineering), The University of Tokyo, Japan, 2009	Nguyen, T. K. X., Thayanukul, P., Pinyakong, O., & Suttinun, O. (2017). Tiamulin removal by wood-rot fungi isolated from swine farms and role of ligninolytic enzymes. International biodeterioration & biodegradation, 116, 147-154.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			- วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2548	
3.2.2.23	Ms. Puangpaka Umpunjun 3-1005-0300x-xxx	Assoc Prof	- Ph. D. (Sciences des agroressources) INPT France, 1995 - D.E.A. (Traitment des matires premires vgtales) INPT France, 1991 - M.Sc. (Botany) Chulalongkorn University - B.Sc (Botany), 1990 Chulalongkorn University	Jeangkhwoa, P., Bandhaya, A., Umpunjun, P., Chuenboonngarm, N., & Panvisavas, N. (2017). Identification of Cannabis sativa L. using the 1-kbTHCA synthase-fluorescence in situ hybridization probe. Science & Justice, 57(2), 101-106.
3.2.2.24	Ms. Unchera Viboonjun 3-1002-0029x-xxx	Asst Prof	- Ph.D. (Biotechnology), Mahidol University, Bangkok, Thailand, 2002 - M.S. (Biotechnology), Mahidol University, Bangkok, Thailand - B.S. (Biotechnology), Mahidol University, Bangkok, Thailand	Kongsawadworakul, P., Viboonjun, U., & Narangajavana, J. (2018). Potential functional EST-derived SSR markers for latex and wood yield traits in rubber tree (Hevea brasiliensis (Willd. ex A. Juss.) Müll. Arg.). Thai Journal of Botany, 10(1):63-76.
3.2.2.25	Mr. Kanchit Thammasiri 3-1020-0263x-xxx	Assoc Prof	- Ph.D. (Horticulture), University of Hawaii, Honolulu, Hawaii, U.S.A., 1984 - M.S., (Horticulture), University of Hawaii, Honolulu, Hawaii, U.S.A., 1982 - M.S., (Agriculture), Kasetsart University, Bangkok, Thailand, 1981 - B.S., (Agriculture),	Pornchuti, W., K. Thammasiri, N. Chuenboonngarm and N. Panvisavas. 2017. Alteration of *Spathoglottis eburnean* Gagnep. Ploidy level after colchicine treatments. Walailak Journal of Science & Technology. 14(3): 243-252.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Kasetsart University, Bangkok, Thailand, 1977	
3.2.2.26	Ms. Paweena Traiperm 3-1405-0013x-xxx	Assoc Prof	- Ph.D. (Biological Science), Chulalongkorn University, Bangkok, Thailand, 2551 - M.Sc. (Botany), Chulalongkorn University, Bangkok, Thailand - B.Sc. (Biology), Khon Kaen University, Khon Kaen, Thailand	Ketjarun, K., Traiperm, P., Suddee, S., Watthana, S., & Gale, S. W. (2019). Labellar anatomy of the Nervilia plicata complex (Orchidaceae: Epidendroideae) in tropical Asia. Kew Bulletin, 74(1), 1.
3.2.2.27	Ms. Aussanee Pichakum 3-1306-0015x-xxx	Asst Prof	- Ph.D. (Plant Science), Chiba University, Japan, 1995 - M.S. (Agriculture), Kasetsart University , Thailand - B.Sc. (Agriculture), Kasetsart University , Thailand	Romyanon, K., Watana, K., Pichakum, A., Mosaleeyanon, K., & Kirdmanee, C. (2017). Adjustment of medium composition and iso-osmotic potential in direct-shoot organogenesis produces true-to-type oil palm (Elaeis guineensis Jacq.) plantlets. Horticulture, Environment, and Biotechnology, 58(6), 601-612.
3.2.2.28	Ms. Thaya Jenjittikul 3-1007-0062x-xxx	Asst Prof	- Ph.D. (Horticulture), Kasetsart University, Bangkok, Thailand, 2003 - M.Sc. (Horticulture), Kasetsart University, Bangkok, Thailand - B.Sc. (Agriculture), Kasetsart University, Bangkok, Thailand	Nopporncharoenkul, N., & Jenjittikul, T. (2018). Kaempferia graminifolia (subgen. Protanthium: Zingiberaceae), a new endemic species from Thailand. Phytotaxa, 379(3), 261-266.
3.2.2.29	Ms. Ngarmnij Chuenboonngarm 3-1008-0022x-xxx	Asst Prof	- Ph.D. (Bioscience), Kasetsart University, Bangkok, Thailand, 2007	Chuengpanya, R., Chuenboonngarm, N., Thammasiri, K., Jenjittikul, T., Soonthornchainaksaeng, P. and

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			- M.Sc. (Environmental Biology), Mahidol University, Bangkok, Thailand - B.Sc. (Chemical Biology), Silpakorn University, Nakornpathom, Thailand	Muangkroot, A. (2017). Investigation of colchicine incubation time on the regeneration rate of *Globba williamsiana* 'Dok Khao'. Acta Horticulturae 1167: 149-156.
3.2.2.30	Ms. Sasivimon Swangpol 3-1005-0033x-xxx	Asst Prof	- Ph.D. (Biological Sciences), Chulalongkorn University, Bangkok, Thailand, 2007 - M.S. (Horticulture), University of Florida, Gainesville, U.S.A., 1991 - B.S. Honor (Botany), Chulalongkorn University, Bangkok, Thailand, 1988	Sumanon, P., Swangpol, S. C., & Traiperm, P. (2018). Culm internodal Anatomy of the Tribe Oryzeae (Poaceae) in Thailand. CHIANG MAI JOURNAL OF SCIENCE, 45(2), 832-845.
3.2.2.31	Ms. Panida Kongsawadworakul 3-1022-0204x-xxx	Asst Prof	- Ph.D. (Plant Cell and Molecular Biology), Universite Montpellier II, France - M.Sc. (Plant Biotechnology), Mahidol University, Thailand - B.Sc. (Biotechnology), Mahidol University, Thailand	BONGCHEEWIN, B., DARBYSHIRE, I., SATITPATIPAN, V., & KONGSAWADWORAKUL, P. (2019). Taxonomic revision of Clinacanthus (Acanthaceae) in Thailand. Phytotaxa, 391(4), 253-263.
3.2.2.32	Ms. Wisuwat Songnuan 3-9001-0003x-xxx	Asst Prof	- Ph. D. (Medical Sciences Biological and Biomedical Sciences (BBS) program), Harvard Medical School and Graduate School of Arts and Sciences	Songnuan, W., Bunnag, C., Soontrapa, K., Pacharn, P., Wangthan, U., Siriwattanakul, U., & Malainual, N. (2018). Airborne fungal spore distribution in Bangkok, Thailand: correlation with meteorological

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Cambridge, Massachusettes, USA, 2009 - B.Sc. in Biology Trinity College of Arts and Sciences, Duke University Durham, North Carolina, USA	variables and sensitization in allergic rhinitis patients. Aerobiologia, 34(4), 513-524.
3.2.2.33	Ms. Alyssa Stewart 5-9080-0000x-xxx	Lecturer	- Ph.D. (Biology), University of Maryland at College Park, USA, 2015 - B.S. (Biology), University of North Carolina at Chapel Hill, USA, 2007	**Stewart AB,** Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. *Biotropica*, 50:98-105.
3.2.2.34	Mr. Saroj Ruchisansakun 1-1014-0112x-xxx	Lecturer	- Ph.D. (Biology: Understanding Evolution), Leiden University, The Netherlands - M.Sc. (Plant Sciences), Mahidol University, Thailand - B.S. (Plant Sciences), Mahidol University, Thailand	Ruchisansakun, S., Suksathan, P., Van der Niet, T., Smets, E. F., & Janssens, S. B. (2018). Balsaminaceae of Myanmar. Blumea-Biodiversity, Evolution and Biogeography of Plants, 63(3), 199-267.

3.2.3 Special Instructors

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.4.1	Mr. Thomas Neal Stewart	Lecturer	- Ph.D. (Biochemistry) University of North Carolina, U.S.A, 1986 - B.Sc. (Chemistry) University of Florida, U.S.A, 1982	Boehm, R. D., Jaipan, P., Yang, K. H., Stewart, T. N., & Narayan, R. J. (2016). Microstereolithography-fabricated microneedles for fluid sampling of histamine-contaminated tuna. International Journal of Bioprinting, 2(1).

4. Components Related to Field Training Experience (Trainings or Multi-Activity Education) (If any)

4.1 Standard of Learning Outcome for Field Training Experience

1) Apply knowledge and technical skills in Bioresources and Environmental Biology
2) Integrate discipline-specific knowledge and technical skills across different discipline
3) Demonstrate proficiency in oral and written communication of Bioresources and Environmental Biology
4) Demonstrate accountability and responsibility
5) Apply concept of laboratory safety and laboratory or field study skills.
6) Able to set, plan and accomplish assigned project in a timely manner

4.2 Duration

The Internship may involves laboratory or field works and will take at least 126 hours.

4.3 Schedule and Timetable

Internships are offered in the summer of each academic year upon requesting by students. Places for the internship will be environmental consulting firms, government labs or sections that the BE program committee approve.

Total time: not less than 126 hours during the summer.

4.4 Number of Credits

3 (0-9-6)

4.5 Preparation

1. Eligibility for internship: students must complete at least 90 credits before registering for Internship courses. Internship placement will be subjected to the internship policy of the Bioresources and Environmental Biology Program.

2. The program committee will assist student in figuring out his or her goals, location for placement, signing placement contracts and possibly finding a grant.

4.6 Evaluation Procedure

The assessment is based on 3 factors; advisor evaluation (50%), student evaluation report from the employer (25%) and student internship experience final report (25%).

5. Requirements for Project or Research Work (If any)

5.1 Brief Description

The independent research project in Bioresources and Environmental Biology (SCBE 499) is offered to students in the 2nd semester of the 3rd year of their study. Students must complete at least 90 credits before registering for this course. In SCBE499, students are introduced to research project in biological- and environmental- research or related fields through engagement in a research project of limited scope under the close guidance of an advisor. Students are expected to independently carry out the learning process, employing their knowledge and technical skills, and implement the scientific process to address the research question of interest. Not only critical thinking and problem-solving skills should be demonstrated, but the students should also value scientific integrity and professionalism. Mastery of tools, scientific inquiry, and intellectual curiosity is expected.

5.2 Standard of Learning Outcome

1) Apply knowledge and technical skills of diverse biological disciplines to address health, societal and environmental issues
2) Critically appraise information from scientific articles/journals, biological research methodology and experimentation to draw meaning conclusion from the materials

3) Proficient in oral and written communication of biological science concepts formally and informally to both scientific community and general audience
4) Apply scientific integrity, professionalism, and competencies to function independently as well as a team player
5) Apply moral and ethical values when dealing with issues relating to humans, animals and the environment, enabling actions based on moral and ethical judgment
6) Demonstrate innovative mindset to formulate and create solutions for situations relevant to oneself, the well-being of others, and the natural environment

5.3 Duration

A semester

5.4 Number of Credits

3(0-9-3)

5.5 Preparation

Students can start their practical any time during the course of study. The period of conducting experiment can take as long as they need to complete the research project. Once registering for SCBE 499, they will receive information regarding the protocol to carry out this course, grading and evaluation scheme. The research report should be submitted within that semester.

5.6 Evaluation Procedures

Students are expected to give oral presentation at the end of their project and hand in a research report. The assessments are oral presentation (10%), written submission (60%), mastery of tool utilization (10%), and attitude/professional-ism/conduct (20%).

Section 4 Program-level Learning Outcomes, Teaching Methods, and Evaluation

1. Development of Student Characteristics

Characteristics	Teaching Strategies and Student Activities
Innovativeness	- Courses provide necessary knowledge and practices to allow students to practice skills, such as implementing scientific processes to draw conclusion(s) from quantitative and qualitative data, critical reading of scientific literature, formulating lines of enquiry that drive problem solving. - Activities include lectures, presentations, discussions, laboratory practice, field work and projects. - Reflection of the learning experience and discussion with instructor
Ethicality	- Courses provide a platform for strengthening students' moral and appropriate behavior, as well as to practice their systematic, logical and global thinking. - Activities include lectures, presentations and case discussions.
Professionality	- Courses are designed for students to practice their professional skills, such as making relevant scientific observations and asking pertinent scientific questions, independently acquiring information, time management, and collaborating with members of the team. - Activities include lectures,

Characteristics	Teaching Strategies and Student Activities
	presentations, discussions, laboratory practice, field work and projects.
Communicativeness	- Courses provide a platform for students to communicate among themselves and to publics to inform or raise awareness on issues related to bioresources and environments. - Activities include presentations, discussions, in-class workshop, field work and projects.

2. Relation between PLOs and the professional standard or National Qualifications Framework for Higher Education / TQF (Shown in Appendix 3)

3. Program-level Learning Outcomes, Teaching Methods, and Evaluation

Program-level Learning Outcomes	Teaching strategies	Evaluation strategies
PLO1 Solve biological- and environmental-related problem logically and systematically at local, regional and global levels by applying interdisciplinary approaches.	1) Interactive lecture 2) Case studies 3) Group and individual discussions and feedback	1) Evaluate behavior in classrooms and laboratories 2) Evaluate by using multiple-choice and written examinations 3) Evaluate class participation and group discussion by rubrics
PLO2 Carry out laboratory-based and field-based experiments to address biological and environmental impacts on sustainability with international	1) Lectures 2) Demonstration 3) Group discussion 4) Individual and group presentations	1) Evaluate behavior in classrooms 2) Self-evaluation by formative assessment 3) Evaluate class

Program-level Learning Outcomes	Teaching strategies	Evaluation strategies
standard methodologies.	5) Case studies and problem-based learning	participation and group discussion by rubrics 4) Report evaluation and plagiarism assessment
PLO3 Create an independent project in bioresources and environmental biology, analyzed from scientific journals and laboratory reports along with laboratory safety skills and professional code of conduct.	1) Lectures 2) Group discussion 3) Demonstration of practical skills 4) Laboratories and written report assignments 5) Individual and group presentations 6) Research projects 7) Case studies and problem-based learning	1) Evaluate by using multiple-choice and written examinations 2) Evaluate class participation and group discussion by rubrics 3) Evaluate the quality of research projects, including rationale, coherence, data analysis, and conclusion 4) Evaluate regular progress meeting and evaluation by senior project advisors using rubrics
PLO4 Communicate concepts of bioresources and environmental biology clearly and purposefully with target audiences in English, in both written and oral forms with appropriate technologies in an organized manner.	1) Laboratory meetings and seminars 2) Laboratories and written report assignments 3) Group assignments	1) Evaluate behavior in classrooms 2) Evaluate class participation and group discussion by rubrics 3) Evaluate the quality of reports and group assignments by rubrics
PLO5 Work independently and coordinate with others to achieve team goals based on roles and responsibilities of an	1) Group discussion 2) Laboratories and report assignments 3) Individual and group	1) Evaluate behavior in classrooms and laboratories 2) Evaluate class

Program-level Learning Outcomes	Teaching strategies	Evaluation strategies
environmental biologist.	presentations 4) Research projects 5) Case studies and problem-based learning	participation and group discussion by rubrics 3) Evaluate the quality of reports and group presentations by rubrics

Section 5 Student Evaluation Criteria

1. Grading Rules/Guidelines

Students receive grades according to the criteria stated in Mahidol University's regulations on undergraduate studies as well as SC's regulations and/or announcements.

(1) The symbols and their assigned scores

Grade results of each course may be shown in symbolic type as follows

Symbol	Meaning	Score
A	Excellent	4.00
B+	Very Good	3.50
B	Good	3.00
C+	Fairly Good	2.50
C	Fair	2.00
D+	Poor	1.50
D	Very Poor	1.00
F	Failed	0.00

(2) The symbols without scores

The outcome of the study for each course may be in the forms of certain symbols with the meaning as follows

Symbol	Meaning
AU	Audit
O	Outstanding
S	Satisfactory
T	Transfer of Credit
U	Unsatisfactory
I	Incomplete
P	In Progress
X	No Report
W	Withdrawal

2. Standard Verification Process for Student Achievement

Student achievement is assessed through their ability to achieve the course learning outcomes stated in TQF3.

2.1 Both formative and summative assessments are used to monitor student achievement. Analyze students' learning from class participation, group activities, presentations, quizzes and examinations. Rubrics and marking schemes are used to ensure validity, reliability and fairness of student assessment.

2.2 Consider student evaluation of teachers

2.3 Consider course reports

3. Graduation Requirements

Plan A

3.1 Following Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009) and the Announcement of Faculty of Science, Mahidol University on Undergraduate Study, B.E. 2553 (2010)

3.2 Total time of study should not exceed 8 academic years

3.3 Students have to complete their credits as stated in the curriculum which includes:

- General education courses
- Specific courses
- Free elective courses

3.4 Students must have a minimum 2.00 CUM-GPA

3.5 Students must pass the criteria set for the English competency prior to their graduation as specified by the Mahidol University's announcement.

- TOEFL: internet-based $\geq$ 80, computer-based $\geq$ 210
- IELTS $\geq$ 6.5
- Equivalent score from other English competency tests which are certified by Mahidol University.

3.6 Student must demonstrate proper conduct in compliance with the Bachelor of Science degree.

Plan B

3.1 Following Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009) and the Announcement of Faculty of Science, Mahidol University on Undergraduate Study, B.E. 2553 (2010)

3.2 Student must have a minimum 2.00 CUM-GPA.

3.3 Student must demonstrate proper conduct in compliance with the Bachelor of Science degree.

3.4 Student must pass the criteria for the English competency, i.e. TOEFL or IELTS, declared in the student transfer agreement between the Faculty of Science, Mahidol University and the State University of New York, College of Environmental Science and Forestry (SUNY-ESF).

3.5 Student must pass all the required courses within Year 1 and Year 2 according to the program curriculum and completed all the required courses in Year 3 and Year 4 following the agreement between the Faculty of Science, Mahidol University and the State University of New York, College of Environmental Science and Forestry (SUNY-ESF).

3.6 If a student cannot continue or complete his/her study at SUNY-ESF, credits and courses can be transferred in accordance with Mahidol University and MUSC regulations.

4. Students' Appeals

According to Mahidol University Regulations on Disciplinary Measures 2010, the student, who is subject to disciplinary punishment, has the right to appeal to the procedures outlined here. In the case that student wishes to check on the scores, student can contact the instructor directly or submit formal complaint or academic appeal directly to

International Education And Administration Unit, Division of Salaya Campus
Room SC1-116, SC1-Building, Faculty of Science (Salaya Campus), Mahidol University
999 Phuttamonthon 4 Road, A. Phuttamonthon, Nakhon Pathom 73170, Thailand
E-mail: scsim@mahidol.ac.th; Phone: + 66 2 4419820 ext. 1199.

If it is considered that a case exists, the matter will be investigated in accordance with the procedures, and the complainant informed of the outcome.

Section 6 Instructor's Professional Development

1. New Instructor Orientation

1) New instructors have to attend an orientation that aims to provide objectives and goals of program complying with National Qualifications Framework for Higher Education in Thailand and the Standard of Undergraduate Programs of Study B.E. 2558 announced by the Ministry of Education.
2) New instructors will be made aware of teaching and learning strategies, quality assurance, related regulation or announcement, and the department of biology's activities.

2. Knowledge and Skill Development for Instructor

2.1 Development of Teaching Skills, Assessment, and Evaluation

1) Provide workshops to develop skills on teaching and learning as well as assessment methods.
2) Allow the instructors to engage in scholarship in teaching and learning research.
3) Allow instructors to participate in the evaluation and revision of the curriculum and courses as well as develop a new curriculum.

2.2 Other Academic and Professional Development

1) Support instructors to carry out research, produce and present academic projects and continue their studies.
2) Encourage and support instructors to participate in meetings, conferences, training sessions, seminars and studies at other institutes and organizations.
3) Encourage networking among professionals within biological science and other disciplines.

2.3 Indicators / Measurements

(1) Every new instructor (if any) has to participate in the orientation and receive adequate information on teaching and learning requirements.
(2) Full-time instructors must demonstrate academic and/or profession improvement at least once a year.

Section 7 Quality Assurance

1. Standard Control

The curriculum has employed the Thai Qualification Framework for Higher Education and the Standard of Undergraduate Programs of Study B.E. 2558. The details of the curriculum are provided in TQF2 documents (Key performance criteria no. 2). It is revised every 5 academic years, by which the Bioresources and Environmental Biology Program has set up a curriculum committee to develop and improve the curriculum based on stakeholders' requirement. Stakeholders are identified as academic faculty, current students, alumni, parents and employers. The curriculum committee meets on a regular basis to review stakeholder's inputs and evaluate courses (Key performance criteria no. 1). An external committee also participates in the curriculum development, consisting of three Biological Science experts from other universities or institutes and at least one employer or a representative of graduate schools. Once the curriculum (TQF2) has been approved, the curriculum structure is translated into course structures that have aligned objectives and learning outcomes. The details of the course structure have been documented in TQF3 and TQF4 (Key performance criteria no. 3). The quality of the curriculum and courses is monitored throughout the period of implementation by the student and instructor self-evaluation through TQF7, TQF5 and 6 documents (Key performance criteria no. 4 and 5). Minor changes can be made in TQF3 to improve the teaching and learning. The curriculum design procedure is illustrated in Figure 1. Indicators/measurements used in the evaluation of this process's efficiency and effectiveness are in accordance with the TQF indicator guidelines

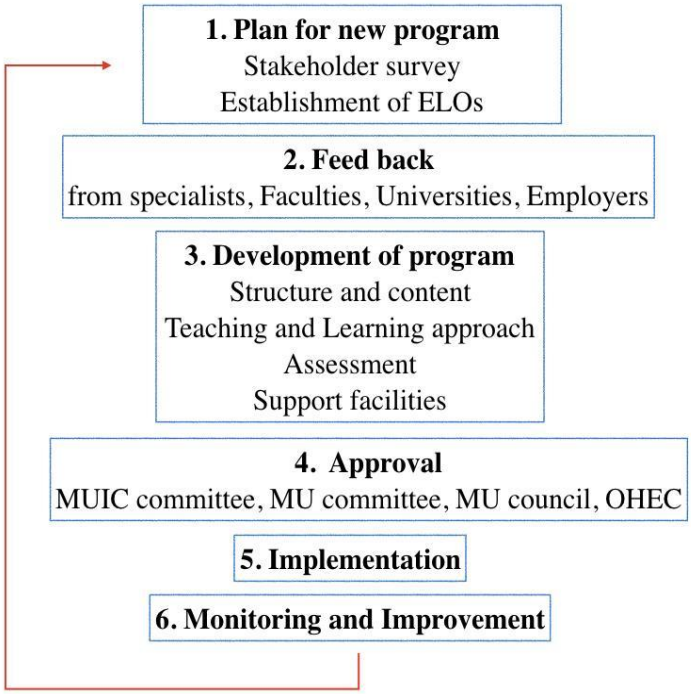

Figure 1: Structure of curriculum management.

2. Graduates

Graduates achieve the learning areas including ethics and moral, knowledge, cognitive skills, interpersonal skills and responsibility, and numerical analysis, communication, and information technology skills. These characteristics will allow graduates to be able to work or pursue further study in any biological science disciplines. The foundation of these comes from the knowledge and skills that individual courses set for students to achieve. Therefore, the quality of graduates is tightly related to our teaching and learning strategy. The survey is conducted to obtain feedback from employers on their satisfaction of the graduates. All the survey results are used to improve the quality of our teaching and learning.

Indicators/measurements used in the evaluation of this process's efficiency and effectiveness.

(1) At least 70 percent of new graduates either go on to employment or further study.

(2) The average graduate users' satisfaction score is at least 3.5 from 5.0.

3. Students

3.1 Student recruitment and admission

Recruitment involves activities such as roadshows, open houses, campus visits, and public communication. In a roadshow, the Public Relations Unit along with faculty members may attend educational conferences and exhibitions, deliver classroom presentation, or meet with school counselors and teachers. The PR Unit will visit Thai schools, schools with English Program, international schools, and even schools abroad (e.g., China, India, and ASEAN). In an Open House activity, schools, students and parents visit Mahidol University, Salaya campus and our laboratories and facilities. This annual activity is organized in line with Mahidol University Open House policy. To increase promotion for recruitment purpose, social media channels, website, and news articles encourage more communication with the public and students.

Student admission criteria will be according to the policy set forth by the MU Admissions Committee and will be according to Thai university Central Admission System (TCAS).

3.2 Academic consultation and guidance

Each student is assigned an academic advisor upon entering the program**.** The advisor's role is to oversee students' academic performance, approve their registration, and guide both the academic and non-academic matter. Academics advisors, together with, the Office of Academic Affairs oversees the overall academic performance and addresses issues that may arise and give advices accordingly. Students may make an appointment to meet with advisors directly and regularly.

3**.**3 Students' satisfaction and management of students' appeal

Students have a right to review their exam papers and grades. Moreover, if students are charged and/or punished for cheating, they can appeal within seven days after the time that they received such a notice. The procedure for filing a complaint is according to Mahidol University Regulations on Disciplinary Measures 2010.

Indicators/measurements used in the evaluation of this process's efficiency and effectiveness.

(1) At least 70 percent of students remain in the program.

(2) The average students' satisfaction score towards the courses' quality is at least 3.5 from 5.0.

(3) At least 80 percent of final-year students graduate.

4. Instructors

4.1 Recruitment of new faculty members

General requirements are made according to Mahidol University and Faculty of Science regulations. New faculty members have to pass a trial period of teaching before being accepted as full-time instructors. New instructors are required to participate in an orientation which is organized by the Faculty of Science.

4.2 Instructor's main responsibility

Program committee and instructors are committed to meet at least once per semester to plan and improve teaching and learning methods according to student and self-evaluations. Faculty members are also encouraged to produce one academic product every three academic years as well as participate in conferences or training that may be beneficial to their profession.

Indicators/measurements used in the evaluation of this process's efficiency and effectiveness.

(1) Each instructor must produce TQF3 and TQF5 for all assigned courses.

(2) Every new instructor (if any) has participated in the orientation or received advice on teaching and learning.

(3) Full-time instructors are encouraged to participate in conferences or training workshop that will help them to develop academically/professionally in their related field at least once a year.

5. Curriculum, Teaching and Learning, Student Evaluation

The program description stated in TQF2 form complies with the Thai Qualifications Framework for Higher Education. Descriptions of all courses and field work sessions are stated in the TQF3 and TQF4 forms at least before the semesters begin. Students' achievement verification is made as stated in the TQF3 and TQF4 at least 20 percent of the subjects in each semester. The teaching and learning approaches for this curriculum follow an outcome-based education (OBE) strategy, based on the AUN-QA criteria. Teaching strategy and students evaluation are developed/improved based on the information in the previous year's TQF7 reported within 60 days after the academic year ends.

Indicators/measurements used in the evaluation of this process's efficiency and effectiveness.

(1) Use the TQF indicator guidelines

6. Learning Supports

6.1 Budgeting

Mahidol University and Faculty of Science provides an annual budget for providing a suitable physical environment for studying and purchasing an adequate number of materials in order to support studying both inside and outside the classrooms.

6.2 Available resources

Students have access to papers, books, journals, teaching media, internet databases from the Mahidol University Library, Salaya Campus and the Faculty of Science Library (Stang Mongkolsuk Library). The Faculty of Science Library, also known as the Stang Mongkolsuk Library, houses a large collection of books and information on science and medical science. It also provides services in inter-library loan and retrieval of articles and databases on science and technology. The Mahidol University Library, Salaya Campus, houses and collects books and information on science, medical sciences and technology to support teaching, learning, and research of university members, government officials, scientists, researchers and students of the university. The library services include books, journals, research reports, electronic journals, web databases,

and also educational technology resources in the form of videotapes, recorded cassette tapes, slides and microfilms. Information technology (IT) facilities, including e-learning, are also available.

6.3 Studying the sufficiency of the resources

A survey of instructor and student satisfaction towards services and resources is carried out every semester. This survey is used to improve the number and quality of resources. If the resources are not adequate, the faculty committee will take into consideration and set action plan.

Indicators/measurements used in the evaluation of this process's efficiency and effectiveness.

(1) The average staffs and students' satisfaction score towards the learning supports is at least 3.5 from 5.0

7. Key Performance Indicators

Key Performance Indicators	Academic Years				
	2019	2020	2021	2022	2023
(1) At least 80 percent of the program instructors in-charge take part in meetings to plan, monitor, and revise the program's operation.	✓	✓	✓	✓	✓
(2) The program description stated in TQF2 form complies with TQFHE or the program TQF (if any).	✓	✓	✓	✓	✓
(3) Descriptions of all courses and field work sessions (if any) are stated in the TQF3 and TQF4 forms at least before the semesters begin.	✓	✓	✓	✓	✓
(4) The assessment of all courses and fieldwork sessions (if any) are reported in the TQF5 and TQF6 forms within 30 days after the semester ends.	✓	✓	✓	✓	✓
(5) The program report is made in the TQF7 form within 60 days after the academic year ends.	✓	✓	✓	✓	✓

Key Performance Indicators	Academic Years				
	2019	2020	2021	2022	2023
(6) Students' achievement verification is made as stated in the TQF3 and TQF4 (if any) in at least 25 percent of the subjects in each semester.	✓	✓	✓	✓	✓
(7) Teaching strategy and students evaluation are developed/improved based on the information in the previous year's TQF7.		✓	✓	✓	✓
(8) Every new instructor (if any) has to participate in the orientation and receive adequate information on teaching and learning requirements.	✓	✓	✓	✓	✓
(9) Full-time instructors must demonstrate academic and/or profession improvement at least once a year.	✓	✓	✓	✓	✓
(10) At least 50 percent of the teaching assistants (if any) receive academic or professional development annually.	✓	✓	✓	✓	✓
(11) The average final-year students' satisfaction score or the fresh graduates' satisfaction score towards the program's quality is at least 3.5 from 5.0.				✓	✓
(12) The average graduate users' satisfaction score is at least 3.5 from 5.0.					✓

Evaluation criteria: A curriculum that meets the standards of Thai Qualifications Framework must qualify for the following conditions: (1) the compulsory performance indicators (numbers 1-5) must pass beyond expectations and (2) the total number of performance indicators must reach their goal by no less than 80 percent each year.

Additional indicators from Section 7

Indicators and Goal	Academic Years				
	2019	2020	2021	2022	2023
2. **Graduates**					

Indicators and Goal	Academic Years				
	2019	2020	2021	2022	2023
2.1 At least 70 percent of new graduates either go on to employment or further study.					✓
3. Students					
3.1 At least 70 percent of students remain in the program.			✓	✓	✓
3.2 The average students' satisfaction score towards the courses' quality is at least 3.5 from 5.0.		✓	✓	✓	✓
3.3 At least 80 percent of final-year students graduate.				✓	✓
4. Instructors					
4.1 Each instructor must produce TQF3 and TQF5 for all assigned courses.	✓	✓	✓	✓	✓
6. **Academic Supports**					
6.1 The average staffs and students' satisfaction score towards the learning supports is at least 3.5 from 5.0	✓	✓	✓	✓	✓

Section 8 Evaluation, Improvement, and Implementation

1. Assessment of Teaching Effectiveness

1.1 Assessment of Teaching Strategy

- Obtain qualitative and quantitative feedback from both the faculty and students. Analysis of students and instructors' feedback toward courses, services, and support will provide insights into strength, weaknesses, threats, and opportunities of each course and of the program.
- Peer feedback and assessment of teaching as conducted by having peer instructor or division chairman observe the instructional activity can also provide constructive improvement.

1.2 Assessment of the Instructor's Skills in Applying Teaching Strategies

- Analyze from students' evaluation toward courses and instructors.
- Workshop on course improvement with the participation of all instructors in the courses

2. Overall Evaluation of the Program

- Survey on final-year students' satisfaction towards the program's quality
- Survey on employers' satisfaction with graduates
- Curriculum evaluation from external expertise

3. Assessment of the Program Implementation Based on the Program Specification

Evaluation is made annually by instructors and the curriculum committee according to key performance indicators of section 7, item 7.

4. Review of Evaluation Results and Plans for Improvement

Instructors in the program involved in revising, evaluating, and planning to improve and/or develop courses and the curriculum by analyzing results from students' evaluations of instructors; job availability of graduates; level of employers' satisfaction with graduates; and other evaluation results that relate to courses. In general, the curriculum committee has five-year cycle for curriculum change.

Appendix shown in the TQF2

Revised program of academic year 2019

Appendix 1	Mahidol University Degree Profile
Appendix 2	2.1 Program-level Learning Outcomes (PLOs) and Sub Program-level Learning Outcomes (SubPLOs) 2.2 Relationship between Program-level Learning Outcomes and MU Graduate Attributes 2.3 Goals for each academic year
Appendix 3	Table showing the comparison of the PLOs and the national TQF ● Corresponding with the educational degrees: Level 2 bachelor' degree
Appendix 4	4.1 Curriculum Mapping (*Shown with the symbols I, R, P, M, A)*
Appendix 5	Major Improvements of the Bachelor of Science Program in Bioresources and Environmental Biology (International Program), issued in Academic Year 2019
Appendix 6	Details of the program instructors in-charge, regular instructors, and special instructors
Appendix 7	Mahidol University Regulations on Diploma and Undergraduate Studies of the Year B.E. 2560 and the affiliation's educational announcements/ regulations
Appendix 8	Order of Curriculum Development Committee or Curriculum Screening Procedure Committee or Person In-charge
Appendix 9	MOUs made between domestic and foreign organizations
Other Appendixes	

Appendix 1

Mahidol University Degree Profile

Mahidol University Degree Profile

Bachelor's Degree Program	
1. Program Title (In Thai) หลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ) (In English) Bachelor of Science Program in Bioresources and Environmental Biology (International Program) 2. Degree Offered (In Thai) วิทยาศาสตรบัณฑิต (ทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม) (In English) Bachelor of Science (Bioresources and Environmental Biology)	
General information of the program	
Type of program	Bachelor's Degree (International Program), Academic Program
Total credits required	Plan A – no less than 126 credits of courses taken while studying at Faculty of Science, Mahidol University (MUSC) Plan B – no less than 83 credits of courses taken while studying at Faculty of Science, Mahidol University (MUSC) and no less than 43 credits of courses taken while studying at State University of New York, College of Environmental Science and Forestry (SUNY-ESF). If a student cannot continue or complete his/her study at SUNY-ESF, credits and courses can be transferred in accordance with Mahidol University and MUSC regulations.
Studying duration / Program cycle	4-Year Program
The program's status and opening schedule	1. Revised Program 2019 2. Program start: Semester I Academic Year 2019
Degree granting	One degree of one major

Degree-granting Institutions (MOU with other institutions)	Mahidol University, Thailand
Organization certifying the standards	-
Specific information of the program	
Purpose / Goals / Objectives	**Goals** The goal of the Bioresources and Environmental Biology program is to produce bachelor degree graduates who meet the requirements and specifications of the national and international standards and expectations, and possess Mahidol core values. The graduates will be equipped with knowledge in different disciplines, professional skills, social skills, innovative and ethical mindset to serve future employment, graduate studies and social needs. **Objectives** To produce graduates who have the characteristics, knowledge and skills as follows: 1. integrate and apply knowledge in bioresources and environmental biology and related sciences to address environmental and biological-related needs 2. demonstrate technical skills appropriate for the planning and development of research projects in bioresources and environmental biology or related fields 3. have responsibility for society, problem solving, and creative thinking as well as self-development 4. have teamwork, professional ethics, and

	formulate ideas and products to serve social needs
Distinctive features Distinctive features (Con.)	1. Learners have opportunity to choose 4 study plans aboard through dual degree with SUNY-ESF. 2. Bioresources and Environmental Biology Program provides academic knowledge from diverse biological disciplines, including ecology and conservation, environmental sciences, environmental health, biotechnology, plant and animal diversity and other related areas. 3. Learners have opportunities to do internship with companies or any institutes they like. 4. They can choose to do senior projects that fit their needs in any specialties within the bioresources and environmental biology context. 5. Learners of the Bioresources and Environmental Biology Program will be trained to utilize integrative knowledge to solve problems and formulate sustainable solutions to serve social needs.
Educational system	Semester System
Graduates' advancement	
Career opportunities	1. Researcher and research assistant in any government research unit, academic institutes or universities related to bioresources and environmental biology. 2. Teaching career as primary- and secondary-school teachers in the field of bioresources, environment and biology at any schools, especially in the English Program (EP) section. 3. Personnel performing quality control/assurance

Career opportunities (Con.)	and conducting experiments and reports for biological and environmental-related issues in any companies or manufacturers 4. Sale or marketing person in scientific instruments and chemical trading and services companies. 5. Customer relations for biological or environmental product companies that require personnel with good command of English. 6. Entrepreneur of the companies related to products or services in the field of bioresources and environmental biology.
Further fields of study	Graduates can continue their studies for higher degree in any fields of biotechnology, environmental sciences, environmental health, environmental resources engineering, ecology and conservation, plant science, zoology and much more at the SUNY-ESF providing that they spend their last year at SUNY-ESF.
Philosophy in program administration	
Educational philosophy	Our primary focus is on educating the learners, as for them to attain academic achievement through learning-centered education, outcome-based education and constructivism. To become a wisdom graduate, learners combine what they have learned so far with the new knowledge, and with experiential learning activities. While the role of a lecturer in the learning process is shift from an information provider to a coach or a facilitator creating challenge-based activities.
Strategy / teaching guidelines	The program is aware of student differences in backgrounds, strengths and weaknesses, interests, and learning styles. Therefore, a range of teaching styles are set through the diverse learning activities

	according to the learning outcomes including interactive lectures, laboratory practical, individual and group discussions and assignments, active research projects with emphasis on student's demonstration of ideas, logical reasoning, and problem-solving
Strategy / student's evaluation guidelines	The assessments and evaluations align with the teaching strategies and the desired learning outcomes such as written and oral examination, practical test, oral presentation, individual or group class participation and project-based research learning. Rubrics based on the objectives of the course are announced clearly and used to score the students' achievement.
Competences provided to the students	
Generic competences	1. **Ethics**: demonstrate moral and ethical behavior and be responsible in their own action including awareness of plagiarism 2. **Critical thinking and analysis**: be capable of analytical and critical thinking and be able to evaluate both general and scientific information with logical and systematic thinking 3. **Creativity**: be able to bridge research to innovation which further enhance basic knowledge. 4. **Communication**: be able to choose appropriate forms of English communication such as listening, speaking, reading and writing skills, depending on target audience and for academic purposes 5. **Collaboration**: be able to work with others appropriately and accept the difference

	between people 6. **ICT**: be able to choose the appropriate information technology for searching of information and data and be able to analyze the reliability of data from various sources.
Subject-specific competences	1. The use of tools and processes in biological and environmental sciences, to study in molecular, cellular and organismic levels of life in the environment and ecosystem, both in the laboratory and in the fieldworks with a code of ethics and professional conduct. 2. Basic knowledge and skills in zoology, plant science, industrial and environmental microbiology, environmental biotechnology for waste treatment, food crop planting and harvesting technology, plant and animal cell technology. 3. Integration of scientific and environmental knowledge for industrial use and environmental protection.
Graduates' learning outcomes	At the end of the program, successful students will be able to:
PLO1	Solve biological- and environmental-related problem logically and systematically at local, regional and global levels by applying interdisciplinary approaches.
PLO2	Carry out laboratory-based and field-based experiments to address biological and environmental impacts on sustainability with international standard methodologies.
PLO3	Create an independent project in bioresources and environmental biology, analyzed from scientific journals and laboratory reports along with

	laboratory safety skills and professional code of conduct.
PLO4	Communicate concepts of bioresources and environmental biology clearly and purposefully with target audiences in English, in both written and oral forms with appropriate technologies in an organized manner.
PLO5	Work independently and coordinate with others to achieve team goals based on roles and responsibilities of an environmental biologist.

Appendix 2

2.1 Program-level Learning Outcomes and Sub Program-level Learning Outcomes (PLOs and SubPLOs)

Table in Appendix 2.1

Program-level Learning Outcomes (PLOs) and Sub Program-level Learning Outcomes (SubPLOs)

PLOs	SubPLOs
PLO1: Solve biological- and environmental-related problem logically and systematically at local, regional and global levels by applying interdisciplinary approaches.	1.1 Define the concepts in basic science including biology, chemistry, mathematics, and physics for bioresources and environmental biology study. 1.2 Explain a broad knowledge in bioresources and environmental biology. 1.3 Aware of self in a global society and effectively engage in diverse perspectives, values, and cultures, ranging from local to global, in dealing with biological, environmental and social issues. 1.4 Demonstrate the ability to use appropriate technology to find, evaluate, and ethically used information from research or lessons from successful projects to a focused biological and environmental solution with potential local or regional stakeholders.
PLO2: Carry out laboratory-based and field-based experiments to address biological and environmental impacts on sustainability with international standard methodologies.	2.1 Explain the principle of bioresources and modern environmental theory and related fields and its related problem-solving strategies. 2.2 Students can effectively use scientific instruments with respect to biosafety and the laboratory standards. 2.3 Demonstrate integrity, honesty, morality, and ethics in doing research 2.4 With multi-skilled and versatile knowledge, graduates can perform any lab or field investigation of problems relating to bioresources and environment.
PLO3: Create an independent project in bioresources and environmental biology, analyzed from scientific journals and laboratory reports along with laboratory safety skills and professional code of conduct.	3.1 Demonstrate the ability to design experiments and have proper conduct of scientific research. 3.2 Apply knowledge and international standard laboratory skills to analyze a selected research problem. 3.3 Develop a research project in bioresources and environmental biology with social impact.
PLO4: Communicate	4.1 Practice academic writing and speaking skills in English for transferring

concepts of bioresources and environmental biology clearly and purposefully with target audiences in English, in both written and oral forms with appropriate technologies in an organized manner.	knowledge and exchanging ideas. 4.2 Present experiment or project results both written and oral forms in English, proper to appropriate audience, such as verbal discussion with peers, and written project reports.
PLO5: Work independently and coordinate with others to achieve team goals based on roles and responsibilities of an environmental biologist.	5.1 Demonstrate time management skills to complete assignments and duties as individual and as a team in timely manner. 5.2 Demonstrate ability to accommodate different personality types and ability levels among team members 5.3 Demonstrate ability to work with others and adapt themselves and effectively work with others both as a leader and member of the team.

2.2 Relation between Program-Learning Outcomes and 4 Graduate Attributes

Table in Appendix 2.2

Relation between Program Learning Outcomes & 4 Graduate Attributes

Program Learning Outcomes / 4 Graduate Attributes	PLO1	PLO2	PLO3	PLO4	PLO5
T-shaped Breadth & Depth – Understanding thoroughly both breadth & depth	✓	✓			
Globally Talented – Having talented and experiences to contending against globally	✓	✓	✓	✓	✓
Socially Contributing - Having a public consciousness advantaging to the society				✓	✓
Entrepreneurially Minded – Decisively thinking, doing, making a decision to accordingly contributing creativity		✓	✓		

Table in Appendix 2.3

2.3 Goals for each academic year

Goals for each academic year			
at the end of year 1	**at the end of year 2**	**at the end of year 3**	**at the end of year 4**
Students are able to relate knowledge of science and mathematics to other disciplines.	Students are able to understand principles of bioresources and environmental biology and can perform experiments under guidance.	Students are able to analyse, discuss, and solve bioresources and environmental biology questions.	Students are able to create research related to bioresources and environmental biology and effectively present the findings.

Appendix 3

Table showing the comparison between the PLOs and the national TQF

- Corresponding with the educational degrees: Level 2 bachelor' degree

Table in Appendix 3

Comparison of the PLOs and the national TQF

TQF Level 2 Competencies / Skills / LOs	PL01	PL02	PL03	PL04	PL05
Domain 1 Ethical and Moral Development					
1.1 Have honesty and integrity	✓	✓	✓	✓	
1.2 Have self-discipline	✓	✓		✓	✓
1.3 Have awareness and realize in compliance with academic and professional ethics	✓	✓	✓		✓
1.4 Respect rights and opinion of other people			✓		✓
1.5 Have public mind			✓	✓	✓
Domain 2 Knowledge					
2.1 Have knowledge on principles and theories of science and/or mathematics	✓	✓	✓	✓	
2.2 Have basic knowledge on science and mathematics that can be used to explain principles and theories in specific field	✓	✓	✓	✓	
2.3 Be able to catch up academic advancement and development of new knowledge especially in science and mathematics	✓	✓	✓		
2.4 Possess broad knowledge in various fields that can be applied in daily life	✓			✓	✓
Domain 3 Cognitive Skills					
3.1 Be able to systematically and reasonably analyze based on scientific principles and methods	✓	✓	✓		
3.2 Correctly and appropriately apply scientific and mathematical knowledge in various situation	✓	✓	✓	✓	

3.3 Have desire for knowledge, be able to correctly analyze and synthesize knowledge from various sources of data that will lead to creating innovation	✓	✓	✓		
Domain 4 Interpersonal Skills and Responsibility					
4.1 Have leadership and be able to work with other people as a good leader and a good team member		✓			✓
4.2 Have responsibility for society and organization as well as self-development and work development	✓	✓			✓
4.3 Be able to adapt self to organizational situation and culture	✓				✓
Domain 5 Analytical and Communication Skills, Mathematics and IT Application					
5.1 Be able to apply mathematical and statistical knowledge to appropriately analyze, process, solve problem and present information	✓		✓	✓	
5.2 Possess language skills to effectively communicate knowledge on science and mathematics as well as be able to select appropriate forms of communication	✓	✓		✓	✓
5.3 Possess skills and knowledge on English or other foreign language that are suitable and necessary for doing research	✓	✓		✓	✓
5.4 Be able to apply information technology on searching and collecting data that is effective and suitable for the situation	✓		✓	✓	
Domain 6 Psychomotor (if applicable)					
6.1 Possess skills to perform laboratory experiment in environmental biology using scientific instruments with precision and safety precautions.		✓	✓		

Appendix 4

Curriculum Mapping

Table in Appendix 4.1 Curriculum Mapping (Plan A)

Course Codes and Titles		Number of credits	Program-level Learning Outcomes (PLOs)				
			PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 1**
Semester 1							
PRPR 102	Regional Studies	2 (2-0-4)				I	I
SCBE 153	Computer for Science Research and Presentation	2 (2-0-4)				I	
LAEN 180	English for Academic Purpose I	2 (2-0-4)				I	
SCBE 111	Principles of Biology I	3 (3-0-6)	I			I	I
SCBE 102	General Biology Laboratory I	1 (0-3-1)	I	P	P	I	I
SCCH 161	General Chemistry	3 (3-0-6)	I			I	I
SCPY 160	General Physics Laboratory	1 (0-3-1)	I			I	I
SCCH 189	Chemistry Laboratory	1 (0-3-1)	I	I/P	I	I	I
SCMA 174	Calculus and System of Differential Equations	3 (3-0-6)	I				
SCGI 103	Basic Physics	2 (2-0-4)	I				
SCBE 106	Orientation Seminar	1 (0-3-1)	I				I
Semester 2							
PRPR 101	Population and Development	2 (2-0-4)				I	i
LAEN 181	English for Academic Purpose II	2 (2-0-4)	I				
SCBE 113	Principles of Biology II	3 (3-0-6)	I	I	I	I	I
SCBE 104	General Biology Laboratory II	1 (0-3-1)	I	P	I	I	I
SCBE 105	Global Environment	3 (3-0-6)	I		I	I	I
ENGE 105	Integrated Health and Environment	3 (3-0-6)	I		I	I	I
SCCH 172	Organic Chemistry	3 (3-0-6)	I		I	I	I
SCBE 150	Science communication for life sciences	3 (3-0-6)				I/P	I
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 2**
Semester 1							
SCBE 201*	General Zoology	3 (3-0-6)	R		R	R	
SCBE 202*	General Zoology Laboratory	1 (0-3-1)	R	P	R	R	R
LAEN 380	Academic Presentations in English	2 (2-0-4)				R/P	
SCBE 220	Principle of Water Chemistry	3 (3-0-6)	R		R	R	
SCBE 221	Water Chemistry Laboratory	1 (0-3-1)	R	P	P	R	R
SCBE 203	General Genetics	3 (3-0-6)	R		R	R	R
SCBE 204	General Genetics Laboratory	1 (0-3-1)	R	P	P	R	R
SCBE 205	General Botany	3 (3-0-6)	R		R	R	R
SCBE 206	General Botany Laboratory	1 (0-3-1)	R	P	R	R	R

SCBM 281	Basic Biochemistry	3 (3-0-6)	R		R	R	R
SCBM 282	Biochemistry Laboratory	1 (0-3-1)		P	R	R	

Course Codes and Titles		Number of credits	Program-level Learning Outcomes (PLOs)				
			PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 2**
Semester 2							
SCBE 207	Basic Cell and Molecular Biology	3 (3-0-6)	R		R	R	R
SCBE 256	Natural Products	3 (2-3-5)		R/P	R/P	R	R
SCBE 208	General Ecology	3 (3-0-6)	R		R	R	R
SCBE 253	Fundamentals to Finesse: Microbes for Quality Life	3 (2-3-5)	R	R/P	R/P	R	R
SCBE 254	Gardening	3 (2-3-5)	R	R/P	R	R	R
SCBE 210	General Microbiology	3 (2-3-5)	R	R/P	R	R	R
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 3**
Semester 1							
SCBE 301	Principles of Environmental Science	3 (3-0-6)	R		R	R	R
SCBE 302	Biostatistics	3 (3-0-6)	R		R	R	R
SCBE 303	Evolution	3 (3-0-6)	R		R	R	R
SCBE 209*	Ecological Monitoring and Assessment of Bioresources	4 (3-3-6)	R	R/P	M	M	M
SCBE 497	Seminar in Bioresources and Environmental Biology	1 (0-3-1)	M		M	M	M
Semester 2							
SCBE 304	Bioethics	2 (2-0-4)	M		M	M	M
SCBE 305	Scientific Research and Presentation	1 (0-3-1)	M	M/A	M	M	M
SCBE 402	Internship in Bioresources and Environmental Biology	3 (0-9-3)	M/A	M/A	M/A	M/A	M/A
SCBE 499	Independent Research Project in Bioresources and Environmental Biology	3 (0-9-3)	M/A	M/A	M/A	M/A	M/A
Bachelor of Science Program in Bioresources and Environmental Biology (free electives)							**Year 4**
SCBE 419	Organismic Ecology to Eco-complexity	3 (2-3-5)	M/A	M/A	M/A	M/A	M/A

*These courses are taught as modular courses.

I : PLO is Introduced and Assessed R : PLO is Reinforced and Assessed

P : PLO is Practiced and Assessed M : Level of Mastery is Assessed

A : Assessment

Table in Appendix 4.2 Curriculum Mapping (Plan B)

Course Codes and Titles		Number of credits	Program-level Learning Outcomes (PLOs)				
			PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 1**
Semester 1							
PRPR 102	Regional Studies	2 (2-0-4)				I	I
SCBE 153	Computer for Science Research and Presentation	2 (2-0-4)				I	
LAEN 180	English for Academic Purpose I	2 (2-0-4)				I	
SCBE 111	Principles of Biology I	3 (3-0-6)	I			I	I
SCBE 102	General Biology Laboratory I	1 (0-3-1)	I	P	P	I	I
SCCH 161	General Chemistry	3 (3-0-6)	I			I	I
SCPY 160	General Physics Laboratory	1 (0-3-1)	I			I	I
SCCH 189	Chemistry Laboratory	1 (0-3-1)	I	I/P	I	I	I
SCMA 174	Calculus and System of Differential Equations	3 (3-0-6)	I				
SCGI 103	Basic Physics	2 (2-0-4)	I				
SCBE 106	Orientation Seminar	1 (0-3-1)	I				I
Semester 2							
PRPR 101	Population and Development	2 (2-0-4)				I	i
LAEN 181	English for Academic Purpose II	2 (2-0-4)	I				
SCBE 113	Principles of Biology II	3 (3-0-6)	I	I	I	I	I
SCBE 104	General Biology Laboratory II	1 (0-3-1)	I	P	I	I	I
SCBE 105	Global Environment	3 (3-0-6)	I		I	I	I
ENGE 105	Integrated Health and Environment	3 (3-0-6)	I		I	I	I
SCCH 172	Organic Chemistry	3 (3-0-6)	I		I	I	I
SCBE 150	Science communication for life sciences	3 (3-0-6)				I/P	I
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 2**
Semester 1							
SCBE 201*	General Zoology	3 (3-0-6)	R		R	R	
SCBE 202*	General Zoology Laboratory	1 (0-3-1)	R	P	R	R	R
LAEN 380	Academic Presentations in English	2 (2-0-4)				R	
SCBE 220	Principle of Water Chemistry	3 (3-0-6)	R		R	R	
SCBE 221	Water Chemistry Laboratory	1 (0-3-1)	R	P	P	R	R
SCBE 203	General Genetics	3 (3-0-6)	R		R	R	R
SCBE 204	General Genetics Laboratory	1 (0-3-1)	R	P	P	R	R
SCBE 205	General Botany	3 (3-0-6)	R		R	R	R
SCBE 206	General Botany Laboratory	1 (0-3-1)	R	P	R	R	R
SCBM 281	Basic Biochemistry	3 (3-0-6)	R		R	R	R
SCBM 282	Biochemistry Laboratory	1 (0-3-1)		P	R	R	

Course Codes and Titles		Number of credits	Program-level Learning Outcomes (PLOs)				
			PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
Bachelor of Science Program in Bioresources and Environmental Biology							**Year 2**
Semester 2							
SCBE 207	Basic Cell and Molecular Biology	3 (3-0-6)	R		R	R	R
SCBE 256	Natural Products	3 (2-3-5)		R/P	R/P	R	R
SCBE 208	General Ecology	3 (3-0-6)	R		R	R	R
SCBE 253	Fundamentals to Finesse: Microbes for Quality Life	3 (2-3-5)	R	R/P	R/P	R	R
SCBE 254	Gardening	3 (2-3-5)	R	R/P	R	R	R
SCBE 210	General Microbiology	3 (2-3-5)	R	R/P	R	R	R

*These courses are taught as modular courses.

Bachelor of Science Program in Bioresources and Environmental Biology							**Year 3**
Semester 1							
ENS 494	Environmental Science Capstone	1	R		R	R	R
APM 391	Introduction to Probability and Statistics	3	R		R	R	R
EFB 311	Principles of Evolution	3	R		R	R	R
EFB 202	Ecological Monitoring and Biodiversity Assessment	4	R	R/P	M	M	M
EWP 220	Public Presentation Skills	1	M		M	M	M
Semester 2							
EST 366	Attitudes, values and the environment	2	M		M	M	M
EFB 420	Internship	3	M/A	M/A	M/A	M/A	M/A
EFB 498	Independent Research Project	3	M/A	M/A	M/A	M/A	M/A
***Bachelor of Science Program in Bioresources and Environmental Biology (Environmental Biology: free electives)**							**Year 4**
EFB 500	Forest Biology Field Trip	3	M	M	M	M	M
***Bachelor of Science Program in Bioresources and Environmental Biology (Environmental Science: free electives)**							**Year 4**
EST 366	Attitudes, Values and the Environment	3	M		M	M	M
***Bachelor of Science Program in Bioresources and Environmental Biology (Environmental Health: free electives)**							**Year 4**
FOR 487	Environmental law and policy	3	M	M	M	M	M
***Bachelor of Science Program in Bioresources and Environmental Biology (Biotechnology: free electives)**							**Year 4**
BTC 420	Internship in Biotechnology	3	M	M	M	M	M

*Students can choose to study any courses offered at SUNY-ESF that are equivalent to courses offered at Mahidol University with approval of the advisor, however, the chosen courses shall not be contrary to the regulations of both universities.

I : PLO is Introduced and Assessed R : PLO is Reinforced and Assessed

P : PLO is Practiced and Assessed M : Level of Mastery is Assessed A : Assessment

Appendix 5

Major Improvements of the Bachelor of Science Program in Bioresources and Environmental Biology (International Program) issued in Academic Year 2014

Program under Revision Bachelor of Science Program in Bioresources and Environmental Biology (International Program)

Field of Study.....Science.....Year 2014

Faculty of Science, Mahidol University

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1. The curriculum was approved by the Office of the Higher Education Commission on November 13, 2014.

2. The Mahidol University Council has approved this revised curriculum in the meeting no. 536 on September 19, 2018.

3. The revised curriculum will be effective with student ID 62xxxxx from the 1st semester of the Academic Year 2019 onwards.

4. Reasons for the revision
   4.1. To comply with the Standard of Undergraduate Programs of Study announced by the Ministry of Education 2015.
   4.2. To meet Mahidol University policy to educate the learners, as for them to attain academic achievement through learning-centered education, outcome-based education and constructivism.
   4.3. To modify the program to ensure that our graduates have the MU Graduate Attributes
   4.4. To meet the requirements of each AUN-QA criterion.
   4.5. To modify the courses in accordance with the outcome-based education, having the effective teaching and learning pedagogy

5. Contents of the revision

5.1 Changing course code in Thai from วททช to วททส because วททช has been previously registered by Department of Biotechnology.

5.2 Removing General Education courses

SCBE 251	Scientific Illustration	2 (1-3-3)
วททช ๒๕๑	นิทัศน์ทางวิทยาศาสตร์	๒ (๑-๓-๓)
SCBE 252	Plant and Society	2 (1-3-3)
วททช ๒๕๒	พืชและสังคม	๒ (๑-๓-๓)
SCMA 161	Technology in Daily Life	3 (3-0-6)
วทคณ ๑๖๑	เทคโนโลยีในชีวิตประจำวัน	๓ (๓-๐-๖)

5.3 Adding General Education Courses

SCBE 100	Wonder of Life	3 (3-0-6)
วททส ๑๐๐	มหัศจรรย์แห่งชีวิต	๓ (๓-๐-๖)
SCBE 109	Human and Its Surroundings	2 (2-0-4)
วททส ๑๐๙	มนุษย์และสิ่งรอบตัว	๒ (๒-๐-๔)
SCBE 150	Science communication for life sciences	3 (3-0-6)
วททส ๑๕๐	การสื่อสารวิทยาศาสตร์เพื่อวิทยาศาสตร์ชีวภาพ	๓ (๓-๐-๖)
SCBE 151	Plants and civilization	3 (2-2-5)
วททส ๑๕๑	พืชและอารยธรรม	๓ (๒-๒-๕)
SCBE 152	Natural science illustration	3 (1-4-4)
วททส ๑๕๒	นิทัศน์ทางวิทยาศาสตร์ธรรมชาติ	๓ (๑-๔-๔)
SCBE 254	Gardening	3 (3-0-6)
วททส ๒๕๔	งานสวน	๓ (๓-๐-๖)
SCBE 255	Aesthetics for fragrance and flavor	3 (3-0-6)
วททส ๒๕๕	สุนทรียศาสตร์ของกลิ่นและรส	๓ (๓-๐-๖)

SCBE 256	Natural products	3 (3-2-5)
วททส ๒๕๖	ผลิตภัณฑ์ธรรมชาติ	๓ (๓-๒-๕)
SCBM 101	Basic Information Literacy	1 (1-0-2)
วทชพ ๑๐๑	การเรียนรู้สารสนเทศพื้นฐาน	๑ (๑-๐-๒)
SCBE 153	Computer for Science Research and Presentation	2 (2-0-4)
วททส ๑๕๓	คอมพิวเตอร์เพื่อการวิจัยและนำเสนองานทางวิทยาศาสตร์	๒ (๒-๐-๔)
SCBC 207	Science in Social Media	2 (2-0-4)
วทชค ๒๐๗	วิทยาศาสตร์ในสื่อสังคม	๒ (๒-๐-๔)
SCPA 203	Young Blood Detective	2 (2-0-4)
วทพธ ๒๐๓	ยอดนักสืบสายเลือดใหม่	๒ (๒-๐-๔)
SCBE 325	Environmental economics	2 (2-0-4)
วททส ๓๒๕	เศรษฐศาสตร์สิ่งแวดล้อม	๒ (๒-๐-๔)

5.4 Removing Specific Courses

SCBE 101	General Biology I	3 (3-0-6)
วททช ๑๐๑	ชีววิทยาทั่วไป ๑	๓ (๓-๐-๖)
SCBE 103	General Biology II	3 (3-0-6)
วททช ๑๐๓	ชีววิทยาทั่วไป ๒	๓ (๓-๐-๖)
SCPY 178	General Physics	3 (3-0-6)
วทฟส ๑๗๘	ฟิสิกส์ทั่วไป	๓ (๓-๐-๖)
SCME 221	Analytical Chemistry	3 (3-0-6)
วทวน ๒๒๑	เคมีวิเคราะห์	๓ (๓-๐-๖)
SCBM 232	Fundamental Microbiology	2 (2-0-4)
วทชพ ๒๓๒	จุลชีววิทยาพื้นฐาน	๒ (๒-๐-๔)
SCME 281	Analytical Chemistry Laboratory	1 (0-3-1)
วทวน ๒๘๑	ปฏิบัติการเคมีวิเคราะห์	๑ (๐-๓-๑)
SCMA 192	Statistics	3 (3-0-6)
วทคณ ๑๙๒	สถิติศาสตร์	๓ (๓-๐-๖)

5.5 Adding Specific Courses

SCBE 111	Principles of Biology I	3 (3-0-6)
วททส ๑๑๑	หลักการทางชีววิทยา ๑	๓ (๓-๐-๖)
SCBE 113	Principles of Biology II	3 (3-0-6)
วททส ๑๑๓	หลักการทางชีววิทยา ๒	๓ (๓-0-๖)
SCBE 121	Essential Biology	2 (2-0-4)
วททส ๑๒๑	สาระสำคัญทางชีววิทยา	๒ (๒-๐-๔)
SCBE 210	General microbiology	3 (2-3-5)
วททส ๒๑๐	จุลชีววิทยาทั่วไป	๓ (๒-๓-๕)
SCBE 220	Principle of Water Chemistry	3 (3-0-6)
วททส ๒๒๐	หลักการทางเคมีของน้ำ	๓ (๓-๐-๖)
SCBE 221	Water Chemistry Laboratory	1 (0-3-1)
วททส ๒๒๑	ปฏิบัติการเคมีของน้ำ	๑ (๐-๓-๑)
SCBE 223	Toxicology in public health	3 (3-0-6)
วททส ๒๒๓	พิษวิทยาทางสาธารณสุข	๓ (๓-๐-๖)
SCBE 320	Occupational health and safety	3 (3-0-6)
วททส ๓๒๐	อาชีวอนามัยและความปลอดภัย	๓ (๓-๐-๖)
SCBE 321	Epidemiology and disease control	3 (3-0-6)
วททส ๓๒๑	ระบาดวิทยาและการควบคุมโรค	๓ (๓-๐-๖)
SCBE 322	Air quality monitoring and management	3 (3-2-5)
วททส ๓๒๒	การจัดการและการตรวจวัดมลพิษทางอากาศ	๓ (๓-๒-๕)
SCBE 323	Noise and vibration	3 (3-2-5)
วททส ๓๒๓	เสียงและการสั่นสะเทือน	๓ (๓-๒-๕)
SCBE 324	Solid waste and sewage	3 (3-2-5)
วททส ๓๒๔	สิ่งปฏิกูลและน้ำเสีย	๓ (๓-๒-๕)

5.6 Changing requirements on Elective Courses

Current Curriculum:

The students have to register 17 credits of elective courses from specific tracks with minimum credits from each track. Elective tracks are 1) Structure and functions, 2) Diversity of living things, and 3) Applications of bioresources and environmental biology.

New Curriculum (B.E. 2562):

The students have to register 19 credits from their any track of their choice. Elective tracks are 1) Environmental Science and Health, 2) Environmental Biotechnology, and 3) Bioresources and Environmental Biology with 3 sub-modules (Structure and function module, Biodiversity module, and Bioresources and environmental biology application module). The students have to register courses in Bioresources and Environmental Biology track under the following requirements:

- At least 3 credits from Structure and Function module
- At least 11 credits from Biodiversity module in 3 different sub-modules (Microbial diversity, Plant diversity, Invertebrate diversity, and Vertebrate diversity)
- At least 3 credits from Bioresources and environmental biology application module

6. Program structure after revision compared to the previous structure and the undergraduate curriculum standard and guidelines issued by the Commission of Higher Education 2015.

Course Category	Standard guideline of the Ministry of Education for the undergraduate level of education of the year 2015 (4-year program) (credits)	Current Program		Revised Program	
		Plan A (credits)	Plan B (credits)	Plan A (credits)	Plan B (credits)
1. General Education Courses	**no less than 30**	33	33	30#	30#
1) Social Sciences and Humanities		4	4		
2) Languages		8	8		
3) Science and Mathematics		21	21		
4) Health and Recreation		-	-		
2. Specific Courses	**no less than 72**	82	82	90	51+39*
1) Core Courses		24	24	34	27+7*
2) Major Required Courses		39	39	41	24+17*
3) Major Elective Courses (Module)		20	20	15	0+15*
3. Free Elective Courses	**no less than 6**	6	6	6	2+4*
Total Credits	**no less than 120**	126	126	126	83+43*

* credits while studying at SUNY-ESF

Students have the choice of completing the General Education courses provided by other programs/departments/faculties to fulfill the credit requirement.

Appendix 6

Details of the program instructors in-charge, regular instructors, and special instructors

Appendix for details of the program instructors in-charge, regular instructors, and special instructors

a. Program instructors in-charge and regular instructors

1. Full name.....Prayad Pokethitiyook.....

Title / Academic title .....Associate Professor, Ph.D. .....

Affiliation..... Department of Biology, Faculty of Science, Mahidol University .....

Work Place ... 272 Rama VI Road, Phayathai, Bangkok 10400, THAILAND....

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
Ph.D.	Chemical Engineering	University of Melbourne, Australia	1999
M.S.	Environmental Science and Engineering	Virginia Polytechnic Institute and State University (Virginia Tech), U.S.A.	1989
วท.ม.	ชีววิทยาสภาวะแวดล้อม	Mahidol University	1981
วท.บ.	ชีววิทยา	Mahidol University	1978

Research interests or research skills

1) Bioremediation, phytoremediation,hHazardous waste management, electronic waste treatment and metal recovery

2) Biodiesel production by algae and oleaginous bacteria, wastewater treatment by algae, Algae as a source of value-added products (including omega-3 and omega-6 fatty acids and carotenoids).

3) Benzene and hydrogen sulfide removal by bioscrubber

4) Electronic waste management and recovery of valuable metals by phytoremediation technique incorporated with rhizosphere bacteria

5) Detecting of petroleum contaminated water and soil by a novel gene technique

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (2015)

- Academic works

1) Sricoth, T., **Pokethitiyook, P.***, Kruatrachue, M., Janvilisri, T., Kalambaheti, C. 2008. Desulfurization by recombinant *Rhodococcus gordoniae* strain R3. The 13th International Biotechnology Symposium and Exhibition (IBS-2008), October 12 to 17, 2008, Dalian, China. Abstract in *Journal of Biotechnology*, 136S (2008) S49.
2) **Pokethitiyook, P.***, Poolpak, T., Tanhan, P., Siangjaeo, S., Mahakittikun, P. 2008. Enhancement of zinc and cadmium uptake in Brassicaceae plants by Rhizosphere bacteria. The 13th International Biotechnology Symposium and Exhibition (IBS-2008), October 12 to 17, 2008, Dalian, China. Abstract in *Journal of Biotechnology*, 136S (2008), S30.
3) **Pokethitiyook, P.***, Sonboonnidhidhorn, P., Pugkaew, W., Chaicalerm, S., Meetham, M. 2009. Biodiesel production from microalgae in Thailand. Abstracts of the 14th European Congress on Biotechnology, Barcelona, Spain 13–16 September, 2009 in *New Biotechnology*, 25 (Supplement), September 2009, Page S273.

- Research papers (2015-2019)

1) Putwattana, N., Kruatrachue, M., Kumsopa, A., **Pokethitiyook, P.** (2015) Evaluation of Organic and Inorganic Amendments on Maize Growth and Uptake of Cd and Zn from Contaminated Paddy Soils. *International Journal of Phytoremediation*, 17(2), 165-174. **Impact Factor 1.466**
2) Chayapan P, Kruatrachue M*, Meetam M, **Pokethitiyook P.** (2015) Effects of amendments on growth and uptake of Cd and Zn by wetland plants, *Typha angustifolia* and *Colocasia esculenta* from contaminated sediments. *International Journal of Phytoremediation*, 17(9), 900-906.
3) Chayapan P, Kruatrachue M*, Meetam M, **Pokethitiyook P.** (2015) Phytoremediation potential of Cd and Zn by wetland plants, *Colocasia esculenta* Schott, *Cyperus malaccensis* Lam. and *Typha angustifolia* L. grown in hydroponics. *J Environmental Biology*, 36(5):1179-1183.
4) Dummee V, Tanhan P*, Kruatrachue M, Damrongphol P, **Pokethitiyook P.** (2015) Histopathological changes in snail, *Pomacea canaliculata*, exposed to sub-lethal copper sulfate concentrations. *Ecotoxicology and Environmental Safety*, 122:290-295.

5) Limcharoensuk T, Sooksawat N, Sumarnrote A, Awutpet T, Kruatrachue M, **Pokethitiyook P**, Auesukaree C* (2015). Bioaccumulation and biosorption of $Cd^{2+}$and Zn^{2+} by bacteria isolated from a zinc mine in Thailand. *Ecotoxicology and Environmental Safety*, 122:322-330.

6) Seepratoomrosh, Jitpisut, **Pokethitiyook, Prayad***, Meetam, Metha, Yokthongwattana, Kittisak, Yuan, Wenqiao, Pugkaew, Wanvisa, & Kangvansaichol, Kunn. (2016). The effect of light stress and other culture conditions on photoinhibition and growth of *Dunaliella tertiolecta*. *Applied Biochemistry and Biotechnology*, 178(2): 396-407.

7) Sirikhachornkit A , Vuttipongchaikij S , Suttangkakul A , Yokthongwattana K , Juntawong P , Pokethitiyook P , Kangvansaichol K , Meetam M (2016). Increasing the triacylglycerol content in *Dunaliella tertiolecta* through isolation of starch-deficient mutants. *Journal of Microbiology and Biotechnology*, 26 (5): 854-866.

8) Jampasri, K., **Pokethitiyook, P.***, Kruatrachue, M., Ounjai, P., Kumsopa, A. (2016). Phytoremediation of fuel oil and lead co-contaminated soil by *Chromolaena odorata* in association with *Micrococcus luteus*. *International Journal of Phytoremediation*, 18(10): 994-1001.

9) Sricoth, T., **Pokethitiyook, P**.*, Kruatrachue, M., Poolpak, T. (2016). Fatty acid methyl ester production from industrial waste by *Rhodococcus erythropolis* IGTS8 and *Rhodococcus gordoniae* R3. *ScienceAsia*, 42(2): 99-108.

10) Sooksawat, N., Meetam, M., Kruatrachue, M., **Pokethitiyook, P.**, Inthorn, D. (2017). Equilibrium and kinetic studies on biosorption potential of charophyte biomass to remove heavy metals from synthetic metal solution and municipal wastewater. *Bioremediation Journal*, 20(3): 240-251.

11) Jampasri, K., **Pokethitiyook, P.***, Kruatrachue, M., Ounjai, P., Kumsopa, A. (2017). Phytoremediation of fuel oil and lead co-contaminated soil by *Chromolaena odorata* in association with *Micrococcus luteus*. *International Journal of Phytoremediation*, 18(10): 994-1001.

12) Sooksawat, N., Meetam, M., Kruatrachue, M., **Pokethitiyook, P**., Inthorn, D. (2017). Performance of packed bed column using *Chara aculeolata* biomass for removal of Pb and Cd ions from wastewater. *Journal of Environmental Science and Health - Part A Toxic/Hazardous Substances and Environmental Engineering*, 52(6): 539-546.

13) Yongpisanphop, J., Babel, S., Kruatrachue, M., **Pokethitiyook, P.** (2017). Hydroponic Screening of Fast-growing Tree Species for Lead Phytoremediation Potential. *Bulletin of Environmental Contamination and Toxicology*, 99(4):518-523.

14) Yongpisanphop, J., Babel, S., Kruatrachue, M., **Pokethitiyook, P.** (2017). Phytoremediation Potential of Plants Growing on the Pb-Contaminated Soil at the Song Tho Pb Mine, Thailand. *Soil and Sediment Contamination*, 26(4), 426-437.

15) Pugkaew, W., Meetam, M., Ponpuak, M., Yokthongwattana, K., **Pokethitiyook, P.*** (2017). Role of autophagy in triacylglycerol biosynthesis in *Chlamydomonas reinhardtii* revealed by chemical inducer and inhibitors. *Journal of Applied Phycology*, 30(1): 15–22.

16) Tiralerdpanicha, P., Sonthiphand, P., Luepromchai, E., Pinyakong, O., **Pokethitiyook, P**. (2018) Potential microbial consortium involved in the biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Marine Pollution Bulletin*, 33: 595-605.

17) Yongpisanphop J, Babel S, Kurisu F, Kruatrachue M, **Pokethitiyook P**. (2019). Isolation and characterization of Pb-resistant plant growth promoting endophytic bacteria and their role in Pb accumulation by fast-growing trees. *Environmental Technology* 9:1-28.

- <u>Academic papers</u>

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- <u>Books/textbooks</u>

  1) Upatham, E. S., Kruatrachue, M., **Pokethitiyook, P.,** Panich-Pat, T. and Lanza, G.R. (2015) Phytoremediation in Thailand: A Summary of Selected Research and Case Histories. In, A.A. Ansari et al. (eds.), Phytoremediation: Management of Environmental Contaminants, Volume 1, Springer International Publishing Switzerland, ISBN 978-3-319-10395-2; pp 333-342.

  2) Sricoth, T., **Pokethitiyook, P.***, Poolpak, T., Kruatrachue, M. (2016) Desulfurization of Oil by Recombinant *Rhodococcus Gordoniae* Strain R3. In, B. Saha (ed.), Environmental Science and Sustainable Development, World Scientific, Singapore, 506 pp.

  3) **Pokethitiyook, P.*** and Poolpak, T. (2016) Biosorption of Heavy Metal from Aqueous Solutions. In, Ansari, A.A., Gill, S.S., Gill, R., Lanza, G.R., Newman, L. (eds.), Phytoremediation: Management of Environmental Contaminants, Volume 3, Springer International Publishing Switzerland, ISBN 978-3319-40148-5; pp 113-141.

  4) **Pokethitiyook, P.*** (2017) Phytoremediation of petroleum-contaminated soil in association with soil bacteria. In, Ansari, A.A., Gill, S.S., Gill, R., Lanza, G.R., Newman, L.

(eds.), Phytoremediation: Phytoremediation: Management of Environmental Contaminants, Volume 51, Springer International Publishing Switzerland, ISBN 978-3319-52379-8, pp 77-99

- Other academic works

Teaching responsibility

Current teaching responsibility

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส ๑๐๑	ชีววิทยาทั่วไป ๑	๓ (๓-๐-๖)
2	วททส ๑๐๒	ปฏิบัติการชีววิทยาทั่วไป ๑	๑ (๐-๓-๑)
3	วททส ๑๐๔	ปฏิบัติการชีววิทยาทั่วไป ๒	๑ (๐-๓-๑)
4	วททส ๑๐๕	สิ่งแวดล้อมโลก	๓ (๓-๐-๖)
5	วททส ๓๐๑	หลักการวิทยาศาสตร์สิ่งแวดล้อม	๓ (๓-๐-๖)
6	วททส ๓๐๕	การวิจัยและการนำเสนอทางวิทยาศาสตร์	๑ (๐-๓-๑)
7	วททส ๓๐๗	การควบคุมและจัดการมลพิษทางน้ำ	๓ (๒-๓-๕)
8	วททส ๓๓๐	จุลชีววิทยาสิ่งแวดล้อม	๓ (๓-๐-๖)
9	วททส ๔๙๗	สัมมนาทางทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๑ (๐-๓-๑)
10	วททส ๔๙๙	โครงงานวิจัยอิสระทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๓ (๐-๙-๓)

Teaching responsibility in the new program / revised program

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส ๑๐๑	ชีววิทยาทั่วไป ๑	๓ (๓-๐-๖)

2	วททส ๑๐๒	ปฏิบัติการชีววิทยาทั่วไป ๑	๑ (๐-๓-๑)
3	วททส ๑๐๕	สิ่งแวดล้อมโลก	๓ (๓-๐-๖)
4	วททส ๒๒๐	หลักการทางเคมีของน้ำ	๓ (๓-๐-๖)
5	วททส ๒๒๑	ปฏิบัติการเคมีของน้ำ	๑ (๐-๓-๑)
6	วททส ๒๒๒	หลักการพื้นฐานทางอนามัยสิ่งแวดล้อมและพิษวิทยา	๒ (๒-๐-๔)
7	วททส ๓๐๑	หลักการวิทยาศาสตร์สิ่งแวดล้อม	๓ (๓-๐-๖)
8	วททส ๓๐๗	การควบคุมและจัดการมลพิษทางน้ำ	๓ (๒-๓-๕)
9	วททส ๓๑๗	ของเสียอันตรายและเป็นพิษ	๓ (๓-๐-๖)
11	วททส ๓๑๙	พลังงานทดแทน	๓ (๓-๐-๖)
11	วททส ๔๐๑	การจัดการของเสียอันตราย	๓ (๓-๐-๖)
12	วททส ๔๙๙	โครงงานวิจัยอิสระทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม	๓ (๐-๙-๓)

2. **Full name**.....**Patompong Saengwilai**.....

Title / Academic title .....Assistant Professor, Ph.D. .....

Affiliation ..... Department of Biology, Faculty of Science, Mahidol University .....

Work Place ... 272 Rama VI Road, Phayathai, Bangkok 10400, THAILAND....

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
Ph.D.	Plant Biology	Pennsylvania State University, U.S.A.	2013
วท.บ.	ชีววิทยา	มหาวิทยาลัยมหิดล	2007

Research interests or research skills

1) Root and rhizosphere biology

2) Genetic and phenotypic variations in root traits of crops

3) QTL mapping and Genome-wide association mapping of quantitative traits

4) Bio-Phytoremediation of environmental pollutions

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (B.E. 2558)

- Academic works

1) Suparad Klinsawang, Thitinun Sumranwanich, Ayuwat Wannaro, **Patompong Saengwilai**. Effects of root hair length on potassium acquisition in rice (Oryza sativa L.). Applied Ecology and Environmental Research (2018): 16(2):1609-1620
2) **Patompong Saengwilai**, Suparad Klinsawang, Methanon Sangachart, Alexander Bucksch. Comparing phenotypic variation of root traits in Thai rice (*Oryza sativa* L.) across growing systems. Applied Ecology and Environmental Research (2018): 16(2):1069-1083
3) Jirawat Salungyu, Jitrana Kengkanna, William LaVoy, **Patompong Saengwilai**. Exploring natural variation of root architectural traits in seedlings of Thai maize hybrid and inbred lines. Applied Ecology and Environmental Research (2018)16(2):1119-1130
4) Theeta Sricoth, Weeradej Meeinkuirt, John Pichtel, Puntaree Taeprayoon, **Patompong Saengwilai (2017)**. Synergistic phytoremediation of wastewater by two aquatic plants (Typha angustifolia and Eichhornia crassipes) and potential as biomass fuel.Environ Sci Pollut Res. 25(6):5344-5358.

- Research papers

1) Meeinkuirt, W., Phusantisampan, T., **Saengwilai, P**. (2018). Root system architecture influencing cadmium accumulation in rice (Oryza sativa L.). International journal of phytoremediation, 21, 19-26.
2) Sricoth T, Meeinkuirt W, **Saengwilai P**, Pichtel J, Taeprayoon P. Aquatic plants for Phytostabilization of cadmium and zinc in hydroponic experiments. Environ Sci Pollut Res. (2018)25: 14964-14976
3) Suparad Klinsawang, Thitinun Sumranwanich, Ayuwat Wannaro, **Patompong Saengwilai**. Effects of root hair length on potassium acquisition in rice (Oryza sativa L.). Applied Ecology and Environmental Research (2018): 16(2):1609-1620

4) **Patompong Saengwilai**, Suparad Klinsawang, Methanon Sangachart, Alexander Bucksch. Comparing phenotypic variation of root traits in Thai rice (*Oryza sativa* L.) across growing systems. Applied Ecology and Environmental Research (2018): 16(2):1069-1083
5) Jirawat Salungyu, Jitrana Kengkanna, William LaVoy, **Patompong Saengwilai**. Exploring natural variation of root architectural traits in seedlings of Thai maize hybrid and inbred lines. Applied Ecology and Environmental Research (2018)16(2):1119-1130
6) Meredith T. Hanlon, Swayamjit Ray, **Patompong Saengwilai**, Dawn Luthe, Jonathan P. Lynch and Kathleen M. Brown. Buffered delivery of phosphate to Arabidopsis alters responses to low phosphate (2018). Journal of Experimental Botany.69(5):1207-1219
7) Theeta Sricoth, Weeradej Meeinkuirt, John Pichtel, Puntaree Taeprayoon, **Patompong Saengwilai (2017)**. Synergistic phytoremediation of wastewater by two aquatic plants (Typha angustifolia and Eichhornia crassipes) and potential as biomass fuel. Environ Sci Pollut Res. 25(6):5344-5358.
8) **Patompong Saengwilai,** Weeradej Meeinkuirt, John Pichtel, Preeyaporn Koedrith (2017). Influence of amendments on Cd and Zn uptake and accumulation in rice (Oryza sativa L.) in contaminated soil. Environ Sci Pollut Res: 24(18):15756-15767
9) Theerawut Phusantisampan, Weeradej Meeinkuirt, **Patompong Saengwilai,** John Pichtel Rattanawat Chaiyarat (2016) Phytostabilization potential of two ecotypes of *Vetiveria zizanioides* in cadmium-contaminated soils: greenhouse and field experiments, Environ Sci Pollut Res. 23(19) 20027-38
10) Weeradej Meeinkuirt, Maleeya Kruatrachue, John Pichtel, Theerawut Phusantisampan, **Patompong Saengwilai (**2016**).** Influence of organic amendments on phytostabilization of Cd**–**contaminated soil by *Eucalyptus camaldulensis*, Science Asia, 42:83-91
11) **Patompong Saengwilai**, Eric A. Nord, Kathleen M. Brown, and Jonathan P. Lynch (2014). Root cortical aerenchyma enhances nitrogen acquisition in maize (Zea mays L.), Plant Physiol.166:726-735
12) **Patompong Saengwilai**, Xiaoli Tian, and JonathanP.Lynch (2014). Low crown root num ber enhances nitrogen acquisition from low N soils in maize (Zea mays L.), Plant Physiol.166:581- 589

- Academic papers

1) บทความเรื่อง แบคทีเรียในดินช่วยเพิ่มการเจริญเติบโตและผลผลิตของพืชได้, เคหการเกษตร, ฉบับเดือนพฤศจิกายน 2559 หน้า 180-182
2) **Patompong Saengwilai** (2015) Root research for crop improvement (in Thai). Proceedings of the Annual Conference of Plant Breeding and Multiplication Association of Thailand, July 23-24 2015.
3) Rawinsak Phomthananivet and **Patompong Saengwilai** (2015) Phosphorus Crisis-World Crisis, University Social Responsibility (USR), available at http://www.sc.mahidol.ac.th/usr/?p=461.
4) **Patompong Saengwilai** (2015) Root traits for crop improvement: Maize. Proceedings of the 37th National Corn and Sorghum Research Conference, Thailand, Aug 5-7 2015
5) บทความเรื่อง Root lab ห้องปฏิบัติการรากพืชแห่งแรกของไทย, เคหการเกษตร, ฉบับเดือนพฤศจิกายน 2558 หน้า 197-198
6) บทความเรื่อง ประสบการณ์การศึกษาข้าวทนแล้งที่สถาบันวิจัยข้าวนานาชาติ IRRI (I), อู่ข้าว ฉบับเดือนพฤศจิกายน 2558 หน้า 41-43
7) บทความเรื่อง ประสบการณ์การศึกษาข้าวทนแล้งที่สถาบันวิจัยข้าวนานาชาติ IRRI (I), อู่ข้าว ฉบับเดือนธันวาคม 2558 หน้า 28-30

Teaching responsibility

Current teaching responsibility

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส ๑๐๖	ปฐมนิเทศ	๑ (๐-๓-๑)
2	วททส ๒๐๓	พันธุศาสตร์ทั่วไป	๓ (๓-๐-๖)
3	วททส ๒๐๔	ปฏิบัติการพันธุศาสตร์ทั่วไป	๑ (๐-๓-๑)

Teaching responsibility in the new program / revised program

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส ๑๐๖	ปฐมนิเทศ	๑ (๐-๓-๑)
2	วททส ๒๐๓	พันธุศาสตร์ทั่วไป	๓ (๓-๐-๖)
3	วททส ๒๐๔	ปฏิบัติการพันธุศาสตร์ทั่วไป	๑ (๐-๓-๑)
4	วททส ๒๕๔	งานสวน	๓ (๒-๓-๕)

3. **Full name** ...Alyssa Stewart.....

Title / Academic title ...Lecturer, PhD.....

Affiliation ...Department of Plant Science, Faculty of Science, Mahidol University.....

Work Place ...Mahidol University.....

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
Ph.D.	Biological Sciences	University of Maryland	2016
B.Sc.	Biology	University of North Carolina	2008

Research interests or research skills

1) Pollination

2) Ecology

3) Biodiversity and Conservation

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (B.E. 2558)

- <u>Academic works</u>

1) Stewart AB , Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. Biotropica, 50:98-105.

2) Stewart AB, Sritongchuay T, Teartisup P, Kaewsomboon S, Bumrungsri S. 2018. Habitat and landscape factors influence pollinators in a tropical megacity, Bangkok, Thailand. PeerJ, 6:e5335.

3) Olaranont Y, Stewart AB, Traiperm P. 2018. Physiological and anatomical responses of a common beach grass to crude oil pollution. Environmental Science and Pollution Research, 25:28075-28085.

- **Research papers**

1) Stewart AB, Sritongchuay T, Teartisup P, Kaewsomboon S, Bumrungsri S. 2018. Habitat and landscape factors influence pollinators in a tropical megacity, Bangkok, Thailand. PeerJ, 6:e5335.

2) Stewart AB , Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. Biotropica, 50:98-105.

3) Olaranont Y, Stewart AB, Traiperm P. 2018. Physiological and anatomical responses of a common beach grass to crude oil pollution. Environmental Science and Pollution Research, 25:28075-28085.

4) Stewart AB , Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. Biotropica, 50:98-105.

5) Stewart AB , Dudash MR. 2017. Field evidence of strong differential pollen placement by Old World bat-pollinated plants. Annals of Botany, 119:73-79.

6) Stewart AB , Dudash MR. 2017. Flower-visiting bat species contribute unequally towards agricultural pollination ecosystem services in southern Thailand. Biotropica, 49:239–248.

7) Stewart AB, Dudash MR. 2016. Differential pollen placement on an Old World nectar bat increases pollination efficiency. Annals of Botany, 117:145-152.

8) Carter G, Stewart AB. 2015. The floral bat lure dimethyl disulphide does not attract the palaeotropical Dawn bat. Journal of Pollination Ecology, 17:129-131.

9) Stewart AB, Makowsky R, Dudash MR. 2014. Differences in foraging times between two feeding guilds within Old World fruit bats (Pteropodidae) in southern Thailand. Journal of Tropical Ecology, 30:249-257.

10) Sritongchuay T, Gale GA, Stewart AB, Kerdkaew T, Bumrungsri S. 2014. Seed rain in abandoned clearings in a lowland evergreen rain forest in southern Thailand. Tropical Conservation Science, 7:572-585.

- Academic papers

- Books/textbooks

- Other academic works

1) Presented at the following conferences: Botanical Conference of Thailand, Ecological Society of America, North American Society of Bat Research, Association for Tropical Biology and Conservation, Evolution, International Congress for Conservation Biology.

Teaching responsibility

Current teaching responsibility

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส 415	วิทยาศาสตร์ชีวนานาพันธุ์	(3-0-6)

Teaching responsibility in the new program / revised program

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส 415	วิทยาศาสตร์ชีวนานาพันธุ์	(3-0-6)

4. **Full name** Prinpida Sonthiphand

Title / Academic title PhD

Affiliation Department of Biology, Faculty of Science, Mahidol University

Work Place SC2-241

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
PhD	Biology	University of Waterloo	2014
MSc	Environmental Management	Chulalongkorn University	2009
BSc	Biochemistry	Chulalongkorn University	2005

Research interests or research skills

1) Community and diversity of microorganisms in natural and engineered environments

2) *In situ* activity investigation of microorganisms in natural and engineered environments

3) The use of metagenomics and bioinformatics to predict microbial function

4) Function of recently discovered microorganisms involved in the arsenic and nitrogen cycles for the purpose of bioremediation

5) Application of novel molecular tools to investigate the function of hydrocarbon-degrading microorganisms in environments

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (B.E. 2558)

- Academic works
- Research papers

1) Tiralerdpanich P, **Sonthiphand P**, Luepromchai E, Pinyakong O, Pokethitiyook P. (2018) Potential microbial consortium involved in the biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Mar Pollut Bull*.;133:595-605. doi: 10.1016/j.marpolbul.2018.06.015.

2) **Sonthiphand P** and Neufeld JD. (2014) Nitrifying bacteria mediate aerobic ammonia oxidation and urea hydrolysis within the Grand River. Aquat. Microb. Ecol. 73: 151-162.

3) **Sonthiphand P,** Hall MW, and Neufeld JD. (2014) Biogeography of anaerobic ammonia-oxidizing (anammox) bacteria. Front. Microbiol. 5: 399. doi:10.3389/fmicb.2014.00399.

- Academic papers
- Books/textbooks
- Other academic works

Teaching responsibility

Current teaching responsibility

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส **330**	จุลชีววิทยาสิ่งแวดล้อม	3-0-6

Teaching responsibility in the new program / revised program

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วททส 330	จุลชีววิทยาสิ่งแวดล้อม	3-0-6

5. **Full name**.....**Puey Ounjai** .....

Title / Academic title .....Assistant Professor, Ph.D.....

Affiliation .....Department of Biology, Faculty of Science, Mahidol University.....

Work Place ....Mahidol University .....

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
ปร.ด.	อณูพันธุศาสตร์และพันธุวิศวกรรม	มหาวิทยาลัยมหิดล	2007
วท.บ.	เทคโนโลยีชีวภาพ	สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง	2001

Research interests or research skills

1) Molecular Cell Biology & Biophysics

2) Biotechnology, Biochemistry & Structural Biology

3) Science Education, Science Communication, Citizen Science

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (B.E. 2558)

Academic works (2014-present)

- **Research papers**

1) Samranwanich T, Boonthaworn K, Singhakaew S, **Ounjai P** (2019) Time-Restricted Inquiry-Based Learning Promotes Student Active Engagement in Undergraduate Zoology Laboratory. *Journal of Microbiology and Biology Education.* https://doi.org/10.1128/jmbe.v20i1.1571
2) Kiatmetha P, Chotwiwatthanakun C, Jariyapong P, Santimanawong W, Ounjai P, Weerachatyanukul W (2018) Nanocontainer designed from an infectious hypodermal and hematopoietic necrosis virus (IHHNV) has excellent physical stability and ability to deliver shrimp tissues. PeerJ. 2018 Dec 18;6:e6079. doi: 10.7717/peerj.6079.
3) Harnvoravongchai P, Chankhamhaengdecha S, Ounjai P, Singhakaew S, Boonthaworn K, Janvilisri T (2018) Antimicrobial Effect of Asiatic Acid Against Clostridium difficile Is Associated With Disruption of Membrane Permeability. Frontiers in Microbiology, https://doi.org/ 10.3389/ fmicb.2018.02125
4) Kitdumrongthum S, Metheetrairut C, Charoensawan V, Ounjai P, Janpipatkul K, Panvongsa W, Weerachayaphorn J, Piyachaturawat P, Chairoungdua A. (2018) Dysregulated microRNA expression profiles in cholangiocarcinoma cell-derived exosomes. Life Sci. pii: S0024-3205(18)30520-4. doi: 10.1016/j.lfs.2018.08.058
5) Phothichaisri W, Ounjai P, Phetruen T, Janvilisri T, Khunrae P, Singhakaew S, Wangroongsarb P, Chankhamhaengdecha S (2018) Characterization of Bacteriophages Infecting Clinical Isolates of *Clostridium difficile*, Frontiers in Microbiology, https://doi.org/10.3389/fmicb.2018. 01701
6) Hanpaibool C, Chakcharoensap T, Arifin, Hijikata Y, Irle S, Wolschann P, Kungwan N, Pongsawasdi P, Ounjai P, Rungrotmongkol T (2018) Theoretical analysis of orientations and tautomerization of genistein in β-cyclodextrin. Journal of Molecular Liquids. 265: 16-23. doi: 10.1016/j.molliq.2018.05.109
7) Reynolds MJ, Phetruen T, Fisher RL, Chen K, Pentecost BT, Gomez G, Ounjai P, Sui H (2018)

The Developmental Process of the Growing Motile Ciliary Tip Region. Scientific Reports, 8(1):7977. doi: 10.1038/s41598-018-26111-2.

8) Ramphan S, Suksathan S, Wikan N, Ounjai P, Boonthaworn K, Rimthong P, Kanjanapruthipong T, Worawichawong S, Jongkaewwattana A, Wongsiriroj N, Smith DR (2017) Oleic acid Enhances Dengue Virus But Not Dengue Virus-Like Particle Production from Mammalian Cells, Mol Biotechnol. doi: 10.1007/s12033-017-0029-4.

9) Somrit M, Watthammawut A, Chotwiwatthanakun C, Ounjai P, Suntimanawong W, Weerachatyanukul W, (2017) C-terminal domain on the outer surface of the *Macrobrachium rosenbergii* Nodavirus capsid is required for Sf9 cell binding and internalization. Virus Res. 2016 Sep 28;227:41-48. doi: 10.1016/j.virusres.2016.09.017.

10) Jampasri K, Pokethitiyook P, Kruatrachue M, Ounjai P, Kumsopa A, (2016) Phytoremediation of fuel oil and lead co-contaminated soil by *Chromolaena odorata* in association with Micrococcus luteus. Int J Phytoremediation. 2016 Oct 2;18(10):994-1001.

11) Liu, Y, Tran, BN, Wang, F, Ounjai, P., Wu, JL, Hew, CL, (2016) Visualization of Assembly Intermediates and Budding Vacuoles of Singapore Grouper Iridovirus in Grouper Embryonic Cells, Scientific Reports, 6:18696. doi: 10.1038/srep18696

12) Ojha SC, Chankhamhaengdecha S, Singhakaew S, Ounjai P, Janvilisri T, (2016) Inactivation of *Clostridium difficile* spores by microwave irradiation. Anaerobe, S1075-9964(15)30075-5. doi: 10.1016/j.anaerobe.2015.10.015.

- **Academic papers**

1) Aroonnual, A, Janvilisri, T, Ounjai, P, Chankhamhaengdecha, S (2017) Microfluidics: Innovative Approaches for Rapid Diagnosis of Antibiotic Resistant Bacteria, Essays in Biochem. 61(1):91-101. doi: 10.1042/EBC20160059 (Featured as cover)

2) Singhakaew S, Boonthaworn K, Sonpho E, Ounjai P (2016) An Overview of Sample Preparation Methods for Biological Electron Microscopy. Siriraj Med J 2016;68:(Supl 1):S91-S95

3) Charngkaew K, Boonthaworn K, Sonpho E, Chomanee N, Ounjai P (2016) A Primer to Electron Tomography. Siriraj Med J 2016;68:(Supl 1):S86-S90

4) Chaturongakul S, Ounjai P (2014) Phage-host interplay: examples from tailed phages and Gram-negative bacterial pathogens. Frontiers in Microbiology, 5:442. doi:10.3389/fmicb, 2014.00442.

- **Books/textbooks**
- **Other academic works**

1) รายการ DeScience ตอนบุกโลกใบเล็ก (รายการโทรทัศน์ 2 ตอน) ออกอากาศช่อง Mahidol Channel และช่อง ThaiPBS (2557); www.thaipbs.or.th/DeScience
2) รายการฉายแวว ตอนกล้องจุลทรรศน์ DIY ออกอากาศช่อง Mahidol Channel และช่อง OneHD (2558); http://www.onehd.net/program/showmanship (ผลงานสิ่งประดิษฐ์ของนายแก่นพงษ์ บุญถาวร นักศึกษาปริญญาเอกในห้องปฏิบัติการ)
2) รายการฉายแวว ตอนสืบจากศพหนอนตัวแบน ออกอากาศช่อง Mahidol Channel และช่อง OneHD (2558); http://www.onehd.net/program/showmanship (ผลงานวิจัยของนายเอกสิทธิ สอนโพธิ์ นักศึกษาปริญญาตรีในห้องปฏิบัติการ)
3) รายการฉายแวว ตอนถอดรหัสสัตว์แบ่งร่าง ออกอากาศช่อง Mahidol Channel และช่อง OneHD (2558); http://www.onehd.net/program/showmanship (ผลงานวิจัยของ น.ส. ชนิฎา วุฒิชัย รังสรรค์ นักศึกษาปริญญาตรีในห้องปฏิบัติการ)
4) ป๋วย อุ่นใจ, 2559, แมลงสาบ : ดีไซน์ใหม่แห่งวงการหุ่นยนต์ยืดหยุ่น, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
5) ป๋วย อุ่นใจ, 2559, ตุ๊กแก มด และซูเปอร์หุ่นยนต์จิ๋ว, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
6) ป๋วย อุ่นใจ, 2559, ติดไฟให้เมืองด้วยแบคทีเรีย, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
7) ป๋วย อุ่นใจ, 2559, ปฏิบัติการดักจับ CO2 จากชั้นบรรยากาศ, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
8) ป๋วย อุ่นใจ, 2559, Microbiota แก้วิกฤตอาหารโลก, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
9) ป๋วย อุ่นใจ, 2559, จาก Alpha Go สู่แพทย์ปัญญาประดิษฐ์, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
10) ป๋วย อุ่นใจ, 2560, เก็บหนังสั้นในแบคทีเรีย, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
11) ป๋วย อุ่นใจ, 2560, เมื่อเซรุ่มต้านพิษงูจะหมดโลก, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
12) ป๋วย อุ่นใจ, 2560, ยุทธการจัดการข่าวลองโลก, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
13) ป๋วย อุ่นใจ, 2560, โรงงานวัคซีนจิ๋วขนาดพกพา, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
14) ป๋วย อุ่นใจ, 2560, จาก “ไคมีรา” สู่ “หมูหัวใจคน”, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
15) ป๋วย อุ่นใจ, 2560, เมื่อโลกทั้งใบอยู่ที่ปลายนิ้วสัมผัส, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด
16) ป๋วย อุ่นใจ, 2560, Dragonfleye ไซบอร์กแมลงปอ, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด

17) ป๋วย อุ่นใจ, 2560, อภิมหาโปรเจ็คต์สร้างแผนที่เซลล์มนุษย์, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด

18) ป๋วย อุ่นใจ, 2560, ภาพสามมิติจากโมเลกุลแช่แข็ง, นิตยสารสารคดี, บ. วิริยะธุรกิจ จำกัด

19) ป๋วย อุ่นใจ, 2561, (บรรณาธิการ) เว็บไซต์ http://toxicant.org และเฟซบุ๊คเพจ ToxicAnt เพราะทุกสิ่งล้วนเป็นพิษ

Teaching responsibility

Current teaching responsibility

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วทชว 163	ชีววิทยาสาระสำคัญ	2-0-4
2	วทชว 192	ปฏิบัติการชีววิทยา 1	0-3-6
3	วททช 251	นิทัศน์ทางวิทยาศาสตร์	1-3-3
4	วททส 316	ไมโครเทคนิค	3-0-6

Teaching responsibility in the new program / revised program

Number	Course Code (Thai)	Course Name (Thai)	Number of Credits (Theory – Practice – Self-study)
1	วทชว 163	ชีววิทยาสาระสำคัญ	3-0-6
2	วทชว 192	ปฏิบัติการชีววิทยา 1	0-3-6
3	วททส 152	นิทัศน์ทางวิทยาศาสตร์ธรรมชาติ	1-4-4
4	วททส 316	ไมโครเทคนิค	3-0-6

6. Full name: Lecturer Pahol Kosiyachinda, Ph.D.

Title / Academic title: Lecturer

Affiliation: Department of Biology, Faculty of Science, Mahidol University

Work Place: Department of Biology, Faculty of Science, Mahidol University

Education (degree, filed of study, institution, and year of graduation ranging from the highest degree level to the bachelor's degree**)**

Degree	Field of Study	Institution	Year
Ph.D.	Plant Pathology	College of Agriculture and Life Sciences, Cornell University, New York, USA	2002
B.Sc.	Biology	Mahidol University, Thailand	1996

Research interests or research skills

1) Plant-microbe interactions
2) Plant physiology
3) Environmental biotechnology
4) Natural resources

Research or academic works (according to Standards Criteria for the Higher Education Curriculum (B.E. 2558)

- **Academic works**

Giving lectures in the following courses pertaining SCBE program

- General Biology I & II (SCBE101 & SCBE103)
- General Biology Laboratory I & II (SCBE102 & SCBE 104)
- General Genetics (SCBE 203 & SCBE 204)
- Fundamentals to Finesse: Microbes for Quality Life (SCBE253)
- Bioethics (SCBE304)
- Biological Control (SCBE412)

- **Research papers**
  - Puengthern, P., Senarat, S., Poolprasert, P., Kanchanareka, T., Kettratad, K, and Kosiyachinda, P. (2018) Ovarian histology of *Trypauchen vagina* during breeding season.

KKU Sci. J. 46(3): 462-468.

- Imsomboon, T., Thammasiri, K., Kosiyachinda, P. (2017) Effects of pH and sucrose on seed germination of Paphiopedilum exul (Ridl.) Rolfe. Acta Horticulturae: 1167, 95-100.

- **Academic papers**

1) Laboratory manual for General Biology I (SCBE102)

2) Laboratory manual for General Biology II (SCBE104)

- **Books/textbooks**

1) Wiwatanaratanabutr I., Kosiyachinda P., Boonplueang R., and Onparn N. (2019). Essential Biology 1. (Mader S. and Windelspecht M., Trans.) Bangkok, Thailand. McGrawHill. (Original work published 2014).

2. Wiwatanaratanabutr I., Kosiyachinda P., Boonplueang R., and Onparn N. (2019). Essential Biology 2. (Mader S. and Windelspecht M., Trans.) Bangkok, Thailand. McGrawHill. (Original work published 2014).

- **Other academic works**

None

Teaching responsibility

Current teaching responsibility

Number	Course Code	Course Name	Number of Credits (Theory – Practice – Self-study)
1	SCBE 101	General Biology I	3 (3-0-6)
2	SCBE 103	General Biology II	3 (3-0-6)
3	SCBE 253	Fundamentals to Finesse: Microbes for Quality Life	3 (2-3-5)
4	SCBE 304	Bioethics	2 (2-0-4)
5	SCBE 412	Biological Control	3 (3-0-6)

Teaching responsibility in the new program / revised program

Number	Course Code	Course Name	Number of Credits (Theory – Practice – Self-study)
1	SCBE 111	Fundamental Biology I	3 (3-0-6)
2	SCBE 113	Fundamental Biology II	3 (3-0-6)
3	SCBE 253	Fundamentals to Finesse: Microbes for Quality Life	3 (2-3-5)
4	SCBE 255	Aesthetics for fragrance and flavor	3 (3-0-6)
5	SCBE 304	Bioethics	2 (2-0-4)
6	SCBE 412	Biological Control	3 (3-0-6)

Table: Name lists of regular instructors

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.1	Mr. Prayad Pokethitiyook 3-7498-0000x-xxx	Assoc Prof	- Ph.D. (Chemical Engineering), University of Melbourne, Australia, 1999 - M.S. (Environmental Science and Engineering), Virginia Polytechnic Institute and State University, USA, 1989 - M.Sc. (Environmental Biology), Mahidol University, 1981 - B.Sc. (Biology), Mahidol University, 1978	Yongpisanphop J, Babel S, Kurisu F, Kruatrachue M, **Pokethitiyook P.** (2019). Isolation and characterization of Pb-resistant plant growth promoting endophytic bacteria and their role in Pb accumulation by fast-growing trees. *Environmental Technology* 9:1-28.
3.2.2.2	Mr. Sompoad Srikosamatara 3-7098-0004x-xxx	Assoc Prof	- Ph.D (Zoology) University of Florida, USA: 1987 - วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2523 - วท.บ. (ชีววิทยา) มหาวิทยาลัยมหิดล: 2520	Prayong, N., & Srikosamatara, S. (2017). Cutting trees in a secondary forest to increase gaur Bos gaurus numbers in Khao Phaeng Ma Reforestation area, Nakhon Ratchasima Province, Thailand. Conservation Evidence, 14, 5-9.
3.2.2.3	Arunee Ahantarig 3-1012-0150x-xxx	Assoc Prof	- Ph.D. (Plant Science) Chiba University, Japan: 1995 -วท.ม. (เกษตรศาสตร์) มหาวิทยาลัยเกษตรศาสตร์: 2531 -วท.บ. (เกษตรศาสตร์) มหาวิทยาลัยเกษตรศาสตร์: 2527	Trinachartvanit, W., Maneewong, S., Kaenkan, W., Usananan, P., Baimai, V., & Ahantarig, A. (2018). Coxiella-like bacteria in fowl ticks from Thailand. Parasites & vectors, 11(1), 670.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.4	Miss Theeraporn Puntheeranurak 5-1012-0009x-xxx	Assoc Prof	-ปร.ด. (พันธุศาสตร์ระดับโมเลกุลและพันธุวิศวกรรม) มหาวิทยาลัยมหิดล: 2546 -วท.บ. (ชีววิทยา) มหาวิทยาลัยเกษตรศาสตร์: 2541	Udomrat, S., Kumkate, S., Puntheeranurak, T., & Osotchan, T. (2018). Poly-L-lysine modified ITO surface for enhanced cell growth. Materials Today: Proceedings, 5(5), 11083-11088.
3.2.2.5	Mr. Philip D. Round 1-0512-54110-xxxx	Assoc Prof	B.Sc (Zoology) University of Aberdeen, UK: 1974	Irving, G. J., Round, P. D., Savini, T., Lynam, A. J., & Gale, G. A. (2018). Collapse of a tropical forest bird assemblage surrounding a hydroelectric reservoir. Global Ecology and Conservation, 16, e00472.
3.2.2.6	Miss Supeecha Kumkate 3-6501-0057x-xxx	Asst Prof	- Ph.D. (Biology) University of York, UK, 2004 -วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2542 - วท.บ. (จุลชีววิทยา), จุฬาลงกรณ์มหาวิทยาลัย, 2538	Udomrat, S., Kumkate, S., Puntheeranurak, T., & Osotchan, T. (2018). Poly-L-lysine modified ITO surface for enhanced cell growth. Materials Today: Proceedings, 5(5), 11083-11088.
3.2.2.7	Miss Wachareeporn Trinachartvanit 3-7298-0010x-xxx	Asst Prof	-Ph.D. (Ecology Ethology and Evolution) University of Illinois at Urbana-Champaign, USA: 2004 -วท.ม. (ชีววิทยาสภาวะแวดล้อม) มหาวิทยาลัยมหิดล: 2538 -วท.บ. (ชีววิทยา) มหาวิทยาลัยมหิดล: 2535	Trinachartvanit, W., Maneewong, S., Kaenkan, W., Usananan, P., Baimai, V., & Ahantarig, A. (2018). Coxiella-like bacteria in fowl ticks from Thailand. Parasites & vectors, 11(1), 670.
3.2.2.8	Miss Jenjit Khudamrongsawat 3-2399-0004x-xxx	Asst Prof	-Ph.D. (Biology) University of Alabama, USA: 2007 -M.Sc. (Plant Science)	Techachoochert, S., Gale, G. A., Khudamrongsawat, J., & Round, P. D. (2018). Habitat Association and

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			University of California, USA: 2002 -B.Sc. (Biological Science) Rochester Institute of Technology: 2000	Conservation Status of the Endangered Giant Nuthatch (Sitta magna) in Thailand. Tropical Conservation Science, 11, 1940082918798332.
3.2.2.9	Mrs. Surang Chankhamhaengdecha 3-2103-0096x-xxx	Asst Prof	-ปร.ด. (เทคโนโลยีชีวภาพ) มหาวิทยาลัยมหิดล: 2547 -วท.ม. (เทคโนโลยีชีวภาพ) มหาวิทยาลัยมหิดล: 2542 -วท.บ. (จุลชีววิทยา) มหาวิทยาลัยบูรพา: 2540	Dowdell, P., Chankhamhaengdecha, S., Panbangred, W., Janvilisri, T., & Aroonnual, A. (2019). Probiotic Activity of Enterococcus faecium and Lactococcus lactis Isolated from Thai Fermented Sausages and Their Protective Effect Against Clostridium difficile. Probiotics and Antimicrobial Proteins, 1-8.
3.2.2.10	Mr. Metha Meetam 3-1022-0082x-xxx	Asst Prof	- Ph.D. (Horticulture) Purdue University, USA, 2006 - B.A.(Biology) Washington University, USA, 1999	Charoonnart, P., Worakajit, N., Zedler, J. A., Meetam, M., Robinson, C., & Saksmerprome, V. (2019). Generation of microalga Chlamydomonas reinhardtii expressing shrimp antiviral dsRNA without supplementation of antibiotics. Scientific reports, 9(1), 3164.
3.2.2.11	Mr. Puey Ounjai 3-1020-0197x-xxx	Asst Prof	- Ph.D. (Molecular Genetics and Genetic Engineering), Mahidol University, 2007 - B.Sc. Biotechnology King Mongkut Institute of Technology Ladkrabang, 2001	Samranwanich T, Boonthaworn K, Singhakaew S, **Ounjai P** (2019) Time-Restricted Inquiry-Based Learning Promotes Student Active Engagement in Undergraduate Zoology Laboratory. *Journal of Microbiology and Biology Education.* https://doi.org/10.1128/jmbe.v20i1.1571

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.12	Mr. Patompong Johns Saengwilai 1-1014-0053x-xxx	Asst Prof	- Ph.D. (Plant Biology), Pennsylvania State University, USA, 2013 - B.Sc. (Biology), Mahidol University, 2007	Meeinkuirt, W., Phusantisampan, T., **Saengwilai, P.** (2018). Root system architecture influencing cadmium accumulation in rice (Oryza sativa L.). *International journal of phytoremediation*, 21, 19-26.
3.2.2.13	Mr. Ekgachai Jeratthitikul 1-5499-0000x-xxx	Asst Prof	- D.Sc (Biological Science) Kyoto University, Japan, 2013 - M.Sc. (Biological Science) Kyoto University, Japan, 2009 - วท.บ. (สัตววิทยา), จุฬาลงกรณ์มหาวิทยาลัย, 2550	Jeratthitikul, E., Phuangphong, S., Sutcharit, C., Prasankok, P., Kongim, B., & Panha, S. (2019). Integrative taxonomy reveals phenotypic plasticity in the freshwater mussel Contradens contradens (Bivalvia: Unionidae) in Thailand, with a description of a new species. Systematics and Biodiversity, 1-14.
3.2.2.14	Miss Chalita Kongrit 3-1019-0038x-xxx	Lecturer	- ปร.ด. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2553 - วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2545	Khudamrongsawat, J., Nakchamnan, K., Laithong, P., & Kongrit, C. (2018). Abnormal Repetitive Behaviours of Confiscated Slow Loris (Nycticebus spp.) in Thailand. Folia Primatologica, 89(3-4), 216-223.
3.2.2.15	Mrs. Thitinun Sumranwanich 3-6204-0023x-xxx	Lecturer	- Ph.D. (Horticulture) Pennsylvania State University, USA, 2003 - - วท.บ. (ชีววิทยา), มหาวิทยาลัยเชียงใหม่, 2539	Kampeera, J., Pasakon, P., Karuwan, C., Arunrut, N., Sappat, A., Sirithammajak, S., Dechokiattawan, N., Sumranwanich, T., Chaivisuthangkura, P., Ounjai, P. and Chankhamhaengdecha, S. (2019). Point-of-Care Rapid Detection of Vibrio parahaemolyticus in Seafood using Loop-Mediated Isothermal Amplification and Graphene-based Screen-Printed Electrochemical Sensor. Biosensors and Bioelectronics.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
3.2.2.16	Mr. Nuttaphon Onparn 3-1002-0032x-xxx	Lecturer	- Ph.D. (Biological Sciences) University of Exeter, UK, 2004 - M.S. (Ecosystems Analysis and Governance) University of Warwick, UK, 1999 - วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2541	Manawatthana, S., Laosinchai, P., Onparn, N., Brockelman, W. Y., & Round, P. D. (2017). Phylogeography of bulbuls in the genus Iole (Aves: Pycnonotidae). Biological Journal of the Linnean Society, 120(4), 931-944.
3.2.2.17	Mr. Pahol Kosiyachinda 3-1022-0061x-xxx	Lecturer	- Ph.D. (Plant Pathology) Cornell University, USA: 2002 - B.Sc. (Biology), Mahidol University, 1996	Pheungtheun, P., Senarat, S., Poonprasert, P., Kanchanareka, T., Kettratad, J., **Kosiyachinda, P**. (2018) Ovarian histology of *Trypauchen vagina* (Bloch & Schneider, 1801) during breeding season from Samut Songkhram Province. *KKU Sci. J*: 46(3) 462-468.
3.2.2.18	Mr. Siravit Sitprija 3-1014-0318x-xxx	Lecturer	- Ph.D. (Animal Physiology) Chulalongkorn University, 2009 - M.Sc. (Industrial microbiology) Chulalongkorn University, 1999 - B.Sc. (Biology) Kasetsart University, 2538	Sitprija, V., & Sitprija, S. (2019). Marine toxins and nephrotoxicity: mechanism of injury. Toxicon.161:44-49.
3.2.2.19	Miss Prinpida Sonthiphand 3-1005-0155x-xxx	Lecturer	- Ph.D. (Biology), University of Waterloo, Canada, 2014 - M.Sc. (Environmental	Tiralerdpanich P, **Sonthiphand P**, Luepromchai E, Pinyakong O, Pokethitiyook P. (2018) Potential microbial consortium involved in the

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Management), Chulalongkorn University, 2009 - B.Sc. (Biochemistry), Chulalongkorn University, 2005	biodegradation of diesel, hexadecane and phenanthrene in mangrove sediment explored by metagenomics analysis. *Mar Pollut Bull*.;133:595-605. doi: 10.1016/j.marpolbul.2018.06.015.
3.2.2.20	Mr. Phurt Harnvoravongchai 1-1014-0116x-xxx	Lecturer	- Ph.D. Eng. (Bioengineering) Tokyo Institute of Technology, Japan, 2015 - M. Eng (Bioengineering) Tokyo Institute of Technology, Japan, 2012	Harnvoravongchai, P., Chankhamhaengdecha, S., Ounjai, P., Singhakaew, S., Boonthaworn, K., & Janvilisri, T. (2018). Antimicrobial Effect of Asiatic Acid Against Clostridium difficile Is Associated With Disruption of Membrane Permeability. Frontiers in microbiology, 9.
3.2.2.21	Mr. Warut Siriwut 1-7199-0015x-xxx	Lecturer	- ปร.ด. (ชีววิทยา) จุฬาลงกรณ์มหาวิทยาลัย, 2556 - วท.บ. (ชีววิทยา) มหาวิทยาลัยขอนแก่น, 2540	Siriwut, W., Edgecombe, G. D., Sutcharit, C., Tongkerd, P., & Panha, S. (2018). Systematic revision and phylogenetic reassessment of the centipede genera Rhysida Wood, 1862 and Alluropus Silvestri, 1912 (Chilopoda: Scolopendromorpha) in Southeast Asia, with further discussion of the subfamily Otostigminae. Invertebrate Systematics, 32(5), 1005-1049.
3.2.2.22	Miss Parinda Thayanukul 1-1014-0010x-xxx	Lecturer	- Ph.D., (Environmental engineering), The University of Tokyo, Japan, 2012 - M. E. (Environmental engineering), The University of Tokyo, Japan, 2009	Nguyen, T. K. X., Thayanukul, P., Pinyakong, O., & Suttinun, O. (2017). Tiamulin removal by wood-rot fungi isolated from swine farms and role of ligninolytic enzymes. International biodeterioration & biodegradation, 116, 147-154.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			- วท.บ. (ชีววิทยา), มหาวิทยาลัยมหิดล, 2548	
3.2.2.23	Ms. Puangpaka Umpunjun 3-1005-0300x-xxx	Assoc Prof	- Ph. D. (Sciences des agroressources) INPT France, 1995 - D.E.A. (Traitment des matires premires vgtales) INPT France, 1991 - M.Sc. (Botany) Chulalongkorn University - B.Sc (Botany), 1990 Chulalongkorn University	Jeangkhwoa, P., Bandhaya, A., Umpunjun, P., Chuenboonngarm, N., & Panvisavas, N. (2017). Identification of Cannabis sativa L. using the 1-kbTHCA synthase-fluorescence in situ hybridization probe. Science & Justice, 57(2), 101-106.
3.2.2.24	Ms. Unchera Viboonjun 3-1002-0029x-xxx	Asst Prof	- Ph.D. (Biotechnology), Mahidol University, Bangkok, Thailand, 2002 - M.S. (Biotechnology), Mahidol University, Bangkok, Thailand - B.S. (Biotechnology), Mahidol University, Bangkok, Thailand	Kongsawadworakul, P., Viboonjun, U., & Narangajavana, J. (2018). Potential functional EST-derived SSR markers for latex and wood yield traits in rubber tree (Hevea brasiliensis (Willd. ex A. Juss.) Müll. Arg.). Thai Journal of Botany, 10(1):63-76.
3.2.2.25	Mr. Kanchit Thammasiri 3-1020-0263x-xxx	Assoc Prof	- Ph.D. (Horticulture), University of Hawaii, Honolulu, Hawaii, U.S.A., 1984 - M.S., (Horticulture), University of Hawaii, Honolulu, Hawaii, U.S.A., 1982 - M.S., (Agriculture), Kasetsart University, Bangkok, Thailand, 1981 - B.S., (Agriculture),	Pornchuti, W., K. Thammasiri, N. Chuenboonngarm and N. Panvisavas. 2017. Alteration of *Spathoglottis eburnean* Gagnep. Ploidy level after colchicine treatments. Walailak Journal of Science & Technology. 14(3): 243-252.

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Kasetsart University, Bangkok, Thailand, 1977	
3.2.2.26	Ms. Paweena Traiperm 3-1405-0013x-xxx	Assoc Prof	- Ph.D. (Biological Science), Chulalongkorn University, Bangkok, Thailand, 2551 - M.Sc. (Botany), Chulalongkorn University, Bangkok, Thailand - B.Sc. (Biology), Khon Kaen University, Khon Kaen, Thailand	Ketjarun, K., Traiperm, P., Suddee, S., Watthana, S., & Gale, S. W. (2019). Labellar anatomy of the Nervilia plicata complex (Orchidaceae: Epidendroideae) in tropical Asia. Kew Bulletin, 74(1), 1.
3.2.2.27	Ms. Aussanee Pichakum 3-1306-0015x-xxx	Asst Prof	- Ph.D. (Plant Science), Chiba University, Japan, 1995 - M.S. (Agriculture), Kasetsart University , Thailand - B.Sc. (Agriculture), Kasetsart University , Thailand	Romyanon, K., Watana, K., Pichakum, A., Mosaleeyanon, K., & Kirdmanee, C. (2017). Adjustment of medium composition and iso-osmotic potential in direct-shoot organogenesis produces true-to-type oil palm (Elaeis guineensis Jacq.) plantlets. Horticulture, Environment, and Biotechnology, 58(6), 601-612.
3.2.2.28	Ms. Thaya Jenjittikul 3-1007-0062x-xxx	Asst Prof	- Ph.D. (Horticulture), Kasetsart University, Bangkok, Thailand, 2003 - M.Sc. (Horticulture), Kasetsart University, Bangkok, Thailand - B.Sc. (Agriculture), Kasetsart University, Bangkok, Thailand	Nopporncharoenkul, N., & Jenjittikul, T. (2018). Kaempferia graminifolia (subgen. Protanthium: Zingiberaceae), a new endemic species from Thailand. Phytotaxa, 379(3), 261-266.
3.2.2.29	Ms. Ngarmnij Chuenboonngarm 3-1008-0022x-xxx	Asst Prof	- Ph.D. (Bioscience), Kasetsart University, Bangkok, Thailand, 2007	Chuengpanya, R., Chuenboonngarm, N., Thammasiri, K., Jenjittikul, T., Soonthornchainaksaeng, P. and

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			- M.Sc. (Environmental Biology), Mahidol University, Bangkok, Thailand - B.Sc. (Chemical Biology), Silpakorn University, Nakornpathom, Thailand	Muangkroot, A. (2017). Investigation of colchicine incubation time on the regeneration rate of *Globba williamsiana* 'Dok Khao'. Acta Horticulturae 1167: 149-156.
3.2.2.30	Ms. Sasivimon Swangpol 3-1005-0033x-xxx	Asst Prof	- Ph.D. (Biological Sciences), Chulalongkorn University, Bangkok, Thailand, 2007 - M.S. (Horticulture), University of Florida, Gainesville, U.S.A., 1991 - B.S. Honor (Botany), Chulalongkorn University, Bangkok, Thailand, 1988	Sumanon, P., Swangpol, S. C., & Traiperm, P. (2018). Culm internodal Anatomy of the Tribe Oryzeae (Poaceae) in Thailand. CHIANG MAI JOURNAL OF SCIENCE, 45(2), 832-845.
3.2.2.31	Ms. Panida Kongsawadworakul 3-1022-0204x-xxx	Asst Prof	- Ph.D. (Plant Cell and Molecular Biology), Universite Montpellier II, France - M.Sc. (Plant Biotechnology), Mahidol University, Thailand - B.Sc. (Biotechnology), Mahidol University, Thailand	BONGCHEEWIN, B., DARBYSHIRE, I., SATITPATIPAN, V., & KONGSAWADWORAKUL, P. (2019). Taxonomic revision of Clinacanthus (Acanthaceae) in Thailand. Phytotaxa, 391(4), 253-263.
3.2.2.32	Ms. Wisuwat Songnuan 3-9001-0003x-xxx	Asst Prof	- Ph. D. (Medical Sciences Biological and Biomedical Sciences (BBS) program), Harvard Medical School and Graduate School of Arts and Sciences	Songnuan, W., Bunnag, C., Soontrapa, K., Pacharn, P., Wangthan, U., Siriwattanakul, U., & Malainual, N. (2018). Airborne fungal spore distribution in Bangkok, Thailand: correlation with meteorological

No.	Name-Surname	Academic Position	Degree (field)/ Institute/ Graduation year	Most recent Academic Work in 5 years
			Cambridge, Massachusettes, USA, 2009 - B.Sc. in Biology Trinity College of Arts and Sciences, Duke University Durham, North Carolina, USA	variables and sensitization in allergic rhinitis patients. Aerobiologia, 34(4), 513-524.
3.2.2.33	Ms. Alyssa Stewart 5-9080-0000x-xxx	Lecturer	- Ph.D. (Biology), University of Maryland at College Park, USA, 2015 - B.S. (Biology), University of North Carolina at Chapel Hill, USA, 2007	**Stewart AB,** Dudash MR. 2018. Foraging strategies of generalist and specialist Old World nectar bats in response to temporally variable floral resources. *Biotropica*, 50:98-105.
3.2.2.34	Mr. Saroj Ruchisansakun 1-1014-0112x-xxx	Lecturer	- Ph.D. (Biology: Understanding Evolution), Leiden University, The Netherlands - M.Sc. (Plant Sciences), Mahidol University, Thailand - B.S. (Plant Sciences), Mahidol University, Thailand	Ruchisansakun, S., Suksathan, P., Van der Niet, T., Smets, E. F., & Janssens, S. B. (2018). Balsaminaceae of Myanmar. Blumea-Biodiversity, Evolution and Biogeography of Plants, 63(3), 199-267.

b. List of special instructors

Number	Full names	Academic titles / titles	Graduate Degree and institutions	Affiliations
1	Mr. Thomas Neal Stewart	Lecturer	- Ph.D. (Biochemistry) University of North Carolina, U.S.A, 1986 - B.Sc. (Chemistry) University of Florida, U.S.A, 1982	Faculty of Environment and Resource studies

Appendix 7

Mahidol University Regulations on Diploma and Undergraduate Studies of the Year B.E. 2552-2560 and the affiliation's educational announcements/regulations

Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009)

Rules and guidelines for diploma and undergraduate studies are to be enforced in accordance with Mahidol University's act, 2007.

Mahidol University Council, under Section 24 (2) of Mahidol University Act B.E.2550 (2007), agreed to enact the following regulations in its 526th meeting, April 22, 2009.

Rule 1: These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009)"

Rule 2: These regulations shall become effective for the diploma and undergraduate students who enroll at Mahidol University in 2009 academic year onwards.

Rule 3: In these regulations

"University"	means	Mahidol University
"Faculty"	means	Faculties and divisions otherwise named, equivalent to other faculties that conduct teaching.
"Faculty committee"	means	Committee of the faculties and other divisions named equivalent to the faculties that conduct teaching.
"Dean"	means	Head of the faculties or other divisions, otherwise named, equivalent to the faculties that conduct teaching.
"Curriculum"	means	Diploma and undergraduate curriculum that supports the policies or operation or regulations and rules of Federations or Division of Art of Healing (if any) approved by the university council and acknowledged by the Higher Education Commission.
"Program Lecturers"	means	Lecturers in the diploma or undergraduate program.
"Program Committee"	means	Committee appointed by the Dean to manage and take the curriculum under consideration.

Rule 4: Admission

University or faculty, through the faculty committee, can accept students according to the conditions and methods indicated in the curriculum or the faculty's announcements approved by the president. Admission can be classified into three types;

4.1 Students are accepted by the quota system.

4.2 Students are accepted through the Office of Higher Education Commission.

4.3 Faculty can select and accept students directly according to the faculty's announcement which has been approved by the university.

Rule 5: Teaching System

5.1 **Semester System:** each academic year is divided into two regular semesters; Semester 1 and Semester 2. Each semester consists of at least 15 weeks broken into intervals. A faculty can organize a summer session if necessary. However, the summer session time period and registered credits must be comparable to the regular semester.

5.2 **Trimester System:** each academic year consists of three regular terms which are Trimester 1, Trimester 2, and Trimester 3, with at least 12 weeks in each trimester with semester breaks. The faculty can organize a summer session if necessary. However, the summer session time period and credit registration must be comparable to the regular semester.

5.3 **Others:** Faculty may use another system, the details of which must be clearly given in the curriculum period and credit registration must be equivalent to the semester or the trimester system.

Rule 6: Credits in each course are assigned according to the following criteria.

6.1 **Semester System**

1. A theoretical course with lectures or discussions or equivalent that is one hour per week or at least 15 hours per semester and two hours self-study per week or at least 30 hours per semester is assigned one semester credit.
2. A practical, laboratory course, or equivalent that is 2-3 hours per week or 30-45 hours per semester, and one hour self-study per week or 15 hours per semester is assigned one semester credit.

3. An internship, a project or any learning activity that has been assigned which is 3-6 hours per week or 45-90 hours per semester, and one hour self-study per week or 15 hours per semester is assigned one semester credit.

6.2 **Trimester System**

1. A theoretical lecture course or equivalent that is one hour per week or at least 12 hours per semester, and two hours self-study per week or at least 24 hours per semester is assigned one trimester credit.
2. A practice, laboratory course or equivalent that is 2-3 hours per week or 24-36 hours per semester, and one hour self-study per week or 12 hours per semester is assigned one trimester credit.
3. An internship, a project or any learning activity that has been assigned which is 3-6 hours per week or 36-72 hours per semester, and one hour self-study per week or 12 hours per semester is assigned one trimester credit.

6.3 **If Rule 6.1 or 6.2 cannot be applied**, the faculty committee or the person appointed by the faculty committee can assign the credits for each course as he/she sees fit and clearly details how they compare with the semester credit system in the curriculum.

Rule 7: Total credits and time of study

7.1 In an undergraduate study (4 years), the total number of credits must be at least 120 semester credits or 150 trimester credits, and the maximum time of study is 8 academic years.

7.2 In an undergraduate study (5 years), the total number of credits must be at least 150 semester credits or 187.5 trimester credits, and the maximum study time is 10 academic years.

7.3 In an undergraduate study (not less than 6 years), the total number of credits must be at least 180 semester credits or 225 trimester credits, and the maximum study time is 12 academic years.

7.4 In an undergraduate study (continuing), the total number of credits must be at least 72 semester credits or 90 trimester credits, and the maximum study time is 4 academic years.

An undergraduate study (continuing) has to be considered as part of an undergraduate study and must reflect the philosophy and contents of that particular undergraduate curriculum completely. The word “continuing” must be clearly written put in the parentheses after the name of the program.

In all cases, study time is to be counted from the first day of the first term for which the student has been accepted in that program.

Rule 8: Symbols showing evaluation results

8.1 **Symbols and their assigned scores**

Grade results of each course may be shown in symbolic type as follows;

Symbol	Score
A	4.00
B+	3.50
B	3.00
C+	2.50
C	2.00
D+	1.50
D	1.00
F	0.00

8.2 **Symbols without scores**

Grade results of each course may be shown in symbolic type as follows;

Symbol	Meaning
AU	Study which leads to no credit (Audit)
I	Awaiting for evaluation (Incomplete)
P	The study is incomplete (In Progress)
S	Satisfactory
T	Transfer of credit
U	Unsatisfactory
W	Withdraw
X	No report

8.3 **Grading system**

1. Symbols with at least 2.00 points, or the symbol S, means **Pass** in that course
2. Symbols with 1.00 or 1.5 points, or the symbol U, means that knowledge or ability of the student is below average. Other grading results are at the discretion of the faculty committee or the person appointed by the committee. On re-grading a course, the grade score will be 2.00 (or S), at the maximum.

8.4 **F will be given** in the following situations;

1. The student took the examination and failed in the exam or project.
2. The student was absent from the exam without any permission from the faculty committee or person appointed by the faculty committee.
3. The student was not allowed to take the exam according to Rule 11.
4. The student violated the examination regulation; for example, being late to the exam, dressed inappropriately according to student uniform regulation or act as in Rule 22.
5. The student who received an I and did not take the exam or finish the project within one regular semester or trimester after they received the I grade, except that the student has the permission as in Rules 15.1 and 15.2.
6. The student who received a P and did not take the exam and/or did not hand in report on time.
7. The student who does not re-take the exam or re-do the project as indicated in 8.3 (2), or the student has re-taken the exam or re-done the project and is still evaluated as “failed”.

8.5 **S or U are given** only in non-credit courses or courses with credits for which the faculty has decided to use the non-score grading system.

8.6 **AU is given** only in the courses in which the student gives his/her intention to study for no credit and the student must participate in classes or practical activities not less than 80 percent of the total study time and practice time period must not be less than 80 percent.

8.7 **I will be given** in according to the following situations;

1. The student did not come to the exam or did not hand in the report in time due to ill health, as evidenced by a medical certificate endorsed by the university’s Health Service Unit. However, the final decision will be made by the person appointed by the committee.

2. The student was not allowed to take the exam according to Rule 11 due to ill health, as evidenced by a medical certificate endorsed by the university's Health Service Unit. However, the final decision will be made by the committee.
3. The student was not able to take the exam or hand in the report due to force majeure. However, the final decision will be made by the person appointed by the committee.

8.8 **P can be** given only in the courses in which the classes are still on going, and/or the courses last longer than one semester/trimester.

8.9 **T can be given** in the case that the credits for the course have been transferred from another faculty or institute.

8.10 **W will be given** in the following situations;

1. The student is allowed to withdraw from the courses according to Rule 10.3.
2. The student is allowed to take a leave.
3. The student is suspended.

8.11 **X can be given** only in courses in which the faculty has not yet received the grade report.

Rule 9: Registration

Students have to register for courses and the total credits must be no less than specified in the curriculum according in the following criteria.

9.1 For a full time student, the number of registered credits should be no less than 9 and no more than 22 credits in each regular session. In the summer session, the number of registered credits can be no greater than 9. Registration will be completed only if the student has completed everything in the specified time period.

The faculty may allow registration which differs from the above criteria if necessary. However, changes must not disrupt the standard and quality of learning, while the total number of registered credits must be as specified in the curriculum

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9.2 Re-registration or re-grading can be done in the following situations;

1. The student received F or W or U, or the committee or the person appointed by the committee agreed that the student should re-grade according to Rule 8.3(2). If it is an

elective course, a student is allowed to register for any other elective courses instead. Or,

2. The student has to re-grade in order to improve CUM-GPA, in which case the approval of the advisor and instructor is needed.
3. The student is allowed to re-grade in each course as stated in Rules 9.2(1) and 9.2 (2), at the number of times set by the faculty, but no more than twice, except when the student has been allowed to take a leave according to Rules 15.1(2), 15.1(2), and 15.1(3).

9.3 Registration in more than one program

A student who wants to study in more than one program can register for courses according to Rule 9.1 for each program. Once the student completes all courses required in each program of study, the student receives a degree of that program. However, the study time must not exceed 8 academic years, counted from his/her first enrollment in the undergraduate study.

Rule 10: Add, drop, and withdrawal

A student can request to add, drop, and withdraw from courses provided the instructors approves and the request has to be approved by the Dean or a person appointed by the Dean. Approval is given according to the following criteria;

10.1 **Adding:** Request for adding the course must be done within the second week of a regular session, counted from the session's starting date or within the first week of summer session. For the courses that are not offered at the start of that session, adding can be requested in the first week of that course counted from the time the course starts.

10.2 **Dropping:** Dropped courses will not be shown in the transcript or grade report. The course will not be counted as having been registered once if dropping is done within the second week of a regular session, counted from the session's starting date or within the first week of the summer session. For the courses that are not offered at the start of that session, dropping can be requested in the first week of that course counted from the time when the course starts.

10.3 **Withdrawal:** Course withdrawal can be done after the second week of the regular session or after the first week of the summer session, or after the first week of the courses that do not start at the start of the session, until the week before the exams are

held. Courses that are withdrawn will be shown in the transcript and grade report, and the course is counted as registered once.

Reasons must be given for either approval or disapproval by the Dean or an appointed person.

Rule 11: Study time

The student has to be present in a theoretical, lecture, practice, internship, or field study no less than 80 percent of the total study time of that course in order to be allowed to take the exam.

Rule 12: Credits counting

12.1 Credits identified as "pass" will be counted in order to complete the program of study.

Only the credits for courses that have been given a "pass" grade are to be counted towards graduation If the student has re-graded the course; only the credits of the course last registered for will be counted if evaluated as passed, and counted only once.

12.2 All scored credits will be counted to calculate the CUM-GPA.

If a student registers for the course more than once, only the latest score will be considered and used to calculate the CUM-GPA.

Rule 13: Calculating GPA

There are 2 types of GPA; GPA per session and CUM-GPA. GPA can be calculated as follows;

13.1 **GPA per session** is calculated from the grades in that session by dividing the sum of the products of the score and the number of credits by the total number of credits in that session. GPA is rounded off to two decimal places.

13.2 **CUM-GPA** is calculated from the first session of study to the last session by dividing the sum of all the products of the score and the number of credits by the total number of credits earned under Rule 12.2. CUM-GPA is rounded off to two decimal places.

If a student has registered for a course more than once, only the latest score is used.

Rule 14: Credits Transfer

A student who changes division or faculties within the university, or transfers from another institute is allowed to request credit transfer in order to acquire the total number of credits in the

program without having to register for those courses again. The transferred courses are shown as T in the transcript and grade report. The transfer of credits or courses can be done only for a student who has been approved to take such courses by the program committee or the person appointed by the faculty committee to be responsible for the program of study from which the transfer is to be made.

14.1 Credits transfer conditions

1. The standard quality of the institute from which the credits are transferred to Mahidol University must be comparable to that of Mahidol University's, and approval must be given by the program committee.
2. The course content must overlap with at least three quarters of the content of the corresponding course, or group of courses, in the university, and the courses must be approved by the program committee.
3. The transferred courses must have been registered for within the last 5 years, if not the decision is up to the program committee.
4. The transferred courses must receive at least Grade C or the equivalence.
5. Credits transfer can be made at most half of the total number of credits in that program.

14.2 In order to transfer the credits, the student has to write a letter to the Dean together with documents related to the course under consideration. Then the program committee and/or the faculty committee considers the request and gives reasons for approval. The matter is then presented to the university and/or the president for approval.

14.3 Grades of transferred courses are shown in the transcript and grade report as T and are not used to calculate the GPA or CUM-GPA.

14.4 Students with transferred courses according to Rules 14.1(1)-14.1(3) are able to receive a degree with honors complying with Rule 21.

14.5 Courses that do not follow the regulation, can still be transferred under the program committee and/or faculty committee with the university/president's approval in compliance with Rule 14.1

Rule 15: Leave of Absence

15.1 A student can request for leave of absence in the following situations;

1. Being conscripted or drafted for the army or military service.

2. Receiving grants to go abroad or on an exchange program under the university's approval.
3. Being sick or having health problems requiring more than 20 percent of class time in order to recover or to be cured as evidenced by a medical certificate endorsed by the Student Health Service of the university.
4. A student having personal reasons may ask for leave provided the student has been studying in the university for at least one session and has a CUM-GPA of at least 2.00.

Under Rule 15.1, the student has to request for leave as soon as possible to get approval from the Dean or the appointed person.

15.2 Under the force majeure, students' reasons may not come under Rule 15.1. The student must request for leave as soon as possible to get approval from the faculty committee or the person appointed by the faculty committee.

15.3 On the approval of leave of absence under Rules 15.1 and 15.2, the maximum time allowed is two regular semesters or 3 regular trimesters. If more time for leave of absence is needed, the student has to request for another leave of absence according to Rule 15.1 or 15.2.

15.4 During a leave of absence, study time is still counted: except in the case of 15.1(1) and 15.1(2) or other force majeure approved by the president.

15.5 During the leave, the student must maintain student status by paying fees according to university regulations; otherwise the student status will not be maintained.

15.6 If a student who has been approved leave wishes to return to study, the student has to request for re-admission to the Dean or the appointed person at least 1 week before the registration period.

Reasons must be given for approval or disapproval of leave of absence by the Dean or an appointed person.

Rule 16: Student Status Classification

16.1 Student status for a freshman is classified at the end of the second semester or trimester after entry. From sophomore onwards, classification is made at the end of each regular session or at the end of the academic year for the continuing program of study. For

students who request to graduate with a diploma or a bachelor's degree, classification may be done at the end of the summer session.

16.2 A student is classified normal or as under probation according to the following;

1. Normal status applies to students who are registered in the very first session or students who have CUM-GPA of at least 2.00.
2. Probation status applies to students who have CUM-GPA greater than or equal to 1.50 but less than 2.00, which can be further classified into 2 types.

Type 1 means a group of students who have Cum-GPA of 1.50 or higher but less than 1.80.

Type 2 means a group of students who have Cum-GPA of 1.80 or higher but less than 2.00.

Rule 17: Student's level

A student's level is classified from the total number of credits that the student has earned out of the total number of credits in the curriculum.

Rule 18: Student status will not be maintained according to the following conditions;

18.1 The student has completed the program of study according to the curriculum and has been approved to receive a diploma or a bachelor's degree under Rule 20.

18.2 The student has been approved from the Dean to be dismissed.

18.3 The president orders the student to be dismissed according to the following situations;

1. After classification, the student has CUM-GPA less than 1.50.
2. The student is under type 1 probation having CUM-GPA less than 1.80 and is still under probation in the next 2 semesters or the next 3 trimesters continuously or for one academic year by Rule 5.3.
3. The student is under type 2 probation having CUM-GPA less than 2.00 and is still under probation in the next 4 semesters or the next 6 trimesters continuously or 2 academic years by Rule 5.3.
4. The student registers in the same course at the maximum number of times stipulated in Rule 9.2(3) and still does not pass the course.
5. The student has used twice the time specified in the curriculum.

6. No registration or no leave of absence request has been made after the first two weeks of the session. The university cannot contact the student and the student has no appropriate reason to explain the situation.
7. The student acts against the university or joint institute regulations on students' discipline.
8. The student has difficulty with studying or working due to mental disorders. In this case, the university will appoint a committee to deliberate on the situation and make recommendations for the university council's approval.
9. The student is punished according to Rule 22.
10. Death.

Rule 19: Graduation

19.1 Graduation from full-time undergraduate study (4 years) can be made on or after the 6th regular semester.

19.2 Graduation from full-time undergraduate study (5 years) can be made on or after the 8th regular semester.

19.3 Graduation from full-time undergraduate study (not less than 6 years) can be made on or after the 10th regular semester.

19.4 Graduation for full-time undergraduate study (continuing) can be made on or after the 4th regular semester.

Rule 20: Granting Diploma or Bachelor's Degree

In order to be eligible to receive a Diploma or a Bachelor's Degree, a student has to;

20.1 Pass all courses and fulfill other criteria indicated in the curriculum.

20.2 Have CUM-GPA of at least 2.00

20.3 Have good behavior suitable for the prestige of the degree.

Rule 21: Degree with Honors

A student who has studied in an undergraduate program in the university with at least 120 credits including transferred courses, is eligible to receive a degree

with honors. However, transferred courses require at least Grade B (or equivalent) and are not used to calculate the CUM-GPA. In order to receive Class 1 honors, the student must have a CUM-GPA of 3.50 or above, while a Class 2 honors student must have a CUM-GPA of 3.25 or above, also a student must;

21.1 Not used time that exceeds that which is indicated in the curriculum.

21.2 Be eligible to receive a degree according to Rule 20.

21.3 Never have re-graded or re-registered in other courses or re-taken an exam or re-done a report or project in any course in the curriculum including the transferred courses.

21.4 If the student has transferred some credits, the sum of the transferred credits should not exceed one quarter of the total number of credits in the curriculum.

Rule 22: Dishonesty Punishments

Cheating during the exam is punished as follows;

22.1 Given F on the course in which cheating is committed.

22.2 Given F on the course in which cheating is committed, and be suspended in the next session for at least one session.

22.3 Given F to all courses registered in that session.

22.4 Given F to all courses registered in that session and be suspended in the next session for at least one session.

22.5 Be dismissed.

The president has the right to dismiss a student who has cheated in the exam, and that student cannot be re-admitted to study at Mahidol University.

Rule 23: Any act that is not included in this regulation, regulations of other universities or faculties that conforms to this regulation may be adopted.

Rule 24: The president is in charge of these regulations. In case of any problems concerning these regulations, the president has the power to make diagnostic interpretation and issue a command as he deems appropriate.

Announced on 27th April, 2009

(Professor Dr. Vicharn Panich, M.D.)

Chairman of Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (2nd Issue), B.E. 2556 (2013)

Whereas it is deemed as appropriate to modify the Mahidol University Regulations on Diploma and Undergraduate Studies B.E. 2552 (2009).

Mahidol University Council, under Section 24 (2) of Mahidol University Act B.E.2550 (2007), agreed to enact the following regulations in its 478th meeting held on 20th November 2013.

1. These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies (2nd Issue), B.E. 2556 (2013)."
2. These regulations shall become effective after the promulgation date and henceforth.
3. The statement, hereby called Number 4 of Mahidol University Regulations on Diploma and Undergraduate Studies, 2009 shall be cancelled, and the following statement shall be applied.

   " 4. Each faculty committee shall consider admitting applicants into their programs in accordance with conditions and procedures stated in the curriculum or in the faculty announcements approved by the President of Mahidol University. The university shall determine the types of opening for undergraduate students which will be in the university announcement."
4. The statement, hereby called Number 18.3 (6) of Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009) shall be cancelled, and the following statement shall be applied.

   "18.3 The President shall expel a student in the following cases:

   (6) within 2 weeks of registration, the student not registering for regular semester, not registering to retain student status, or not being approved for postponing the registration.

5. The following statement shall be added as Number 18/1 to Mahidol University Regulations on Diploma and Undergraduate Studies, B.E. 2552 (2009):

"18/1 Student status reinstatement

18/1.1 The student whose status ends due to Number 18.3 (6) may request reinstatement of student status by presenting the request form for reinstatement of student status to the President within 1 year after the expulsion.

18/ 1. 2 Reinstatement of student status must be approved by the President following the consent of the Chairperson of the Program, the Dean, and Vice President for Education respectively.

18/1.3 After approval by the President, the student can earn student status and return to study regularly in the following semester.

18/1.4 The duration of the study absence will be included in the duration of the program's maximum study period.

18.1.5 The student must pay the fee for the reinstatement of student status as well as the fees incurred during the period of the study absence.

18/ 1.6 After the return of student status is approved, the student will have his/ her regular status as before. However, the computation of the study duration will be made according to Number 7."

Announced on 16th December, 2013

(Professor Dr. Vicharn Panich)

Chairman of Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (3rd Issue), B.E. 2558 (2015)

Whereas it is deemed as appropriate to modify Mahidol University Regulations on the Bachelor's Degrees and the Diploma/Certificate Program B.E. 2552 (2009) and the additionally modified (2nd Issue) B.E. 2556 (2013).

Mahidol University Council, under Section 24 (2) of Mahidol University Act B.E. 2550 (2007), agreed to enact the following regulations in its 495th meeting on 22nd April, 2015.

1. These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies (3rd Issue), B.E. 2558 (2015)."

2. These regulations shall become effective from the promulgation date and henceforth.

3. The following statement, hereby called Number 23/1, is to be added to Mahidol University Regulations on on Diploma and Undergraduate Studies, B.E. 2552 (2009) and additionally modified (2nd Issue) B.E. 2556 (2013).

"Number 23/1: The University Council has the authority to consider cases for exemptions of the regulations provided that the cases have gained approvals from no less than a quarter of the council members presented in the meeting."

Announced on 20th May, 2015

(Professor Dr. Vicharn Panich

Chairman of Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (Issue 4), 2015

Mahidol University Regulations on Diploma and Undergraduate Studies was under consideration for improvement, and thus Mahidol University Council, under Section 24(2) of Mahidol University Act B.E.2550 (2007), agreed to enact the following regulations in its 500th meeting on 16th September 2015.

1. These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies (Issue 4), 2015."

2. These regulations shall be effective from academic year of 2015 and henceforth.

3. The definitions of a "faculty" and a "faculty committee" stated in number 3 of Mahidol University Regulations on Diploma and Undergraduate Studies 2009 shall be cancelled, and the following statements shall be applied:

A "working unit" refers to a faculty, a college, an institute, a graduate school, and other working units, called by other terms that are responsible for teaching and are an equivalent to a faculty; this includes a campus with a curriculum/ curricular complying with the university's regulations.

A "working unit committee" is a term that covers other working unit committees or working units that are called by other terms and are responsible for teaching.

4. The statement in number 8.4 of Mahidol University Regulations on Diploma and Undergraduate Studies 2009 shall be cancelled, and the following statements shall be applied:

"8.4 An "F" grade shall be given to students with the following circumstances:

(1) students who have attended the examination and/or failed the examination or failed in an evaluation of their work

(2) students who have missed the examination despite not being allowed to by the faculty committee or the person authorized by the faculty

(3) students who have not been allowed to take the examination as stated in number 11

(4) students who have violated examination rules, such as showing up later than the indicated time, not following the dress code, or having performed an action as stated in number 22 and therefore it has been decided to fail them in the examination

(5) students who have received an "I" and have not proceeded with the examination or the assigned work after receiving an "I" within one normal academic year of the semester or the trimester system, except for those who have been allowed to drop the semester as stated in numbers 15.1 and 15.2

(6) students who have received a "P" and have not taken the examination and/or submitted the assigned work

(7) students who have not taken the re-examination or have not re-submitted the assigned work as stated in number 8.3 (2); or students who have taken the re-examination or re-submitted the work but still have failed the evaluation

(8) students who lack the qualifications for the subject's evaluation as stated by the "working unit committee"

5. The statement in number 22 of Mahidol University Regulations on Diploma and Undergraduate Studies 2009 shall be cancelled, and the following statements shall be applied:

"22. Students who have cheated in the subject's examination shall get an "F" for that particular subject, and disciplinary actions shall be taken against each student according to the Mahidol University Regulations on Student Disciplines".

6. If the terms "faculty" and "the faculty committee" are used in the Mahidol University Regulations on Diploma and Undergraduate Studies 2009, they shall refer to a "working unit" and a "working unit committee" as stated in this announcement.

Announced on 15th October 2015

(Professor Dr. Vicharn Panich)

Chairman of Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (Issue 5), 2016

Mahidol University Regulations on Undergraduate Studies were under consideration for improvement, and thus Mahidol University Council, under Section 24(2) of Mahidol University Act 2007, agreed to enact the following regulations in its 507th meeting on 20th April 2016.

1. These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies (Issue 5), 2016."
2. These regulations shall be effective from the next day after the announcement.
3. The following statement shall be added as number 19/1 in the Mahidol University Regulations on Diploma and Undergraduate Studies 2009:

"19/1 English Proficiency Tests

Undergraduate students shall pass English proficiency test(s) according to the university's conditions and regulations"

4. The following statement shall be added as number 20.4 in the Mahidol University Regulations on Diploma and Undergraduate Studies 2009:

"20.4 Students are able to pass the English proficiency test according to the university's announcement."

Announced on 30th May 2016

(Professor Dr. Vicharn Panich)

Chairman of Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (Issue 6), 2017

Mahidol University Regulations for Diploma and Undergraduate Studies have been under consideration for improvement, and thus the Mahidol University Council, under section 24(2) of the Mahidol University Act of B.E. 2550 (2007), agreed to enact the following regulations in its 517th meeting on 15th February 2017.

1. These regulations are referred to as "Mahidol University Regulations for Diploma and Undergraduate Studies (Issue 6), 2017".

2. These regulations shall be effective from the announcement date and henceforth.

3. Statement number 14 of the Mahidol University Regulations for Diploma and Undergraduate Studies 2009 shall be cancelled, and the following statements shall be applied:

"14 Credit Transfer

Students who wish to transfer credits from their subjects or their working units (within Mahidol University or from other higher education institutes) may request to transfer credits up to the number of credits that they are required to take to complete their program, without having to enrol in subjects in the program, and the results will be shown as "T". The transfer can be made only after the students have obtained permission to do so, or for students who have been approved to enrol in subjects in other higher education institutes. Such conduct must be agreed by the lecturers responsible for the program, the working unit committee, or the program committee. The credit transfer must follow the following rules:

14.1 Conditions for credit transfer

(1) The credit(s) to be transferred must be of subject(s) in other higher education institutes in Thailand or overseas with a higher or equivalent standard to Mahidol University, and they must have been approved by the program committee.

(2) The credit(s) to be transferred must be of subject(s) that provide at least a three-quarter similarity or equivalent content and learning experiences to students compared to subjects in the program, and this must have been approved by the program committee.

(3) The credit(s) to be transferred must be from subject(s) which the student has been enrolled in within 5 years. If not, the program committee and the working unit committee will consider the matter.

(4) The grade(s) of the credited subject(s) to be transferred must be at least a C.

(5) Students can transfer no more than half of the total number of credits in the program.

14.2 Students who wish to transfer their credits must send evidence regarding those subjects and a letter to the working unit. The head of the working unit, agreed by the relevant department and program committee and/or the working unit committee, is responsible for the credit transfer consideration and will present their findings to the Mahidol University President for approval.

14.3 The transferred credit(s) will be shown in the student's transcript under the name of the subject(s) transferred, marked with "T", and their scores will not be included in the GPA.

14.4 Students who have their credit transferred as stated in number 14.1 (1) – (3) can still obtain a bachelor's degree according to the Mahidol University Regulations for Diploma and Undergraduate Studies.

14.5 Credit transfer can be done under student exchange and student mobility projects between Mahidol University and other higher education institutes in a program or in an MOU, as detailed below:

(1) Bilingual programs that cooperate with overseas higher education institutes – Students will graduate with two bachelor's degrees, one from Mahidol University and another from the overseas institute;

(2) Double or multiple degree programs that cooperate with overseas higher education institutes – Students will graduate with two bachelor's degrees, one from Mahidol University and another from the overseas institute that cooperates in teaching in the program;

(3) Joint degree programs which are programs that cooperate in teaching with overseas institutes – Students will graduate with one bachelor's degree;

(4) Distance education programs with reliable planning, teaching methods, teaching services, and quality assessments; or

(5) MOU between Mahidol University and overseas higher education institutes.

Concerning credit transfer in the cases of numbers 14.5 (1) - (5), students can obtain results for transferred credits as grades and they can be included in the GPA and be recorded on their transcripts. The head of the working unit, agreed by the relevant department and program committee and/or the working unit committee, is responsible for the matter consideration and present it to Mahidol University President for approval.

14.6 Any case of credit transfer other than those described in these regulations shall be considered by the head of the working unit, agreed upon by the relevant department and program committee and/or the working unit committee, and he or she will be responsible for presenting it to the Mahidol University President for approval."

4. The credit transfer that has been made in MOU programs between Mahidol University and other overseas higher education institutes before the inauguration of these regulations shall follow number 14.5 in this announcement.

Announced on 1st March 2017

Prof. Emeritus Kasem Watanachai

Chairman of the Mahidol University Council

Mahidol University Regulations

on Diploma and Undergraduate Studies (Issue 7) 2017

(B.E. 2560)

Mahidol University Regulations on Diploma and Undergraduate Studies have been under consideration for improvement.

Thus, Mahidol University Council, under the Article 24 (2) of the Mahidol University Act B.E. 2550 (2007), agreed to enact the following regulations in its 525th meeting on October 18, 2017.

1. These regulations are referred to as "Mahidol University Regulations on Diploma and Undergraduate Studies (Issue 7) 2017 (B.E. 2560)."

2. These regulations shall be effective from the day after the announcement date and henceforth.

3. The statement in Clause 8.2 of Mahidol University Regulations on Diploma and Undergraduate Studies 2009 (B.E. 2552) shall be cancelled, and the following statements shall be applied:

"8.2 The symbols without grades

The outcome of the study for each course may be in the forms of certain symbols with the meaning as follows:

Symbols	Meaning
AU	Audit
O	Outstanding
S	Satisfactory
T	Transfer of Credit
U	Unsatisfactory
I	Incomplete

P	In progress
X	No report
W	Withdrawal”

4. The following clause shall be added as (3) of Clause 8.3 of Mahidol University Regulations on Diploma and Undergraduate Studies B.E. 2552 (2009):

“(3) The symbol O in each course signifies outstanding knowledge, ability, and skills or knowledge, ability, and skills that are above the normal criteria used for the assessment of each course.”

Announced on 28 November, 2017

Professor Emeritus Kraisit Tantisirin

Vice Chairman of Mahidol University Council

Acting Chairman of Mahidol University Council

Mahidol University Regulation on Diploma and Undergraduate Studies (8th issue) B.E. 2561

Mahidol University Regulation on Diploma and Undergraduate Studies has been deemed appropriate for a revision.

As empowered by the virtue of the Article 24 (2) of the Mahidol University Act B.E. 2550, Mahidol University Council, in the 531st meeting on April 18, 2018, announced the following statements.

1. This regulation is referred to as "Mahidol University Regulation on Diploma and Undergraduate Studies (8th issue) B.E. 2561."

2. This regulation shall be enforced on the announcement date and henceforth.

3. The following statements shall be added as Clause 4/1 in Mahidol University Regulation on Diploma and Undergraduate Studies B.E. 2552.

"4/1 All students shall be supervised by appointed advisors who facilitates their educational planning according to their study plan. The Head of each work unit shall appoint instructors in all programs as advisors for all students of all years as stated in the first paragraph.

The advisors should meet their advisees according to the program's requirements, and the advisors should set certain dates and time when their advisees can meet. All work units shall evaluate the advisors' work every semester. The advisors shall be responsible for the following.

4/1.1 Giving advice and help their advisees plan their study that complies with the program's requirements.

4/1.2 Giving advice about rules, regulations, and announcements in their study.

4/1.3 Giving advice about course registration, adding, dropping, and withdrawing and about their credits in each semester.

4/1.4 Giving advice about their studying and follow up on their study results.

4/1.5 Giving advice about how to process all matters in accordance with the University's rules and regulations.

4/1.6 Giving advice about their advisees' university life and education.

4/1.7 Making sure their advisees' behaviors are appropriate in accordance with the University's rules and regulations.

4/1.8 Reporting their consultation to the Head of the work unit every semester.

4/1.9 Being responsible for other assigned tasks."

Announced on May 21, 2018

(Signature)

(Emeritus Professor Kraisid Tontisirin, MD., PhD)
Vice President of Mahidol University Council
and Acting President of Mahidol University Council

Mahidol University

Disciplinary Measures 2010

To minimize constraints to study within the Mahidol University community, students are protected and bound by a set of social rules. These rules or codes of conduct provide a framework within which students' rights and freedoms can be exercised.

Mandated by Article 24 (2) of the Mahidol University Act, 2007, the 442nd meeting of Mahidol University Council on September 15, 2010 enacted the following measures.

1. These measures are hereby called the "Mahidol University Disciplinary Measures 2010".

2. These measures will be activated on the day of the announcement.

3. They override Mahidol University Disciplinary Measures 2004.

4. With regard to these measures,

"*University*" denotes Mahidol University.

"*President*" denotes President of Mahidol University.

"*Department*" denotes Faculty, College, Institute, Faculty of Graduate Studies, and also any provincial campus using the university curriculum.

"*Chair*" denotes Dean, Director of an institute, and also a Vice President who supervises a provincial campus under the university curriculum.

"*Staff*" denotes civil servants, employees, and university officials at Mahidol University who possess work permits.

"*Student*" denotes certificated, undergraduate and graduate students.

Chapter 1

Codes of Conduct

5. Students must maintain discipline and ethical values. They should abide by any university/department announcements and follow the measures outlined.

6. Students must uphold unity, peace, and the reputation of the university. They should not instigate or participate in any quarrels, physical assaults, or damage to university or the other property.

7. Students must behave themselves. They must abstain from behavior that could demean themselves, others, or the reputation of the university.

8. Students must listen to instructions and warnings from instructors and staff and act accordingly.

9. Students must dress appropriately. They must conform to the dress code of their department. Upon entering a class, an examination, or a department within the university, students must make their identification cards available in case any instructor or staff needs to see them.

10. Students must not drink alcohol or use drugs (or any prohibited substance) while they are in the university (including the provincial campuses) or while they are wearing their university uniform.

11. Students who engage in the following misconduct will be subject to serious disciplinary violation:

(1) Gamble or take part in gambling businesses, or support thereof
(2) Use, possess, or sell illegal drugs
(3) Steal, extort, cheat, embezzle, threaten, force, or rob the other or engage in corruption for financial gain
(4) Possess or carry weapons or toxic substances that may endanger the lives or properties of others
(5) Perform immoral or inappropriate sexual or public behavior that could affect the reputation of the university
(6) Quarrel or cause physical harm that ensues a severe injury or death or an adverse effect on the university's reputation
(7) Commit a crime with the final court decision of imprisonment, except for mistakes made by carelessness
(8) Intentionally cheat in an exam or make an effort to take part in an exam dishonesty
(9) Produce, circulate, or possess media, publications, drawings, or writings or act in other ways to defile the other or the university
(10) Forge a signature, fake a document, or change details in the original document, or file a document that has been adjusted to the university or the other entities that could result in damage to the university or the other
(11) Willingly ruin university properties or those belonging to other
(12) Act in a manner that the President determines as violating the codes of conduct

12. Students who carry out any of the misconducts listed above will be subject to disciplinary punishment. For minor misdemeanors, the departmental chair may omit punishment and instead give the student verbal warning.

13. There are six (6) main types of disciplinary punishment.

(1) Verbal warnings
(2) Written warnings
(3) Dismissal from examination

(4) Cancel, reconsider, or suspend the student's candidacy for a degree or a diploma
(5) Withdraw for study up to one academic year
(6) Dismiss the student from the university

14. Students who are considered as not severely violating the codes of conduct will be on the condition of written promise to behave appropriately. Verbal warnings of misconduct will be administered in cases where the violation is minor or there is a good reason for applying a reduced form of punishment.

15. Students who severely violate the codes of conduct will be subject to dismissal from an examination, degree cancellation, degree reconsideration, suspension of degree, withdrawal for up to one academic year, or dismissal from the university.

16. The departmental chair has the right to make departmental announcements regarding disciplinary measures - as long as the announcements are consistent with, and supplementary to, these existing measures and that they notify the university of their announcements.

Chapter 2

Disciplinary Proceeding

17. For cases with sufficient evidence, investigations and disciplinary punishments will be conducted promptly and fairly.

18.The investigation of the accused student will be performed by the Jury Council as appointed by the President or the departmental chair. This step can be skipped for the cases already settled as follows:

(1) The court makes a judgment on the case, resulting in imprisonment or heavier penalties, except for minor misdemeanors, such as those caused by carelessness.
(2) The student who conducted a wrongdoing confessed in person or in writing to the departmental chair or the Jury Council and the confession was recorded in writing.

19. The Jury Council in item 18 consists of at least 3 people including a President, a Secretary, and Jury(s). An investigation is carried out as early as possible and within 60 days from the date of the Jury Council appointment. If the investigation cannot be finished within the time period, the Jury Council can submit to the authority who appointed them for a maximum extension of 30 days for each submission.

20. The Jury Council must notify the accused person of his or her charges with the available supportive evidence. The name(s) of the witness(es) may or may not be disclosed. This information will allow the accused person to bring to the jury his or her witness(es) and testimonies prior to judgment decision.

21. For minor cases, the departmental chair may give verbal warnings or in writing as they consider appropriate, then notify the university of the incident as soon as possible.

22. For severe cases, departmental chair will report the causes and investigation results to the President for a decision regarding punishment. Depending on severity of the case, they will then proceed to dismiss the student's right of taking an exam, cancel, reconsider, or suspend their degree, or withdraw the student for a maximum of one (1) academic year, or dismiss the student from the university. Withdrawal from the university that the President may order a departmental chair to carry out on his behalf shall be for a maximum of one (1)semester.

23. Disciplinary punishments must be carried out following a formal letter of order. The authority must also provide information about making an appeal and the length of time allowed for this. Depending on the case, once punishment is delivered, the student's parent or guardian, adviser, and the university will be notified.

Chapter 3

Appeal

24. If a student is subject to a disciplinary punishment and does not accept it, the student has the right to appeal according to the procedures outlined here. During the appeal process, the student will still be subject to punishment.

25. The student who makes an appeal must file a signed formal document. Each individual can only appeal for themselves. A student cannot make an appeal on behalf of another student.

26. To support an appeal, the student can ask to check or make a copy of the past investigation record. The record of witness investigations and other documents may or may not be disclosed depending on judgment of the departmental chair or the Jury Council.

27. The Appeal Committee comprises of 5 to 7 people, one of which must be a paralegal professional or a law graduate appointed by the President with a specified operation period.

28. The Appeal Committee will perform the following tasks;

(1) Analyze the appealed matter;
(2) Make a written request for additional documents or visits from a person involved in the case as considered necessary;
(3) Appoint a person or a group of people to make a consideration or to operate on a duty within the committee scope; and
(4) Carry out other responsibilities designated by the university.

29. An appeal must be made to the Appeal Committee within fifty (50) working days starting from the first day that the accused student knows or should know about his or her punishment.

30. An appeal must be made directly to the Appeal Committee. The Committee must finish working on a case within thirty (30) days beginning from the day of the appeal being filed. The length of time for a case consideration may be extended no longer than sixty (60) days from the last of the given thirty (30) days. Written reports and records of the appeal must be made.

31. The Appeal Committee may render the punishment either appropriate or unjust. The Committee will then make a proposal to the President to either immediately dismiss the appealed case, increase, or reduce the punishment. The first deliberation of the Appeal Committee is final. The Committee must immediately pass the deliberation onto the student who made the appeal.

32. To count the exact number of days for these measures, if the end of the period takes place on the weekend, the next working day will be considered as the end.

34. The President acknowledges these measures. When any problem arises regarding compliance with these measures, the President has the power to order an action and his word is final.

Chapter 4

Provisional Clauses

35. Any disciplinary proceedings or appeals that took place prior to the enactment of these measures shall comply with Mahidol University Disciplinary Measures 2004.

36. Until new appointments are made, the appointed body for the Mahidol University Disciplinary Measures 2004 will continue to act in its duty and in compliance with the details in Mahidol University Disciplinary Measures 2010.

Announced on October 8, 2010

Prof. Wijarn Panich, M.D.
Chairman of Mahidol University Council

Mahidol University Announcement

on English Competence Standards for Undergraduate Students of Mahidol University 2017

(B.E. 2560)

Mahidol University agrees to set the English competence standards for undergraduate students of Mahidol University to be in accordance with the Announcement of the Office of Higher Education Commission Thailand on the Policy of the Improvement of the Standard of English Competency dated April 12, 2016, stating that institutions of higher education shall establish the policy and objectives to improve the standard of English ability in every program and every level of education of higher education institutions in order to serve as guideline for developing the English skills and abilities of undergraduate students and enable them to become graduates who have knowledge and abilities both in terms of academic, professional, and English communication skills, as well as to develop a plan to achieve the goals set in the policy, with the objectives and their indicators, as well as a clear system of evaluation.

As empowered by the virtue of the Article 19/1 of Mahidol University Regulations on Diploma and Undergraduate Studies (Issue 5) 2016 (B.E. 2559), in correspondence with the resolution of the 15/2017 meeting of Mahidol University Committee Board on 23 August, 2017, the President of Mahidol University issued This Announcement as follows:

1. The following announcements shall be cancelled

(1) Mahidol University Announcement on English Competence Standards for Undergraduate Students of Mahidol University 2017 (B.E. 2560), dated September 7, 2017

(2) Mahidol University Announcement on English Competence Standards for Undergraduate Students of Mahidol University 2017 (B.E. 2560), dated October 25, 2017

2. All undergraduate students of Mahidol University must meet the standard of English competency equivalent to the average English competency of students based on the Common European Framework of Reference for Languages (CEFR), and in accordance with the National Education Plan B.E. 2560-2574 issued by the Ministry of Education as follows:

2.1 an MU-ELT score of 84 and higher, or

2.2 a TOEIC score of 600 and higher, or

2.3 a TOEFL IBT score of 64 and higher, or

2.4 an IELTS score of 5.0 and higher

3. The MU-ELT test will be held by Mahidol University every semester.

4. Students can take an English competency test every semester prior to graduation and they have to submit the score according to Article number 2 of this announcement within two years after being accepted as an undergraduate student of Mahidol University, so that they can have opportunities to improve their English competency to meet the criteria set by the university before graduation.

5. The test fee for MU-ELT is 400 baht per test.

6. Undergraduate students must pass the criteria set for the English competency prior to their graduation. This is considered one of the requirements for the approval of an undergraduate degree as stated in Article number 20.4 of Mahidol University Regulations on Diploma and Undergraduate Studies (Issue 5) B.E 2559 (2016).

7. The President of Mahidol University is in position of authority over this Announcement. In case of any dispute, the judgment of the President shall be final.

This shall be effective for undergraduate students who enroll in Mahidol University from the academic year 2017 onwards.

Announced on 10 November, 2017

Prof. Banchong Mahaisavariya, M.D

Acting President of Mahidol University

Faculty of Science, Mahidol University Announcement

Subject:

Undergraduate Education B.E. 2553 (2010)

Whereas it is deemed appropriate to define the criteria of undergraduate education to comply with the Mahidol University Regulation on Undergraduate and Diploma Education B.E. 2552 (2009).

Under the provisions of the Mahidol University Regulations on Diploma and Undergraduate Education B.E. 2552 (2009), the Dean of Faculty of Science, by the agreement of the Faculty Committee in its 4/2553 meeting on 7th April 2010, the criteria for undergraduate education has been stipulated as follows:

1. The following regulations and announcements shall be repealed:

1.1 Faculty of Science, Mahidol University Regulations on Education Assessment B.E. 2543 (), Dated 12th May B.E. 2543 (2000)

1.2 Faculty of Science, Mahidol University Regulations on Education Assessment (No. 2) B.E. 2545, Dated 9 January B.E. 2545 (2002)

1.3 Faculty of Science, Mahidol University Announcement, Subject: Criteria and Procedures of Re-examination for Undergraduate Students B.E. 2547, Dated 20th May B.E. 2547 (2004)

1.4 Faculty of Science, Mahidol University Announcement, Subject: Criteria and Procedures of Re-examination for Undergraduate Students B.E. 2547 (Addendum), Dated 15th March B.E. 2550 (2007)

2. In this announcement,

"Faculty" means the Faculty of Science, Mahidol University.

"Dean" means the Dean of Faculty of Science, Mahidol University

"Students" means the undergraduate students of Faculty of Science, Mahidol University, and students enrolled in the subjects provided by the Faculty of Science, Mahidol University.

3. First and Second Semesters are normal mandatory semesters, and students must register their subjects and credits as required by the Faculty of Science, which required at least 9 credits and no more than 23 credits for each normal semester.

4. For subjects with prerequisite(s), the students must be evaluated as "pass" in the prerequisite subjects(s) before they can register for the subject. Except when the requisite and the subject are offered in the same year.

5. Students cannot take 2 subjects which are offered at the same date and time.

6. To evaluate students in more detail, the (+) mark was employed, meaning there will be B+, C+, and D+. The required score and the meaning of the mark would follow the regulations stipulated by the university.

7. The A, B+, B, C+, C, D+, D, S, T, and AU are evaluated as "pass", while F and U are evaluated as "not pass".

8. In cases where the student has to be absent with a cause, the student must submit the examination rescheduling before the exam or within 3 days after the exam to the Educational Affair Division and the penalty of 30% score. Rescheduling without penalty require the consideration of the committee of no less than 3 persons which include the executive of the Educational Affair Division and lecturers of the department.

9. Summer is not a mandatory semester. The Faculty of Science will not offer classes during summer semester, EXCEPT for subjects in which the students received F grade in the first or second semester or have more than 15 accumulated students with the F grade. For subjects with less than 15 accumulated students, the respective department shall arrange a re-examination of the subject(s) during the summer semester, and no course(s) will be offered during the summer semester.

10. If other condition applies, the offer of summer subject(s) shall be considered by the Deputy Dean for Education.

11. Students eligible to register in summer semester include:

11.1 Students with the mark F in the subject offered during the summer semester or

11.2 Students with GPA lower than 2.00 or

11.3 Students approved by the department responsible for the subject offered.

Students must not have been evaluated as Dismissed or prone to being dismissed. In cases that the student has already registered for the subject, but the GPA fell into Dismissed classification, the registration shall be considered void.

12. Students eligible to register for the re-examination include students who had received the F mark in the subject(s) which are open for re-examination in the same year as the opened subject(s).

Students must not have been evaluated as Dismissed or prone to being dismissed. In cases that the student has already registered for the subject, but the GPA fell into Dismissed classification, the registration shall be considered void.

13. Classes in summer semester last for 6 weeks, with the final examination on the 7^{th} week, and the evaluation completed in the 8^{th} week. The maximum credits for the summer semester is 9 credits, and the subjects can be withdrawn within 4 weeks after the class started.

14. The re-examination of the subjects in either the first or the second semester will be held at least 4 weeks after the announcement of the second semester's final results. This is to allow the students to prepare for the examination and submit the re-examination request. The latest grades of the students must also be submitted to the Educational Affair Division within 8 weeks after the announcement of the final examination results, and no re-examination is permitted beyond the given time.

15. The re-examination grade can only be D or F. Except the re-examination of 2^{nd} or 3^{rd} year students of the Faculty of Medicine Ramathibodi Hospital, Bangkok Medical College and Vajira Hospital, Maharat Nakhon Ratchasima Hospital Medical Education

Center, Sawanpracharak Hospital Medical Education Center, and Maharaj Nakhonsithammarat Hospital Medical Education Center, which the re-examination grade can be D+, D, or F.

16. The Dean of Faculty of Science shall ensure the announcement is followed. Should any problem arise following this announcement, the Dean of Faculty of Science shall rule, consider, and make decision as deemed appropriate.

The announcement shall be in effect from 1 June B.E. 2553 (2010).

Announcement made on 11 May B.E. 2553 (2010)

(Prof. Dr. Skorn Mongkolsuk)

Dean
Faculty of Science
Mahidol University

Appendix 8

Order of Curriculum Development Committee or Curriculum Screening Procedure Committee or Person In-charge

คำสั่งคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล
ที่ ๙๖๗ / ๒๕๖๑
เรื่อง แต่งตั้งคณะกรรมการพัฒนาหลักสูตรระดับปริญญาตรี
สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ)
หลักสูตรปรับปรุง ปีการศึกษา ๒๕๖๒

เพื่อให้การดำเนินการพัฒนาหลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ) หลักสูตรปรับปรุง ปีการศึกษา ๒๕๖๒ เป็นไปด้วยความเรียบร้อยและมีประสิทธิภาพ อาศัยอำนาจตามความในมาตรา ๑๗ แห่งพระราชบัญญัติมหาวิทยาลัยมหิดล พ.ศ.๒๕๕๐ คณบดีจึงออกคำสั่งแต่งตั้งคณะกรรมการพัฒนาหลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ) หลักสูตรปรับปรุง ปีการศึกษา ๒๕๖๒ ดังรายนามต่อไปนี้

๑. รองศาสตราจารย์ ดร. ประหยัด โภคฐิติยุกต์	ประธานกรรมการ
๒. ศาสตราจารย์ ดร. สุชาติ ทุปลัมภ์	กรรมการผู้ทรงคุณวุฒิ
๓. คุณศุภรัตน์ โชติสยุเรรัตน์	กรรมการผู้ทรงคุณวุฒิ
๔. ผู้ช่วยศาสตราจารย์ ดร.ป่าย อุ่นใจ	กรรมการ
๕. อาจารย์ ดร.พหล โกสิยะจินดา	กรรมการ
๖. อาจารย์ ดร.พรินท์พิดา สนธิพันธ์	กรรมการ
๗. อาจารย์ ดร.อลิสา สจิวห	กรรมการ
๘. ผศ.ดร.ปฐมพงษ์ แสงวิไล	กรรมการและเลขานุการ

หน้าที่

๑. ดำเนินการพัฒนาหลักสูตรให้แล้วเสร็จตามกำหนด โดยจัดทำรายละเอียดของหลักสูตร รายละเอียดของรายวิชา และรายละเอียดของประสบการณ์ภาคสนาม (ถ้ามี) ให้ชัดเจนตามกรอบมาตรฐานคุณวุฒิระดับอุดมศึกษาแห่งชาติและนโยบายของมหาวิทยาลัย
๒. กำหนดการประกันคุณภาพภายในของหลักสูตร เช่น กำหนดตัวบ่งชี้และเกณฑ์การประเมินผลการดำเนินงาน ฯลฯ
๓. ประสานงานกับงานการศึกษา และกองบริหารการศึกษา เพื่อขอความเห็นชอบจากคณะกรรมการที่เกี่ยวข้อง ตามขั้นตอนการพิจารณาหลักสูตร

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป โดยสิ้นสุดภาระหน้าที่เมื่อสภามหาวิทยาลัยอนุมัติการพัฒนาหลักสูตร

สั่ง ณ วันที่ ๑๙ พฤศจิกายน พ.ศ. ๒๕๖๑

สิทธิวัฒน์ เลิศศิริ

(รองศาสตราจารย์ ดร.สิทธิวัฒน์ เลิศศิริ)
คณบดีคณะวิทยาศาสตร์

คำสั่งคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล
ที่ ๙๖๕/ ๒๕๖๑
เรื่อง แต่งตั้งคณะกรรมการบริหารหลักสูตรระดับปริญญาตรี
สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ)

เพื่อให้การบริหารจัดการหลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ) เป็นไปตามกรอบมาตรฐานคุณวุฒิระดับอุดมศึกษาแห่งชาติ พ.ศ. ๒๕๕๒ แนวทางการปฏิบัติตามกรอบมาตรฐานคุณวุฒิระดับอุดมศึกษาแห่งชาติ พ.ศ.๒๕๕๒ เกณฑ์มาตรฐานหลักสูตรระดับปริญญาตรี พ.ศ. ๒๕๕๘ และนโยบายของมหาวิทยาลัย

อาศัยอำนาจตามความในมาตรา ๓๗ แห่งพระราชบัญญัติมหาวิทยาลัยมหิดล พ.ศ.๒๕๕๐ คณบดีจึงออกคำสั่งแต่งตั้งคณะกรรมการบริหารหลักสูตรระดับปริญญาตรี สาขาวิชาทรัพยากรชีวภาพและชีววิทยาสภาวะแวดล้อม (หลักสูตรนานาชาติ) ดังรายนามต่อไปนี้

๑.	รองศาสตราจารย์ ดร. ประหยัด โภคฐิติยุกต์	ประธานกรรมการ
๒.	ศาสตราจารย์ ดร. สุชาติ อุปถัมภ์	กรรมการผู้ทรงคุณวุฒิ
๓.	ศาสตราจารย์ ดร. มาลียา เครือตราชู	กรรมการผู้ทรงคุณวุฒิ
๔.	ผู้ช่วยศาสตราจารย์ ดร.ป่วย อุ่นใจ	กรรมการ
๕.	อาจารย์ ดร.พทล โกสิยะจินดา	กรรมการ
๖.	อาจารย์ ดร.พรินท์พิดา สนธิพันธ์	กรรมการ
๗.	อาจารย์ ดร.อลิสา สจิวต	กรรมการ
๘.	ผศ.ดร.ปฐมพงษ์ แสงวิโล	กรรมการและเลขานุการ

หน้าที่

๑. บริหารจัดการหลักสูตร เพื่อให้บัณฑิตมีคุณลักษณะตามมาตรฐานการเรียนรู้ที่กำหนดไว้ โดยดำเนินการในเรื่องต่างๆ เช่น พัฒนาอาจารย์ทั้งด้านวิชาการ วิธีการสอน และวิธีการวัดผลอย่างต่อเนื่อง จัดสรรทรัพยากรเพื่อการเรียนการสอนให้เพียงพออย่างมีคุณภาพ จัดให้มีการประเมินผลการเรียนรู้ของนักศึกษาที่ครอบคลุมมาตรฐานผลการเรียนรู้ในทุกๆ ด้าน ฯลฯ
๒. ควบคุม กำกับ ดูแล ให้มีการดำเนินงานตามแผนปฏิบัติงานที่ได้กำหนดไว้ โดยให้มีรายละเอียดในเรื่องต่างๆ เช่น การทำ มคอ.๓-๗ แผนเกี่ยวกับรายวิชาที่เปิดสอนประจำภาคเรียน การรวบรวมข้อมูลทางสถิติของนักศึกษาที่เรียนในหลักสูตร และการประเมินหลักสูตร
๓. ดำเนินการประกันคุณภาพภายในตามระบบประกันคุณภาพภายในของหลักสูตร
๔. ภาระงานอื่นๆ ที่เกี่ยวข้องกับการบริหารหลักสูตรที่ได้รับมอบหมาย

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป

สั่ง ณ วันที่ ๑๙ พฤศจิกายน พ.ศ. ๒๕๖๑

(รองศาสตราจารย์ ดร.สิทธิวัฒน์ เลิศศิริ)
คณบดีคณะวิทยาศาสตร์

คำสั่งคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล
ที่ ๙๘๓ / ๒๕๖๑
เรื่อง แต่งตั้งคณะกรรมการพิจารณากลั่นกรองหลักสูตรวิทยาศาสตรบัณฑิต

ด้วยมีกรรมการบางท่านแจ้งความประสงค์ขอลาออกจากการเป็นคณะกรรมการพิจารณากลั่นกรองหลักสูตรวิทยาศาสตรบัณฑิต อาศัยอำนาจตามความในมาตรา ๓๗ แห่งพระราชบัญญัติมหาวิทยาลัยมหิดล พ.ศ. ๒๕๕๐ คณบดีจึงยกเลิกคำสั่งคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล ที่ ๖๖๔/๒๕๖๑ ลงวันที่ ๒๙ สิงหาคม พ.ศ. ๒๕๖๑ เรื่อง แต่งตั้งคณะกรรมการพิจารณากลั่นกรองหลักสูตรวิทยาศาสตรบัณฑิต และให้แต่งตั้งคณะกรรมการพิจารณากลั่นกรองหลักสูตรวิทยาศาสตรบัณฑิต ดังรายนามต่อไปนี้

๑. ศาสตราจารย์ ดร.สุมาลี ตั้งประดับกุล	ที่ปรึกษา
๒. รองคณบดีฝ่ายการศึกษาและพัฒนาคุณภาพ	ประธานกรรมการ
๓. รองคณบดีฝ่ายแพทยศาสตร์และบัณฑิตศึกษา	รองประธานกรรมการ
๔. รองคณบดีฝ่ายบริการการศึกษา ศาลายา	รองประธานกรรมการ
๕. ผู้ช่วยคณบดีฝ่ายการศึกษา	รองประธานกรรมการ
๖. รองศาสตราจารย์ ดร.กิตติศักดิ์ หยกทองวัฒนา	กรรมการ
๗. ผู้ช่วยศาสตราจารย์ ดร.ขวัญ อารยะธนิตกุล	กรรมการ
๘. ผู้ช่วยศาสตราจารย์ ดร.ไพโรจน์ สถิรคู	กรรมการ
๙. ผู้ช่วยศาสตราจารย์ ดร.มัณฑนา จริยาบูรณ์	กรรมการ
๑๐. ผู้ช่วยศาสตราจารย์ ดร.ศศิวิมล แสวงผล	กรรมการ
๑๑. ผู้ช่วยศาสตราจารย์ ดร.สุพีชา คุ้มเกตุ	กรรมการ
๑๒. หัวหน้างานการศึกษา	กรรมการ
๑๓. นางสาวสายพิณ ทองพัด	กรรมการและเลขานุการ
๑๔. นางสาวเมธาวี กาจุลศรี	กรรมการและผู้ช่วยเลขานุการ

<u>อำนาจหน้าที่</u>

๑. พิจารณากลั่นกรองหลักสูตร ให้ความเห็น และข้อเสนอแนะเกี่ยวกับหลักสูตรที่เสนอเปิดใหม่และหลักสูตรปรับปรุง ในระดับปริญญาตรี คณะวิทยาศาสตร์ รวมถึงตรวจสอบและกำกับคุณภาพของหลักสูตรให้เป็นไปตามเกณฑ์มาตรฐานหลักสูตรระดับปริญญาตรี พ.ศ.๒๕๕๘ และสอดคล้องกับนโยบายของมหาวิทยาลัย

๒. ปฏิบัติหน้าที่อื่นตามที่ได้รับมอบหมายจากคณบดีคณะวิทยาศาสตร์ มหาวิทยาลัยมหิดล

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป

สั่ง ณ วันที่ ๑๘ ธันวาคม พ.ศ.๒๕๖๑

(รองศาสตราจารย์ ดร.สิทธิวัฒน์ เลิศศิริ)
คณบดีคณะวิทยาศาสตร์

Appendix 9

MOUs made between Mahidol University (MU) and state University of New York, college of Environmental Science and Forestry (SUNY-ESF)

Agreement for Educational Cooperation - Dual Degree Program

between

STATE UNIVERSITY OF NEW YORK COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY, USA

AND

FACULTY OF SCIENCE, MAHIDOL UNIVERSITY, THAILAND

This Agreement is designed to establish a Dual Degree Bachelor of Science Program between Faculty of Science, Mahidol University (hereinafter referred to as "MUSC"), and College of Environmental Science and Forestry, the State University of New York (hereinafter referred to as "ESF").

WHEREAS, MUSC has an official address of 272 Rama 6 Road, Phyathai, Rajthevi Bangkok, 10400, Thailand, and is a Faculty created under a public university.

WHEREAS, ESF has an official address of 1 Forestry Drive, Syracuse, New York 13210, United States of America, and is a public college that is part of the State University of New York system (hereinafter referred to as "SUNY").

WHEREAS, ESF and MUSC are referred herein collectively as "the Parties" (and individually as "a Party") to this Agreement.

WHEREAS, this Agreement promotes exchange and cooperation between MUSC and ESF in the fields of education and culture between Thailand and the United States.

WHEREAS, this Agreement intends to provide students from both countries with better international exchange opportunities.

WHEREAS, this Agreement creates two dual degree programs for MUSC students, requiring the enrolled MUSC students to either study for two (2) years at MUSC and two (2) years at ESF; or to study for three (3) years at MUSC and one (1) year at ESF.

WHEREAS, the Parties agree as follows:

A. Eligibility of Students

1. All MUSC applicants shall be matriculated students enrolled in a Bachelor of Science course of study in one of the following programs or their precursor equivalents at MUSC:
   i. BSc in Biology, Biotechnology or Environmental Biology; or
   ii. Other BSc programs as identified in future addenda to this Agreement
2. All MUSC applicants will select one of the following Bachelor of Science majors at ESF:
   i. BSc in Biotechnology
   ii. BSc in Environmental Biology
   iii. BSc in Environmental Health
   iv. BSc in Aquatic Science and Fisheries
   v. BSc in Bioprocess Engineering
   vi. BSc in Paper Science
   vii. BSc in Environmental Science
3. ESF will accept a limited number of students each year from MUSC to participate in the Dual Degree program. The number of MUSC students to participate will be decided mutually by the faculty coordinator at ESF (in collaboration with the ESF Office of Admissions and the ESF Office of the

Provost) and the designated official or faculty coordinator at MUSC. The number of students to be accepted in the program will be decided by ESF at least six (6) months before the anticipated date of enrollment.

B. Selection and Admission of Students

1. Prospective MUSC students must file a timely application with ESF, together with all required documents.
2. The application fees for prospective MUSC students will be waived by ESF.
3. To be considered by ESF, applicants must present a minimum TOEFL (Test of English as a Foreign Language) score of 550 (paper-based test), 213 (computer-based test) or 79 (internet-based test); or minimum IELTS total score of 6.5 (with no less than 5 in Writing); or Grade pre-1 on the STEP EIKEN tests. For complete and updated requirements, see: http://www.esf.edu/graduate/documents/InternationalAdmissioninfo.doc.
4. MUSC students will be selected based on recommendation by the faculty coordinator at MUSC, credentials documented in the application materials, and results of an interview with an ESF faculty member. The ESF Office of Admissions will make the final decision regarding admission to the program.
5. Once accepted by ESF, MUSC students will be admitted to ESF as BSc diploma (degree-seeking) students majoring in one of the programs noted in Section A (2) of this Agreement.
6. Participants are expected to matriculate and begin their studies at ESF in the first term (end of August) of their third year of studies; or the first term (end of August) of their fourth year of studies.

C. Curriculum

1. The curriculum for each Dual Degree program is defined in the articulation agreements attached as Exhibit B.
2. Prior to applying to the Dual Degree program and admission at ESF, MUSC students must take the courses listed in the document TYPICAL SCHEDULE FOR 2 + 2, which is attached as Exhibit C; or the courses listed in the document TYPICAL SCHEDULE FOR 3+1, which is attached as Exhibit D.
3. In order to qualify for the conferral of an ESF Bachelor of Science degree, MUSC students must fulfill all ESF and SUNY degree requirements, including SUNY General Education.
4. MUSC may have additional curriculum requirements over and above the curricula described in the articulation agreements to satisfy Mahidol University degree requirements.
5. The curriculums outlined in Exhibit B and Exhibit C should be reviewed by both Parties every other year beginning in the Fall of 2021. However, updating and/or modification of the curriculum must be approved by both institutions in writing.

D. Program Assessment

1. Each Party will provide documentation on student performance for the required courses and selected elective courses, including those intended to meet SUNY System - General Education requirements, as requested by the other Party for program evaluation and/or assessment purposes.

2. The Dual Degree programs must meet standards for accreditation established by the Middle States Commission of Higher Education; and by the Accreditation Board of Engineering and Technology (ABET) for the BSc programs in Bioprocess Engineering and Paper Science; and by the National Environmental Health Science and Protection Accreditation Council (EHAC) for the BSc programs in Environmental Health.
3. Evaluation and review of the Dual Degree programs will be conducted annually by each Party for the graduating class beginning in the Fall of 2021. The evaluation results will be shared by both Parties.

E. Granting of Degrees

1. Each Party agrees to facilitate the transfer of successfully completed credits to the other Party.
2. To qualify for the ESF diploma as per this Agreement, participants must be physically present at ESF for a minimum of one year and successfully complete a minimum of 32 credits hours of study in residence at ESF.
3. Participants who fulfill all the requirements of the Dual Degree programs will receive diplomas from Mahidol University and ESF, and be recognized as graduates of both institutions.
4. Each Party may grant their degree independently of the other with regard to conferral date, specific degree or major title, or other local custom with regard to degree honors or distinction.

F. Tuition, Fees and Financial Aid

1. Tuition and fees for the Dual Degree program students attending ESF will be the out-of-state rate (less a scholarship) that will average no less than $4,000 per student per year ($2,000 per semester).
2. The Parties agree that all students participating in the program are responsible for paying their own tuition, fees, and other related costs associated with the program.

G. Housing and Other Expenses

1. MUSC students accepted in the programs are responsible for the cost of their room and board. ESF may offer participants options for housing located in close vicinity to the ESF Syracuse campus.
2. MUSC students are responsible for arranging and paying for their own in-country and international travel, medical insurance, passport and visa application fees, textbooks, personal items and any other expenses.

H. Compliance

1. Participants are responsible for complying with ESF and SUNY's immunization policy at their own expense.
2. Participants will be required to comply with the SUNY insurance policies and procedures for international students.
3. Participants shall abide by all applicable rules and regulations of MUSC and ESF, including but not limited to ESF's Student Code of Conduct, and by all applicable laws, rules, and regulations of the home and host countries. In case of violation, both institutions have the right to terminate the student's participation, and ESF has the right to expel the violator.

I. Program Coordinators

1. The program coordinators at ESF will serve as the first point of contact at ESF for the participants. Students will then be directed to the coordinator for the major the student is interested in entering.
2. As of the signing of this Agreement, the ESF program coordinators are: Dr. Gary Scott for Paper Science or Bioprocess Engineering, Dr. Russell Briggs for Environmental Science; and Dr. Lee Newman for the other four majors. Any changes will be reported in writing in a timely manner by ESF to MUSC.

J. Staff Exchange

1. Teaching and research staff from the Parties are encouraged to visit the other institution. The host institution will facilitate such visits but the visiting/traveling faculty and staff's home institution is responsible for paying all travel and lodging costs.
2. ESF may fund one faculty member each year during the term of this Agreement to travel to MUSC to interview prospective students and coordinate the Dual Degree programs. The length and approved cost of said visit is to be determined by the ESF Provost.

K. Term of Agreement

1. This Agreement becomes effective when signed by authorized representatives of the two Parties and shall remain effective for a period of five (5) years.
2. During the final year of the term of this Agreement, a full review of the programs will be conducted by both Parties and renewal for another five-year period will be considered.

L. Additional Terms

1. This Agreement may be executed by the Parties in counterparts, each of which shall be deemed an original but all of which shall together constitute one instrument.
2. The relationship between the Parties is that of an independent contractor. Nothing in this Agreement shall be construed to create a relationship between the Parties of agency, partnership, or joint ventures, nor to render either Party liable for any debts or obligations incurred by the other. Neither Party is authorized to make representations on behalf of the other, or to bind the other in any manner whatsoever.
3. No amendment, modification or addition to this Agreement shall be effective unless set forth in writing and executed by both parties.

M. Termination of Agreement

1. Either Party must give ninety (90) days written notice to the other party in order to terminate this Agreement, provided that such termination will not affect the completion of any activity underway at the time. If future activity has been advertised and either Party has made commitments to students concerning such activity, such termination will not affect that activity.

N. Choice of Law

1. In the event of any fiscal and non-academic dispute, the two Parties should consult each other in attempt to resolve the dispute without judicial intervention or submit to the proper jurisdictional authority under which this supplemental agreement falls.

2. This Agreement shall be construed, and the legal relations between the Parties shall be determined, in accordance with the law of the State of New York, United States, without regard to its conflicts of law provisions.
3. The laws of New York State will govern this Agreement without regard for New York State's choice of law statute. The Parties agree to bring any action to construe, interpret or enforce this Agreement in a New York State court of competent jurisdiction with venue in Onondaga County, New York and agree to submit themselves to such court's jurisdiction."

O. Indemnification

1. Subject to the availability of lawful appropriation and consistent with the New York State Court of Claims Act, ESF shall hold MUSC harmless from, and indemnify it for, any final judgments of a court of competent jurisdiction to the extent attributable to the negligence of ESF or of its officers or employees when acting within the course and scope of their employment in connection with this Agreement.
2. MUSC shall be responsible to and shall defend, indemnify and hold harmless ESF and the State of New York and their respective officers, trustees, directors, employees and agents from and against for any and all losses, expenses, damages and liabilities, including reasonable attorney's fees arising out of the intentional or negligence acts or omissions of MUSC, its officers, employees, agents, or licensees. This provision shall survive the termination of this Agreement.

P. Assignment

1. The Parties shall not assign their rights or responsibilities under this Agreement to any third party.

Q. Notice to Parties

1. All notices and correspondences required to be given hereunder, including invoices and payment, shall be addressed to the following:

Mahidol

Associate Professor Sittiwat Lertsiri

Faculty of Science, Mahidol University

272 Rama 6 Road, Phyathai

Rajthevi Bangkok, 10400, Thailand

deansc@mahidol.ac.th

ESF

David H. Newman

Interim Provost and Vice President for Academic Affairs

1 Forestry Drive,

Syracuse, NY 13210

dnewman@esf.edu

R. Priority of Documents

1. This Agreement, including the SUNY Exhibit A, which is attached hereto as Ex. A, contains the entire agreement between the Parties. In the event of a conflict among the documents, the following order of precedence shall apply: (i) SUNY Exhibit A; and (ii) this Agreement.

SIGNATURE PAGE FOLLOWS

The Parties have caused this Agreement to be signed in duplicate by their duly authorized representatives.

Faculty of Science, Mahidol University	The State University of New York by and on behalf of SUNY College of Environmental Science and Forestry
Name: Associate Professor Sittiwat Lertsiri	**Name**: David H. Neman
Title: Dean, Faculty of Science	**Title**: Interim Provost and Vice President for Academic Affairs
Signature:	Signature:
Date: 17 MAY 2019	Date: May 6, 2019

Standard Contract Clauses
State University of New York

EXHIBIT A

February 11, 2014

The parties to the attached contract, license, lease, amendment or other agreement of any kind (hereinafter, "contract") agree to be bound by the following clauses which are hereby made a part of the contract (the word "Contractor" herein refers to any party other than the State, whether a Contractor, licensor, licensee, lessor, lessee or any other party):

1. **EXECUTORY CLAUSE.** In accordance with Section 41 of the State Finance Law, the State shall have no liability under this contract to the Contractor or to anyone else beyond funds appropriated and available for this contract.

2. **PROHIBITION AGAINST ASSIGNMENT** Except for the assignment of its right to receive payments subject to Article 5-A of the State Finance Law, the Contractor selected to perform the services herein are prohibited in accordance with Section 138 of the State Finance Law from assigning, transferring, conveying, subletting or otherwise disposing of its rights, title or interest in the contract without the prior written consent of SUNY and attempts to do so are null and void. Notwithstanding the foregoing, SUNY may, with the concurrence of the New York Office of State Comptroller, waive prior written consent of the assignment, transfer, conveyance, sublease or other disposition of a contract let pursuant to Article XI of the State Finance Law if the assignment, transfer, conveyance, sublease or other disposition is due to a reorganization, merger or consolidation of Contractor's its business entity or enterprise and Contractor so certifies to SUNY. SUNY retains the right, as provided in Section 138 of the State Finance Law, to accept or reject an assignment, transfer, conveyance, sublease or other disposition of the contract, and to require that any Contractor demonstrate its responsibility to do business with SUNY.

3. **COMPTROLLER'S APPROVAL.** (a) In accordance with Section 112 of the State Finance Law, Section 355 of New York State Education Law, and 8 NYCRR 316, Comptroller's approval is not required for the following contracts: (i) materials; (ii) equipment and supplies, including computer equipment; (iii) motor vehicles; (iv) construction; (v) construction-related services; (vi) printing; and (vii) goods for State University health care facilities, including contracts for goods made with joint or group purchasing arrangements.

(b) Comptroller's approval is required for the following contracts: (i) contracts for services not listed in Paragraph (3)(a) above made by a State University campus or health care facility certified by the Vice Chancellor and Chief Financial Officer, if the contract value exceeds $250,000; (ii) contracts for services not listed in Paragraph (3)(a) above made by a State University campus not certified by the Vice Chancellor and Chief Financial Officer, if the contract value exceeds $50,000; (iii) contracts for services not listed in Paragraph (3)(a) above made by health care facilities not certified by the Vice Chancellor and Chief Financial Officer, if the contract value exceeds $75,000; (iv) contracts whereby the State University agrees to give something other than money, when the value or reasonably estimated value of such consideration exceeds $10,000; (v) contracts for real property transactions if the contract value exceeds $50,000; (vi) all other contracts not listed in Paragraph 3(a) above, if the contract value exceeds $50,000, e.g. SUNY acquisition of a business and New York State Finance Article 11-B contracts and (vii) amendments for any amount to contracts not listed in Paragraph (3)(a) above, when as so amended, the contract exceeds the threshold amounts stated in Paragraph (b) herein. However, such pre-approval shall not be required for any contract established as a centralized contract through the Office of General Services or for a purchase order or other transaction issued under such centralized contract.

(c) Any contract that requires Comptroller approval shall not be valid, effective or binding upon the State University until it has been approved by the Comptroller and filed in the Comptroller's office.

4. **WORKERS' COMPENSATION BENEFITS.** In accordance with Section 142 of the State Finance Law, this contract shall be void and of no force and effect unless the Contractor shall provide and maintain coverage during the life of this contract for the benefit of such employees as are required to be covered by the provisions of the Workers' Compensation Law.

5. **NON-DISCRIMINATION REQUIREMENTS.** To the extent required by Article 15 of the Executive Law (also known as the Human Rights Law) and all other State and Federal statutory and constitutional non-discrimination provisions, the Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, (including gender identity or expression), national origin, sexual orientation, military status, age, disability, predisposing genetic characteristics, marital status or domestic violence victim status. Furthermore, in accordance with Section 220-e of the Labor Law, if this is a contract for the construction, alteration or repair of any public building or public work or for the manufacture, sale or distribution of materials, equipment or supplies, and to the extent that this contract shall be performed within the State of New York, Contractor agrees that neither it nor its subcontractors shall, by reason of race, creed, color, disability, sex, or national origin: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this contract. If this is a building service contract as defined in Section 230 of the Labor Law, then, in accordance with Section 239 thereof, Contractor agrees that neither it nor its subcontractors shall by reason of race, creed, color, national origin, age, sex or disability: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this contract. Contractor is subject to fines of $50.00 per person per day for any violation of Section 220-e or Section 239 as well as possible termination of this contract and forfeiture of all moneys due hereunder for a second or subsequent violation

6. **WAGE AND HOURS PROVISIONS.** If this is a public work contract covered by Article 8 of the Labor Law or a building service contract covered by Article 9 thereof, neither Contractor's employees nor the employees of its subcontractors may be required or permitted to work more than the number of hours or days stated in said statutes, except as otherwise provided in the Labor Law and as set forth in prevailing wage and supplement schedules issued by the State Labor Department. Furthermore, Contractor and its subcontractors must pay at least the prevailing wage rate and pay or provide the prevailing supplements, including the premium rates for overtime pay, as determined by the State Labor Department in accordance with the Labor Law. Additionally, effective April 28, 2008, if this is a public work contract covered by Article 8 of the Labor Law, the Contractor understands and agrees that the filing of payrolls in a manner consistent with Subdivision 3-a of Section 220 of the Labor Law shall be a condition precedent to payment by SUNY of any SUNY-approved sums due and owing for work done upon the project.

7. **NON-COLLUSIVE BIDDING CERTIFICATION.** In accordance with Section 139-d of the State Finance Law, if this contract was awarded based on the submission of competitive bids, Contractor affirms, under penalty of perjury, and each person signing on behalf of Contractor, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that its bid was arrived at independently and without collusion aimed at restricting competition. Contractor further affirms that, at the time Contractor submitted its bid, an authorized and responsible person executed and delivered to SUNY a non-collusive bidding certification on Contractor's behalf.

8. **INTERNATIONAL BOYCOTT PROHIBITION.** In accordance with Section 220-f of the Labor Law and Section 139-h of the State Finance Law, if this contract exceeds $5,000, the Contractor agrees, as a material condition of the contract, that neither the Contractor nor any substantially owned or affiliated person, firm, partnership or corporation has participated, is participating, or shall participate in an international boycott in violation of the federal Export Administration Act of 1979 (50 USC App. Sections 2401 *et seq.*) or regulations thereunder. If such Contractor, or any of the aforesaid affiliates of Contractor, is convicted or is otherwise found to have violated said laws or regulations upon the final determination of the United States Commerce Department or any other appropriate agency of the United States subsequent to the contract's execution, such contract, amendment or modification thereto shall be rendered forfeit and void. The Contractor shall so notify the State Comptroller within five (5) business days of such conviction, determination or disposition of appeal (2 NYCRR 105.4).

9. **SET-OFF RIGHTS.** The State shall have all of its common law, equitable and statutory rights of set-off. These rights shall include, but not be limited to, the State 's option to withhold for the purposes of set-off any moneys due to the Contractor under this contract up to any amounts due and owing to the State with regard to this contract, any other contract with any State department or agency, including any contract for a term commencing prior to the term of this contract, plus any amounts due and owing to the State for any other reason including, without limitation, tax delinquencies or monetary penalties relative thereto. The State shall exercise its set-off rights in accordance with normal State practices including, in cases of set-off pursuant to an audit, the finalization of such audit by the State, its representatives, or the State Comptroller.

10. **RECORDS.** The Contractor shall establish and maintain complete and accurate books, records, documents, accounts and other evidence directly pertinent to performance under this contract (hereinafter, collectively, "the Records"). The Records must be kept for the balance of the calendar year in which they were made and for six (6) additional years thereafter. The State Comptroller, the Attorney General and any other person or entity authorized to conduct an exami-

nation, as SUNY and its representatives and entities involved in this contract, shall have access to the Records during normal business hours at an office of the Contractor within the State of New York or, if no such office is available, at a mutually agreeable and reasonable venue within the State, for the term specified above for the purposes of inspection, auditing and copying. SUNY shall take reasonable steps to protect from public disclosure any of the Records which are exempt from disclosure under Section 87 of the Public Officers Law (the "Statute") provided that: (i) the Contractor shall timely inform an appropriate SUNY official, in writing, that said Records should not be disclosed; and (ii) said Records shall be sufficiently identified; and (iii) designation of said Records as exempt under the Statute is reasonable. Nothing contained herein shall diminish, or in any way adversely affect, SUNY's or the State's right to discovery in any pending or future litigation.

11. **IDENTIFYING INFORMATION AND PRIVACY NOTIFICATION.**

Identification Number(s). Every invoice or New York State Claim for Payment submitted to the State University of New York by a payee, for payment for the sale of goods or services or for transactions (e.g., leases, easements, licenses, etc.) related to real or personal property must include the payee's identification number. The number is any or all of the following: (i) the payee's Federal employer identification number, (ii) the payee's Federal social security number, and/or (iii) the payee's Vendor Identification Number assigned by the Statewide Financial System. Failure to include such number or numbers may delay payment. Where the payee does not have such number or numbers, the payee, on its invoice or Claim for Payment, must give the reason or reasons why the payee does not have such number or numbers.

(b) Privacy Notification. (1) The authority to request the above personal information from a seller of goods or services or a lessor of real or personal property, and the authority to maintain such information, is found in Section 5 of the State Tax Law. Disclosure of this information by the seller or lessor to the State University of New York is mandatory. The principal purpose for which the information is collected is to enable the State to identify individuals, businesses and others who have been delinquent in filing tax returns or may have understated their tax liabilities and to generally identify persons affected by the taxes administered by the Commissioner of Taxation and Finance. The information will be used for tax administration purposes and for any other purpose authorized by law. (2) The personal information is requested by the purchasing unit of the State University of New York contracting to purchase the goods or services or lease the real or personal property covered by this contract or lease. The information is maintained in the Statewide Financial System by the Vendor Management Unit within the Bureau of State Expenditures, Office of the State Comptroller, 110 State Street, Albany, New York 12236.

12. **EQUAL EMPLOYMENT OPPORTUNITIES FOR MINORITIES AND WOMEN.**

(a) In accordance with Section 312 of the Executive Law and 5 NYCRR 143, if this contract is: (i) a written agreement or purchase order instrument, providing for a total expenditure in excess of $25,000.00, whereby a contracting agency is committed to expend or does expend funds in return for labor, services, supplies, equipment, materials or any combination of the foregoing, to be performed for, or rendered or furnished to the contracting agency; or (ii) a written agreement in excess of $100,000.00 whereby a contracting agency is committed to expend or does expend funds for the acquisition, construction, demolition, replacement, major repair or renovation of real property and improvements thereon; or (iii) a written agreement in excess of $100,000.00 whereby the owner of a State assisted housing project is committed to expend or does expend funds for the acquisition, construction, demolition, replacement, major repair or renovation of real property and improvements thereon for such project, then the following shall apply and by signing this agreement the Contractor certifies and affirms that it is Contractor's equal employment opportunity policy that:

(1) The Contractor will not discriminate against employees or applicants for employment because of race, creed, color, national origin, sex, age, disability or marital status, and will undertake or continue existing programs of affirmative action to ensure that minority group members and women are afforded equal employment opportunities without discrimination. Affirmative action shall mean recruitment, employment, job assignment, promotion, upgradings, demotion, transfer, layoff, or termination and rates of pay or other forms of compensation;

(2) at SUNY's request, Contractor shall request each employment agency, labor union, or authorized representative of workers with which it has a collective bargaining or other agreement or understanding, to furnish a written statement that such employment agency, labor union or representative will not discriminate on the basis of race, creed, color, national origin, sex, age, disability or marital status and that such union or representative will affirmatively cooperate in the implementation of the Contractor's obligations herein; and

(3) Contractor shall state, in all solicitations or advertisements for employees, that, in the performance of the State contract, all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.

(b) Contractor will include the provisions of "1", "2" and "3", above, in every subcontract over $25,000.00 for the construction, demolition, replacement, major repair, renovation, planning or design of real property and improvements thereon (the "Work") except where the Work is for the beneficial use of the Contractor. Section 312 does not apply to: (i) work, goods or services unrelated to this contract; or (ii) employment outside New York State. The State shall consider compliance by a Contractor or sub-contractor with the requirements of any federal law concerning equal employment opportunity which effectuates the purpose of this section. SUNY shall determine whether the imposition of the requirements of the provisions hereof duplicate or conflict with any such federal law and if such duplication or conflict exists, SUNY shall waive the applicability of Section 312 to the extent of such duplication or conflict. Contractor will comply with all duly promulgated and lawful rules and regulations of the Department of Economic Development's Division of Minority and Women's Business Development pertaining hereto.

13. **CONFLICTING TERMS.** In the event of a conflict between the terms of the contract (including any and all attachments thereto and amendments thereof) and the terms of this Exhibit A, the terms of this Exhibit A shall control.

14. **GOVERNING LAW.** This contract shall be governed by the laws of the State of New York except where the Federal supremacy clause requires otherwise.

15. **LATE PAYMENT.** Timeliness of payment and any interest to be paid to Contractor for late payment shall be governed by Article 11-A of the State Finance Law to the extent required by law.

16. **NO ARBITRATION.** Disputes involving this contract, including the breach or alleged breach thereof, may not be submitted to binding arbitration (except where statutorily authorized) but must, instead, be heard in a court of competent jurisdiction of the State of New York.

17. **SERVICE OF PROCESS.** In addition to the methods of service allowed by the State Civil Practice Law & Rules ("CPLR"), Contractor hereby consents to service of process upon it by registered or certified mail, return receipt requested. Service hereunder shall be complete upon Contractor's actual receipt of process or upon the State's receipt of the return thereof by the United States Postal Service as refused or undeliverable. Contractor must promptly notify the State, in writing, of each and every change of address to which service of process can be made. Service by the State to the last known address shall be sufficient. Contractor will have thirty (30) calendar days after service hereunder is complete in which to respond.

18. **PROHIBITION ON PURCHASE OF TROPICAL HARDWOODS.** The Contractor certifies and warrants that all wood products to be used under this contract award will be in accordance with, but not limited to, the specifications and provisions of State Finance Law §165 (Use of Tropical Hardwoods), which prohibits purchase and use of tropical hardwoods, unless specifically exempted, by the State or any governmental agency or political subdivision or public benefit corporation. Qualification for an exemption under this law will be the responsibility of the contractor to establish to meet with the approval of the State. In addition, when any portion of this contract involving the use of woods, whether supply or installation, is to be performed by any subcontactor, the prime Contractor will indicate and certify in the submitted bid proposal that the subcontractor has been informed and is in compliance with specifications and provisions regarding use of tropical hardwoods as detailed in Section 165 of the State Finance Law. Any such use must meet with the approval of the State, otherwise, the bid may not be considered responsive. Under bidder certification, proof of qualification for exemption will be the responsibility of the Contractor to meet with the approval of the State.

19. **MacBRIDE FAIR EMPLOYMENT PRINCIPLES.** In accordance with the MacBride Fair Employment Principles (Chapter 807 of the Laws of 1992) , the Contractor hereby stipulates that Contractor and any individual or legal entity in which the Contractor holds a ten percent or greater ownership interest and any individual or legal entity that holds a ten percent or greater ownership interest in the Contractor either (a) have no business operations in Northern Ireland, or (b) shall take lawful steps in good faith to conduct any business operations in Northern Ireland in accordance with the MacBride Fair Employment Principles (as described in Section 165(5) of the State Finance Law), and shall permit independent monitoring of compliance with such principles.

20. **OMNIBUS PROCUREMENT ACT OF 1992.**

It is the policy of New York State to maximize opportunities for the participation of New York State business enterprises, including minority and women-owned business enterprises as bidders, subcontractors and suppliers on its procurement contracts.

Information on the availability of New York State subcontractors and suppliers is available from:

NYS Department of Economic Development
Division for Small Business
30 South Pearl St., 7th Floor
Albany, NY 12245
Tel: 518-292-5100
Fax: 518-292-5884
email: opa@esd.ny.gov

A directory of certified minority and women-owned business enterprises is available from:

NYS Department of Economic Development

Division of Minority and Women's Business Development
633 Third Avenue
New York, NY 10017
212-803-2414

email: mwbecertification@esd.ny.gov
https://ny.newnycontracts.com/FrontEnd/VendorSearchPublic.asp

The Omnibus Procurement Act of 1992 requires that by signing this bid proposal or contract, as applicable, Contractors certify that whenever the total bid amount is greater than $1 million:

(a) The Contractor has made reasonable efforts to encourage the participation of New York State Business Enterprises as suppliers and subcontractors, including certified minority and women-owned business enterprises, on this project, and has retained the documentation of these efforts to be provided upon request to SUNY;

(b) The Contractor has complied with the Federal Equal Employment Opportunity Act of 1972 (P.L. 92-261), as amended;

(c) The Contractor agrees to make reasonable efforts to provide notification to New York State residents of employment opportunities on this project through listing any such positions with the Job Search Division of the New York State Department of Labor, or providing such notification in such manner as is consistent with existing collective bargaining contracts or agreements. The contractor agrees to document these efforts and to provide said documentation to the State upon request; and

(d) The Contractor acknowledges notice that SUNY may seek to obtain offset credits from foreign countries as a result of this contract and agrees to cooperate with SUNY in these efforts.

21. **RECIPROCITY AND SANCTIONS PROVISIONS.** Bidders are hereby notified that if their principal place of business is located in a country, nation, province, state or political subdivision that penalizes New York State vendors, and if the goods or services they offer will be substantially produced or performed outside New York State, the Omnibus Procurement Act of 1994 and 2000 amendments (Chapter 684 and Chapter 383, respectively) require that they be denied contracts which they would otherwise obtain. Contact the NYS Department of Economic Development, Division for Small Business, 30 South Pearl Street, Albany, New York 12245, for a current list of jurisdictions subject to this provision.

22. **COMPLIANCE WITH NEW YORK STATE INFORMATION SECURITY BREACH AND NOTIFICATION ACT.** Contractor shall comply with the provisions of the New York State Information Security Breach and Notification Act (General Business Law Section 899-aa; State Technology Law Section 208).

23. **COMPLIANCE WITH CONSULTANT DISCLOSURE LAW** If this is a contract for consulting services, defined for purposes of this requirement to include analysis, evaluation, research, training, data processing, computer programming, engineering, environmental health and mental health services, accounting, auditing, paralegal, legal or similar services, then in accordance with Section 163(4-g) of the State Finance Law, the Contractor shall timely, accurately and properly comply with the requirement to submit an annual employment report for the contract to SUNY, the Department of Civil Service and the State Comptroller.

24. **PURCHASES OF APPAREL AND SPORTS EQUIPMENT.** In accordance with State Finance Law Section 165(7), SUNY may determine that a bidder on a contract for the purchase of apparel or sports equipment is not a responsible bidder as defined in State Finance Law Section 163 based on (a) the labor standards applicable to the manufacture of the apparel or sports equipment, including employee compensation, working conditions, employee rights to form unions and the use of child labor; or (b) bidder's failure to provide information sufficient for SUNY to determine the labor conditions applicable to the manufacture of the apparel or sports equipment.

25. **PROCUREMENT LOBBYING.** To the extent this agreement is a "procurement contract" as defined by State Finance Law Sections 139-j and 139-k, by signing this agreement the contractor certifies and affirms that all disclosures made in accordance with State Finance Law Sections 139-j and 139-k are complete, true and accurate. In the event such certification is found to be intentionally false or intentionally incomplete, the State may terminate the agreement by providing written notification to the Contractor in accordance with the terms of the agreement.

26. **CERTIFICATION OF REGISTRATION TO COLLECT SALES AND COMPENSATING USE TAX BY CERTAIN STATE CONTRACTORS, AFFILIATES AND SUBCONTRACTORS.** To the extent this agreement is a contract as defined by Tax Law Section 5-a, if the Contractor fails to make the certification required by Tax Law Section 5-a or if during the term of the contract, the Department of Taxation and Finance or SUNY discovers that the certification, made under penalty of perjury, is false, then such failure to file or false certification shall be a material breach of this contract and this contract may be terminated, by providing written notification to the Contractor in accordance with the terms of the agreement, if SUNY determines that such action is in the best interests of the State.

27. **IRAN DIVESTMENT ACT.** By entering into this Agreement, Contractor certifies in accordance with State Finance Law §165-a that it is not on the "Entities Determined to be Non-Responsive Bidders/Offerers pursuant to the New York State Iran Divestment Act of 2012" ("Prohibited Entities List") posted at:
http://www.ogs.ny.gov/about/regs/docs/ListofEntities.pdf

Contractor further certifies that it will not utilize on this Contract any subcontractor that is identified on the Prohibited Entities List. Contractor agrees that should it seek to renew or extend this Contract, it must provide the same certification at the time the Contract is renewed or extended. Contractor also agrees that any proposed Assignee of this Contract will be required to certify that it is not on the Prohibited Entities List before the contract assignment will be approved by the State.

During the term of the Contract, should the state agency receive information that a person (as defined in State Finance Law §165-a) is in violation of the above-referenced certifications, the state agency will review such information and offer the person an opportunity to respond. If the person fails to demonstrate that it has ceased its engagement in the investment activity which is in violation of the Act within 90 days after the determination of such violation, then the state agency shall take such action as may be appropriate and provided for by law, rule, or contract, including, but not limited to, imposing sanctions, seeking compliance, recovering damages, or declaring the Contractor in default.

The state agency reserves the right to reject any bid, request for assignment, renewal or extension for an entity that appears on the Prohibited Entities List prior to the award, assignment, renewal or extension of a contract, and to pursue a responsibility review with respect to any entity that is awarded a contract and appears on the Prohibited Entities list after contract award.

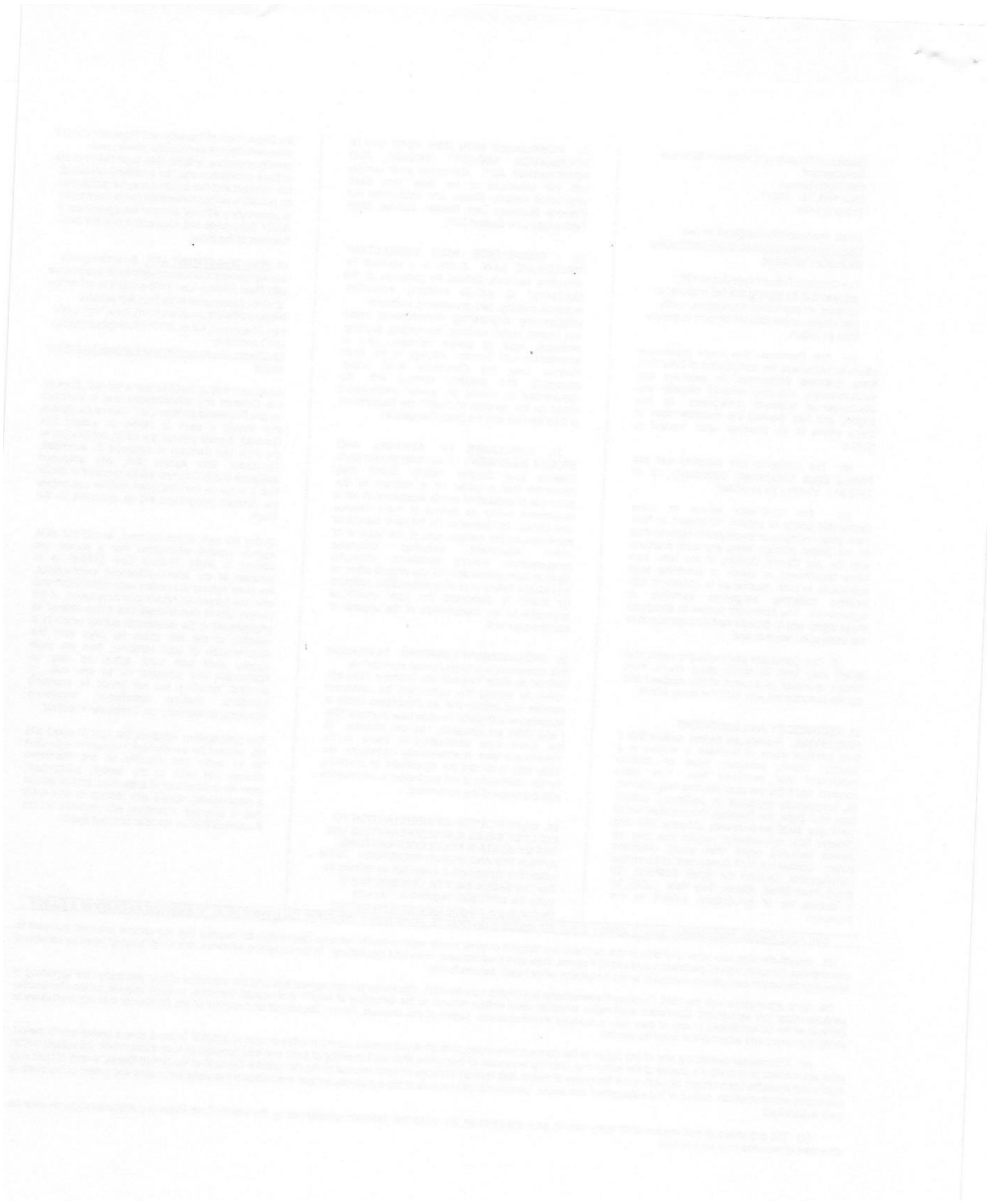
THE FOLLOWING PROVISIONS SHALL APPLY ONLY TO THOSE CONTRACTS TO WHICH A HOSPITAL OR OTHER HEALTH SERVICE FACILITY IS A PARTY

28. Notwithstanding any other provision in this contract, the hospital or other health service facility remains responsible for insuring that any service provided pursuant to this contract complies with all pertinent provisions of Federal, state and local statutes, rules and regulations. In the foregoing sentence, the word "service" shall be construed to refer to the health care service rendered by the hospital or other health service facility.

29. (a) In accordance with the 1980 Omnibus Reconciliation Act (Public Law 96-499), Contractor hereby agrees that until the expiration of four years after the furnishing of services under this agreement, Contractor shall make available upon written request to the Secretary of Health and Human Services, or upon request, to the Comptroller General of the United States or any of their duly authorized representatives, copies of this contract, books, documents and records of the Contractor that are necessary to certify the nature and extent of the costs hereunder.

(b) If Contractor carries out any of the duties of the contract hereunder, through a subcontract having a value or cost of $10,000 or more over a twelve-month period, such subcontract shall contain a clause to the effect that, until the expiration of four years after the furnishing of such services pursuant to such subcontract, the subcontractor shall make available upon written request to the Secretary of Health and Human Services or upon request to the Comptroller General of the United States, or any of their duly authorized representatives, copies of the subcontract and books, documents and records of the subcontractor that are necessary to verify the nature and extent of the costs of such subcontract.

(c) The provisions of this section shall apply only to such contracts as are within the definition established by the Health Care Financing Administration, as may be amended or modified from time to time.



TYPICAL SCHEDULE FOR ENVIRONMENTAL HEALTH

Freshman year	
Fall	
EFB 101 General Bio I: Organismal Bio & Ecol	3
EFB 102 General Bio I Laboratory	1
FCH 150 General Chemistry Lec I	3
FCH 151 General Chemistry Lab I	1
APM 105 Survey of Calculus I	4
EWP 190 Writing and the Environment	3
ENS 132 Orientation Seminar in Biotechnology	1
Total Credits	16
Spring	
EFB 103 General Bio II: Cell Biology & Genetics	3
EFB 104 General Bio I Laboratory	1
FCH 152 General Chemistry Lec II	3
FCH 153 General Chemistry Lab II	1
APM 106 Survey of Calculus II	4
EWP 290 Writing, Humanities & Envrn	3
Total Credits	15
Sophomore year	
Fall	
EFB 303 Intro to Environmental Microbiology	4
FCH 221 Organic Chemistry I	3
FCH 222 Organic Chemistry Lab I	1
ESF 200 Information Literacy	1
EHS 250 Foundations in Environmental Health	1
Electives	6
Total Credits	16
Spring	
APM391 Intro/Probability & Stats	3
FCH 223 Organic Chemistry II	3
FCH 224 Organic Chemistry Lab II	1
EHS 350 Environmental Health Management	3
Electives	6
Total Credits	16
Junior year	
Fall	
PHY 101 Major Concepts of Physics I [1]	4
EFB 400 Toxicology	3
EHS 360 Environmental Sampling Methods	3
FST 102 Food Fights	3
Electives	3
Total Credits	16
Spring	
PHY 102 Major Concepts of Physics II [1]	4
EFB 360 Epidemiology	3
EHS 320 Disease Prevention	2
Electives	6
Total Credits	15
Summer	
EHS 420 Internship in Environmental Health	3
Total Credits	3
Senior year	
Fall	
ENS 470 Risk Assessment	3
EHS 480 Hazardous Materials Management	3
FCH 399 Introduction to Atmospheric Science	3
Electives	7
Total Credits	16
Spring	
EHS 440 Occupational Health and Safety	3
EHS 494 Capstone	1
Electives	12
Total Credits	16

TYPICAL SCHEDULE FOR ENVIRONMENTAL HEALTH 2+2 PROGRAM

Prior to Attending ESF	
General Bio I: Organismal Bio & Ecol and Lab	4
General Bio II: Cell Biology & Genetics and Lab	4
Microbiology II and Lab	4
Calculus I	4
Calculus II	4
Probability & Stats	3
Physics I and Lab	4
Physics II and Lab	4
Writing	3
Literature Review	3
General Chemistry Lec I and Lab	4
General Chemistry Lec II and Lab	4
Organic Chemistry I and Lab	4
Organic Chemistry II and Lab	4
General Education Courses	9
Total Credits	62
Junior year	
Fall	
ESF200 Information Literacy	1
EHS 250 Foundations of Environmental Health	1
EHS 360 Environmental Sampling Methods	3
EFB 400 Toxic Health Hazards	3
ENS 132 Orientation Seminar	1
FST 102 Food Fights	3
Total Credits	12
Spring	
EFB 360 Epidemiology	3
EHS 320 Disease Prevention	2
EHS 350 Environmental Health Management	3
Electives	9
Total Credits	17
Summer	
EHS 420 Internship in Environmental Health	3
Total Credits	3
Senior year	
Fall	
EHS 480 Hazardous Materials Management	3
ENS 470 Risk Assessment	3
FCH 399 Introduction to Atmospheric Science	3
Electives	7
Total Credits	16
Spring	
EHS 440 Occupational Health and Safety	3
EHS 494 Capstone	1
Electives	12
Total Credits	16

TYPICAL SCHEDULE FOR BIOTECHNOLOGY

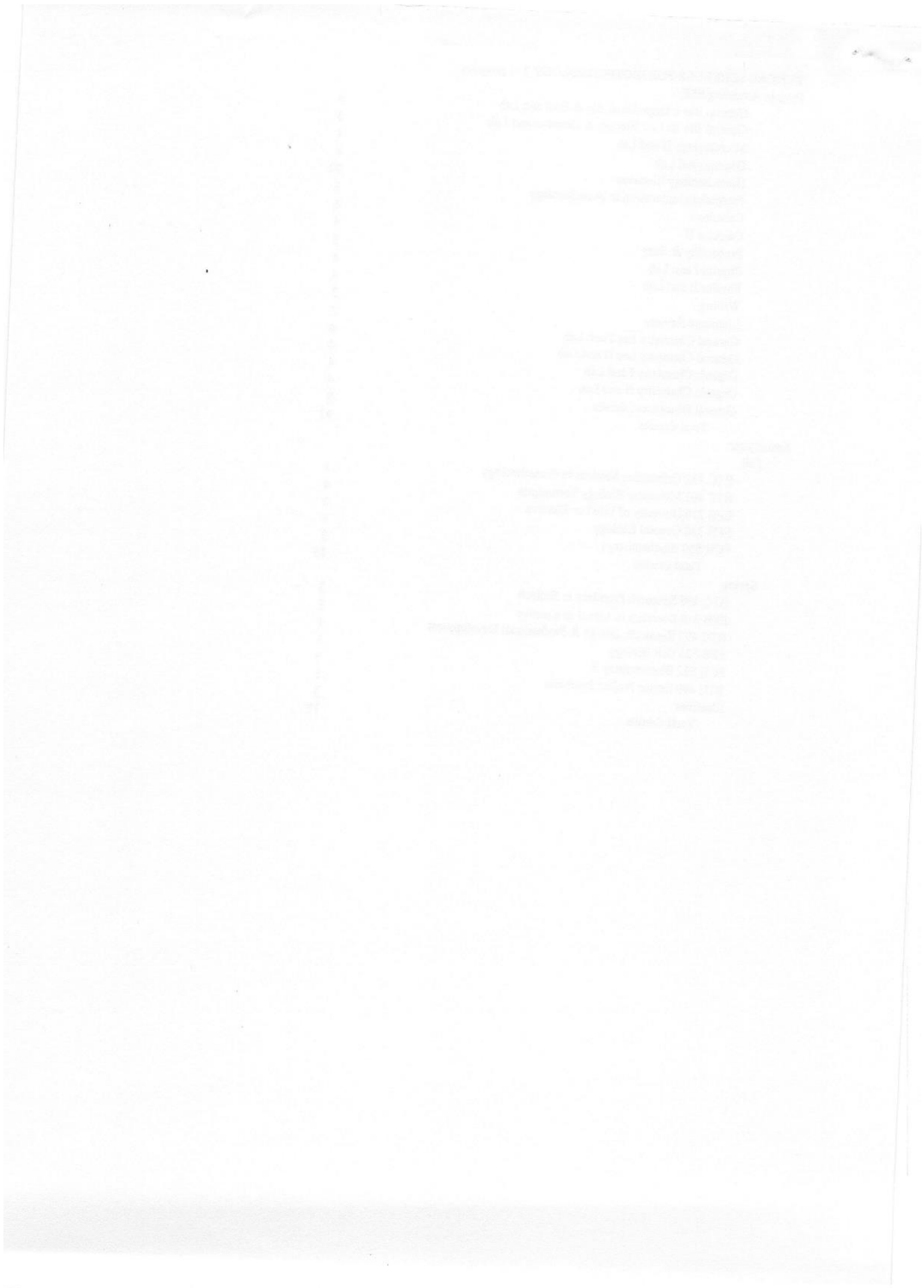
Freshman year	
Fall	
EFB 101 General Bio I: Organismal Bio & Ecol	3
EFB 102 General Bio I Laboratory	1
FCH 150 General Chemistry Lec I	3
FCH 151 General Chemistry Lab I	1
APM 105 Survey of Calculus I	4
CLL 190 Writing and the Environment	3
BTC 132 Orientation Seminar in Biotechnology	1
Total Credits	16
Spring	
EFB 103 General Bio II: Cell Biology & Genetics	3
EFB 104 General Bio I Laboratory	1
FCH 152 General Chemistry Lec II	3
FCH 153 General Chemistry Lab II	1
APM 106 Survey of Calculus II	4
CLL 290 Writing, Humanities & Envrn	3
Total Credits	15
Sophomore year	
Fall	
EFB 303 Intro to Environmental Microbiology	4
FCH 221 Organic Chemistry I	3
FCH 222 Organic Chemistry Lab I	1
EFB 210 Diversity of Life I or Elective 3	
EFB 307 Principles of Genetics	3
EFB 308 Principles of Genetics Lab	1
Total Credits	15
Spring	
APM391 Intro/Probability & Stats	3
FCH 223 Organic Chemistry II	3
FCH 224 Organic Chemistry Lab II	1
BTC 497 Research, Design & Professional Development	1
EFB 210 Diversity of Life II or Elective	3
Electives	3
Total Credits	14
Junior year	
Fall	
PHY 101 Major Concepts of Physics I [1]	4
BTC 401Molecular Biology Techniques	4
EFB 320 General Ecology	4
Electives	3
Total Credits	15
Spring	
PHY 102 Major Concepts of Physics II [1]	4
BTC 498 Research Problems in Biotech	3
EFB 325 Cell Biology	3
Electives	6
Total Credits	16
Summer	
BTC 420 Internship in Biotechnology	3
Total Credits	3
Senior year	
Fall	
FCH 530 Biochemistry I	3
Electives	11
Total Credits	14
Spring	
FCH 532 Biochemistry II	3
BTC 499 Senior Project Synthesis	1
Electives	11
Total Credits	15

TYPICAL SCHEDULE FOR BIOTECHNOLOGY 2+2 program

Prior to Attending ESF	
General Bio I: Organismal Bio & Ecol and Lab	4
General Bio II: Cell Biology & Genetics and Lab	4
Microbiology II and Lab	4
Genetics and Lab	4
Calculus I	4
Calculus II	4
Probability & Stats	3
Physics I and Lab	4
Physics II and Lab	4
Writing	3
Literature Review	3
General Chemistry Lec I and Lab	4
General Chemistry Lec II and Lab	4
Organic Chemistry I and Lab	4
Organic Chemistry II and Lab	4
General Education Courses	6
Total Credits	63
Junior year	
Fall	
BTC 132 Orientation Seminar in Biotechnology	1
BTC 401Molecular Biology Techniques	4
EFB 210 Diversity of Life I or Elective	3
EFB 320 General Ecology	4
General Education Elective	3
Total Credits	15
Spring	
BTC 498 Research Problems in Biotech	3
EFB 210 Diversity of Life II or Elective	3
BTC 497 Research, Design & Professional Development	1
EFB 325 Cell Biology	3
Electives	3
Total Credits	13
Summer	
BTC 420 Internship in Biotechnology	3
Total Credits	3
Senior year	
Fall	
FCH 530 Biochemistry I	3
Electives	11
Total Credits	14
Spring	
FCH 532 Biochemistry II	3
BTC 499 Senior Project Synthesis	1
Electives	11
Total Credits	15

TYPICAL SCHEDULE FOR BIOTECHNOLOGY 3+1 program

Prior to Attending ESF	
General Bio I: Organismal Bio & Ecol and Lab	4
General Bio II: Cell Biology & Genetics and Lab	4
Microbiology II and Lab	4
Genetics and Lab	4
Biotechnology Electives	22
Professional Internship in Biotechnology	3
Calculus I	4
Calculus II	4
Probability & Stats	3
Physics I and Lab	4
Physics II and Lab	4
Writing	3
Literature Review	3
General Chemistry Lec I and Lab	4
General Chemistry Lec II and Lab	4
Organic Chemistry I and Lab	4
Organic Chemistry II and Lab	4
General Education Courses	9
Total Credits	91
Senior year	
Fall	
BTC 132 Orientation Seminar in Biotechnology	1
BTC 401 Molecular Biology Techniques	4
EFB 210 Diversity of Life I or Elective	3
EFB 320 General Ecology	4
FCH 530 Biochemistry I	3
Total Credits	15
Spring	
BTC 498 Research Problems in Biotech	3
EFB 210 Diversity of Life II or Elective	3
BTC 497 Research, Design & Professional Development	1
EFB 325 Cell Biology	3
FCH 532 Biochemistry II	3
BTC 499 Senior Project Synthesis	1
Electives	3
Total Credits	17



TYPICAL SCHEDULE FOR 2 + 2 TRANSER STUDENTS TO ESF

Year One

All Majors

General Bio: Organismal Biology & Ecology with Lab		4	
General Bio: Cell Biology & Genetics with Lab		4	
Calculus I		4	
Calculus II		4	
General Chemistry I with Lab		4	
General Chemistry II with Lab		4	
Introduction to Computer Programing (Bioprocess or Paper Science)	3		
Information Literacy		1	
Writing		3	
Literature Review		3	31 or 34

Year Two

Biotechnology OR Environmental Health

Microbiology with Lab		4	
Genetics with Lab (Biotech or Pre-Med Environmental Health)		4	
Probability & Statistics		3	
Physics I with Lab		4	
Physics II with Lab		4	
Organic Chemistry I with Lab		4	
Organic Chemistry II with Lab		4	
General Education Courses (World History, Art, or Social Science)	6	33	

Environmental Biology OR Aquatic and Fisheries Science

Global Environment		3	
Genetics with Lab		4	
Probability & Statistics		3	
Physics I with Lab		4	
Organic Chemistry I with Lab		4	
Botany		4	
Zoology		4	
General Education Courses (World History, Art, or Social Science)	6	32	

Bioprocess Engineering OR Paper Science

Probability & Statistics		3	
Physics I with Lab		4	
Physics II with Lab		4	
Organic Chemistry I with Lab		4	
Organic Chemistry II with Lab		4	
Economics		3	
Differential Equations		3	
Calculus III		4	
General Education Courses (World History, Art, European History)	6	35	

BACHELOR OF SCIENCE
DUAL DEGREE PROGRAM AGREEMENT
BETWEEN SUNY ESF AND MAHIDOL UNIVERSITY

SUNY ESF	Mahidol University – Faculty of Science
1 Forestry Drive Syracuse, New York 13210, USA	272 Rama 6 Road, Phyathai Ratchathewi Bangkok, 10400 Thailand

This Agreement is made and entered into on the date of the final signature hereto, by and between the State University of New York – College of Environmental Science and Forestry (SUNY ESF) and Mahidol University – Faculty of Science (MUSC), for the purpose of establishing a Bachelor of Science Program in various majors that would be offered jointly by the two institutions.

I. Eligibility of Student Participants

a. All applicants shall be *bona fide* matriculated students and be enrolled in the Bachelor of Science in one of the following programs or their precursor equivalents at MUSC:
   - BS in Bioresources and Environmental Biology
   - Other BS programs as identified in future addenda to this agreement

b. SUNY ESF will accept a limited number of students each year from MUSC to participate in the dual degree program listed above. At least six months before the anticipated date of enrollment, the number of students to participate will be decided mutually by the faculty coordinator at SUNY ESF (in collaboration with the Office of Admissions and the Office of the Provost) and the designated official or faculty coordinator at MUSC.

II. Selection and Admission of Participants

a. Prospective student participants must file an application and all documents required by the SUNY ESF Office of Admissions. However, the application fee will be waived.

b. To be considered, applicants must present a minimum score of 550 (paper-based test), 213 (computer-based test) or 79 (internet-based test) on the TOEFL (Test of English as a Foreign Language); or Total: 6 (with no less than 5 in Writing) on the IELTS; or Grade pre-1 on the STEP EIKEN tests. For complete and updated requirements, see *http://www.esf.edu/graduate/documents/InternationalAdmissioninfo.doc*.

c. Participants will be selected based on recommendation by the faculty coordinator at MUSC, credentials documented in the application materials, and results of an interview with an SUNY ESF faculty member. The SUNY ESF Office of Admissions will make the final decision regarding admission to the program.

d. SUNY ESF will facilitate the selection process by sending one faculty member to MUSC or by arranging a video conference in the late spring or early summer for fall entry, or late summer for spring entry to interview prospective student participants. The SUNY ESF faculty member will provide the completed applications, along with copies of the applicants' academic records from MUSC to the SUNY ESF Office of Admissions.

e. Participants will be admitted to SUNY ESF as BS diploma (degree-seeking) students majoring in one of the programs noted above.

f. Participants are expected to matriculate and begin their studies at SUNY ESF in the first term (beginning in August) of their senior year. On some occasions, if a student elects to spend more than one year at SUNY ESF, they may enter during the second term (January).

III. Curriculum

a. The curriculum for each dual degree program is defined in the attached articulation agreements.

b. The coursework students transfer from MUSC to ESF, when added to that taken in residence at ESF, must fulfill all ESF and SUNY degree requirements, including SUNY General Education, to qualify for the conferral of the ESF Bachelor of Science degree.

c. Participating students must also meet the SUNY ESF residency requirement for degrees to be granted, specifically, that at least 24 of the final 30 credit hours must be registered through SUNY-ESF.

d. MUSC may have additional curriculum requirements over and above the curricula described in the articulation agreements to satisfy MUSC degree requirements.

e. Each curriculum should be reviewed by both institutions every other year. However, updating and/or modification of the curriculum must be approved by both institutions.

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IV. Dual Degree Program Assessment

a. Each institution will provide documentation on student performance for the required courses and selected elective courses, including those intended to meet SUNY System - General Education requirements, as requested by the other institution for program evaluation and/or assessment purposes. The dual degree program must meet standards for accreditation established by the Middle States Commission of Higher Education, and by the Accreditation Board of Engineering and Technology (ABET) for the BS program in Bioprocess Engineering .

b. Evaluation and review of the dual degree program will be conducted annually by each institution for the graduating class. The evaluation results will be shared by both institutions.

V. Granting of Degree to Individual Student Participating in the Program

a. Each institution agrees to facilitate the transfer of successfully completed credits to the other institution.

b. To qualify for the ESF diploma, participants must be physically present at SUNY ESF for a minimum of two semesters and successfully complete a minimum of 30 credits hours of study in residence at SUNY ESF.

c. Participants who fulfill all the requirements of the dual degree program will receive diplomas from MUSC and ESF, and be recognized as graduates of both institutions.

d. Each institution may grant their degree independently of the other with regard to conferral date, specific degree or major title, or other local custom with regard to degree honors or distinction.

VI. Tuition, Fees and Financial Aid

a. Tuition and fees for the dual degree program students attending SUNY ESF will be the out-of-state rate less a scholarship that will average $4000 per student per year ($2000 per semester).

b. Students will pay tuition and fees to ESF. MUSC will be consulted to determine the distribution of scholarship funds among students coming to ESF.

VII. Housing and Other Expenses

a. Participants are responsible for the cost of their room and board. SUNY ESF will offer participants options for housing in SUNY ESF and/or Syracuse University residence facilities, however participants may elect to take lodging in off-campus quarters.

b. Participants are responsible for arranging and paying for their own in-country and international travel, medical insurance, passport and visa application fees, textbooks, personal items and any other expenses.

VIII. Other Related Articles

a. Participants will be required to comply with the SUNY insurance policies and procedures for international students.

b. Participants shall abide by all applicable rules and regulations of MUSC and SUNY ESF, and by all applicable laws, rules, and regulations of the home and host countries. In case of violation, either institution has the right to terminate the student's participation, and SUNY ESF has the right to expel the violator.

c. The faculty coordinator at ESF will serve as the first point of contact at ESF for the participants.

d. MUSC may elect to develop a program that would permit SUNY ESF students to complete a similar dual degree program by completing at least one year of study and a minimum of 30 credit hours at MUSC.

e. Participants in the dual degree program are encouraged to consider graduate study at SUNY ESF following completion of their BS degrees. Participants should contact individual professors and/or the Graduate Coordinator in the Departments of Paper and Bioprocess Engineering (PBE) and/or Environmental and Forest Biology for potential openings. Research or teaching assistantships may be available to provide financial support for graduate study for highly qualified applicants.

IX. Staff Exchange

a. Teaching and research staff from one institution are encouraged to visit the other institution. The host institution will facilitate such visits.

b. ESF will fund one faculty member each year to travel to MUSC to interview prospective students and coordinate the dual degree program.

X. Validity of Agreement

a. All modifications to this agreement must be in writing and signed by both parties.

b. This agreement becomes effective when signed by representatives of the two universities and shall remain effective for a period of five years. During the final year of the agreement, a full review of the program will be conducted by both institutions and renewal for another five-year period will be considered.

c. Either party giving ninety (90) days written notice to the other party may terminate this agreement provided that such termination will not affect the completion of any activity underway at the time. If future activity has been advertised and either party has made commitments to students concerning such activity, such termination will not affect that activity.

By and on behalf of
The State University of New York – College of Environmental Science and Forestry

Dr. Quentin Wheeler.
President

3/5/14
Date

On behalf of
Mahidol University – Faculty of Science

Dr. Skorn Mongkolsuk
Dean

5/5/2014
Date