

COURSE SYLLABUS
ILSE 631 Biology Education
Semester A (2022), 3 (3-0-6) credit hours
Institute for Innovative Learning, Mahidol University

Course Coordinator

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Instructors

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Course Description

Nature of learning biology; misconception in biology; pedagogical content knowledge for teaching cell biology, biodiversity, evolution, biochemistry, modern genetics, bio-nanotechnology, biomass and bioenergy, plant biology, and biomedicine; emerging fields of biological sciences; professional ethics and ethics in biology teaching.

Course Learning Outcomes (CLOs)

After successful completion of this course, students are expected to be able to:

Course learning outcomes	PLO	Sub-PLO
1. display appropriate ethical behaviours in using scientific teaching materials	1	1.1
2. analyze ethical concerns related to teaching and learning which affect public and teachers' professional quality	1	1.1
3. analyze biology concepts and contents under the Pedagogical Content Knowledge (PCK) framework	6	6.1, 6.2, 6.3
4. design an instruction to improve students' understanding of selected topics in biology	2	2.1, 2.2
5. evaluate misconceptions and difficulties in teaching and learning biology	3	3.1
6. propose ways to rectify misconceptions as well as solve difficulties in learning biology	3	3.1, 3.2
7. evaluate the in-depth conceptual understanding of oneself in biology	6	6.1, 6.2, 6.3
8. display the ability to collaborate effectively with others	8	8.1, 8.2

Class Periods: Thursday, 9.00-12.00 hr.

Room: Panyapipat Building, Room 303 (*Note: Online learning is also available in any circumstances where fact-to-face meetings are not possible*)

Online: <https://mahidol.webex.com/mahidol/j.php?MTID=m8856eb0a9a2b601ffbab08e7afa4d612>

Meeting number: 2642 873 9771

Password: ILSE631

Host key: 934589

Course Outline

Week	Date	Content	CLO	Teaching Approach	Instructor	Assignment
1	11 Aug 22	- Course orientation - Nature of learning biology	7, 8	Active lecture, Discussion	PJ	
2	18 Aug 22	The role of PCK in biology teaching	3, 7, 8	Case study, Discussion	<u>PJ</u> WK	Report
3	25 Aug 22	Common misconceptions in biology learning	5, 6, 7, 8	Case study, Discussion	PJ	Take-home assignment
4*	1 Sep 22	Principle of biochemistry in the living organism	1, 4, 5 7, 8	Micro-teaching or Active lecture Discussion	<u>PJ</u> PS	In-class assignment
5*	8 Sep 22	Cell biology: Fundamental concept in life science	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	PJ	Take-home assignment
6*	15 Sep 22	Exploring biodiversity in the community: A case study	1, 4, 7, 8	Micro-teaching or Active lecture, Discussion	PJ <u>NS</u>	Presentation
7	22 Sep 22	Understanding evolution conceptual framework	7, 8	Active lecture, Discussion	PJ <u>NS</u>	Reflective journal
8*	29 Sep 22	A concept of modern genetics	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	PJ <u>NS</u>	Take-home assignment
9*	6 Oct 22	Current trend in bio-nanotechnology	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	<u>NS</u> WK	In-class assignment
10	20 Oct 22	Biomass and bioenergy: Challenges for future resources in society	7, 8	Active lecture, Discussion	NS <u>WK</u>	Report
11*	27 Oct 22	Making biology learning relevant to students: Plant biology	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	NS <u>WK</u>	Take-home assignment
12*	3 Nov 22	New frontiers for biomedicine	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	<u>NS</u> PS	In class assignment
13*	10 Nov 22	Emerging fields of biological sciences	1, 4, 5 7, 8	Micro-teaching or Active lecture, Discussion	NS <u>WK</u>	In-class assignment
14	17 Nov 22	Professional ethics and ethics in biology teaching	1, 2, 8	Active lecture, Discussion	PJ <u>WK</u>	In-class assignment
15	24 Nov 22	Concept mapping & Critical reflection	7	Discussion, Self-reflections	WK PJ	Critical reflection

Remark * Students are allowed to *select two topics for micro-teaching on that day (just 1 hour each), and the teacher will facilitate class discussion.*

Assessment and Evaluation*

Tools/Method*	CLO								Percentage
	1	2	3	4	5	6	7	8	
Active participation								/	5
Report			/				/		10
In-Class assignment		/					/		25
Take-home assignment					/	/	/		20
Presentation	/						/		5
Reflective journal							/		5
Microteaching	/			/					20
Critical Reflection							/		10

*(Remark: * The detail of assessments and their criteria are presented in Appendix)*

Final grade will be determined by the total points earned, that is,

- $\geq 90 - 100\%$ = A
- ≥ 80 and $< 90\%$ = B+
- ≥ 70 and $< 80\%$ = B
- ≥ 60 and $< 69\%$ = C+
- ≥ 50 and $< 59\%$ = C

In addition, a student's final grade may be higher than the suggested guideline if the student's score is close enough (<1% gap) to the next higher score. Close scores will likely earn the same final grade.

Important remark:

1. For credit students to get an evaluation, they must attend at least 80% of class time.
2. For audit students to get a passing grade, they must attend at least 80% of class time with active participation as the same as credit students. Also, the assignment given by instructors have to be included in this Evaluation

Readings:

1. Bybee, R. W. (2002). *Learning science and the science of learning*. Allington, NSTA press.
2. Campbell, N. A., Reece, J. B., & Mitchell, L. J. (1999). *Biology (5th ed.)*. Menlo Park, CA: Cummings.
3. Fisher, K. M., Wandersee, J. H., & Moody, D. E. (2002). *Mapping biology knowledge*. Science & Technology Education Library, Book series (CTISE, volume 11). Springer, Dordrecht. <https://link.springer.com/book/10.1007/0-306-47225-2>.
4. Mintzes, J. J. (2006). *Handbook of college science teaching*. Arlington, NSTA press.
5. National Science Teachers Association. (2009). *The biology teachers' handbook (4th Ed.)*.

Remark: Others Readings will consist of articles drawn from the primary literature of science education and some chapters from the books. The instructors will provide copies of some handouts or literature

APPENDIX

Active participation (5%) *To evaluate CLO 8*

Each student is expected to participate, share, and discuss during the class actively. Students are also likely to show cooperative working in class.

Scoring rubric for active participation

	Poor (1)	Fair (2)	Good (3)	Excellent (4)
Attendance and punctuality	Attend class late or leave early (≥ 15 min.)	Attend class late or leave early (not more than 15 min.)	Attend class on time.	Attend class early.
Engagement	Never contributes to class by offering ideas and asking questions.	Rarely contributes to class by offering ideas and asking questions.	Proactively contributes to class by offering ideas and asking questions once per class.	Proactively contributes to class by offering ideas and asking questions more than once per class.
Listening, questioning, and discussing	Not listen with respect, argues with classmates, and do not consider other ideas. Blocks group form reaching an agreement.	Trouble listening respectfully and taking over discussion without letting other people have a turn.	Respectfully listen, discuss and ask questions.	Respectfully listen, discuss and ask questions and helps direct the group in solving the problem.
Preparation	Not prepared with assignments and required class materials.	Prepare with assignments and required class materials rarely.	Prepare with most assignments and required class materials.	Prepare well with assignments and required class materials rarely.
Problem-solving	Not try to solve problems or help others solve problems.	Not offering solutions but is willing to try solutions suggested by the other group members.	Improves on solutions which other group members suggest.	Actively seeks and suggests solutions to problems.

Assignments (65%)

Students will be assigned to work on the topic identified in the course schedule. The assignments will be divided into five primary forms:

- Report (W2, W10) – *To evaluate CLOs 3 and 7*..... 10 %
- In-class assignments (W4, W9, W12, W13, W14) – *To evaluate CLOs 2, 7*..... 25%
- Take-home assignments (W3, W5, W8, W11) – *To evaluate CLOs 5, 6, 7*..... 20 %
- Presentation (W6) – *To evaluate CLOs 1 and 7*..... 5 %
- A reflective journal (W7) – *To evaluate CLO 7* 5 %

Scoring rubric for the report, assignment, and presentation

Criteria*	Unacceptable 1	Marginal 2	Fair 3	Acceptable 4	Exceptional 5
Content knowledge	The response is completely incorrect or irrelevant.	The application, if attempted, is irrelevant.	The application of the concept to the practical problem or task is adequate.	The concept has been applied to practical problems or tasks.	Effective application of the concept to a practical problem or task reveals insight into the biology education principle
Ethical behaviour	No evidence that the students consider ethical concerns.	Students appear to be aware of some ethical issues but do not fully understand what it means to work ethically and professionally.	Students demonstrate understanding of the significant ethical issues and not full responsibility to work ethically and professionally.	The student demonstrates an understanding of the significant ethical issues and is responsible for working ethically and professionally.	Students can analyze a complex ethical situation and demonstrate an understanding of significant and subtle ethical issues. They also show ethical and professional teaching in their response

*Remark: * The instructor may add another criterion per week's contents and learning objectives.*

Weighing for each measure depends on the instructor.

Microteaching (20%) To evaluate CLOs 1, 4, 7, 8

At the beginning of this course, students must select two topics for micro-teaching. They are allowed to perform the 1-hour micro-teaching on that day. The micro-teaching will be observed, assessed, and discussed for further improvement by instructors and peers.

Scoring rubric for microteaching

Criteria	Limited 1	Basic 2	Developing 3	Exemplary 4
Knowledge of subject matter	Students demonstrate the alternative concepts of the subject matter.	Students demonstrate inadequate knowledge of the subject matter.	Students demonstrate adequate knowledge of the subject matter.	Students demonstrate proficient knowledge of the subject matter.
Conceptual teaching strategies	No evidence of acknowledgement of prior knowledge and misconceptions	Acknowledgement misconceptions with no corresponding confrontation strategy.	Consider confrontation of prior knowledge or common misconception.	Consider confrontation of prior knowledge or misconception. Emphasize the critical conceptual aspect.
Method of presentation	Students demonstrate less ability to teach.	Students demonstrate an ability to use lectures as teaching methods during the lesson.	Students demonstrate an ability to use effective teaching methods but less engage in active learning during the lesson.	Students demonstrate a superior ability to use effective teaching methods and engage in active learning during the lesson.
Communication skills	Communication is not easily understood.	Communication is understood.	Communication is easily understood.	Communication is clearly and easily understood.

Critical reflection (10%) To evaluate CLO 8

Scoring rubric for critical reflection

Criteria	Limited (1-3 points)	Basic (>3 to 6)	Developing (>6 to 9)	Exemplary (>9 to 10 points)
Reflection	Review prior learning (past experiences inside and outside of the classroom) at a surface level, without revealing clarified meaning or indicating a broader perspective about education or life events	Review prior learning (past experiences inside and outside the classroom) with some depth, revealing slightly clarified meaning or indicating a broader perspective about education or life events.	Review prior learning (past experiences inside and outside the classroom) in-depth, revealing full clarified meaning or indicating broader perspectives about educational or life events.	Review prior learning (past experiences inside and outside the classroom) in-depth to reveal significantly changed perspectives about education and life experiences, which provide the foundation for expanded knowledge, growth, and maturity.

Table for summary the summative assessment method used in this course and the expected learning outcomes (ELOs)

Summative assessment	Sub-ELO										Percentage
	1.1	2.1	2.2	3.1	3.2	6.1	6.2	6.3	8.1	8.2	
Active participation									2.50	2.50	5.00
Report						3.33	3.33	3.33			10.00
In-Class assignment	6.25					6.25	6.25	6.25			25.00
Take-home assignment				4.00	4.00	4.00	4.00	4.00			20.00
Presentation	1.25					1.25	1.25	1.25			5.00
Reflective journal						1.67	1.67	1.67			5.00
Microteaching	6.67	6.67	6.67								20.00
Critical Reflection						3.33	3.33	3.33			10.00
Total	14.17	6.67	6.67	4.00	4.00	19.83	19.83	19.83	2.50	2.50	100.00

The PLOs and key performance indicators of the Master of Science Program in Science and Technology Education in Academic Year 2020.

PLOs	Key Performance Indicators
PLO 1: Display moral and ethical behavior for science and technology educators	1.1 Display moral and ethical behavior that aligns with the code of conduct for science and technology educators
PLO 2: Apply principle in science and technology education to design and implement learning activities in science and/or technology classes appropriately	2.1 Adopt instructional sciences to improve learning in science and technology education 2.2 Design learning activities for science and/or technology classes 2.3 Implement the designed activities to improve learning in science and technology education 2.4 Assess students' learning achievement
PLO 3: Synthesize solutions to learning problems in the field of study	3.1 Analyze learning problems in the field of study 3.2 Apply PLO 2 to synthesize new ways and/or means to solve the learning problems

PLOs	Key Performance Indicators
PLO 6: Evaluate knowledge of oneself	6.1 Classify criteria for self-evaluation 6.2 Reflect oneself against the criteria 6.3 Evaluate oneself validly and reliably
PLO 8: Display leadership quality and ability to effectively collaborate with others	8.1 Display leadership quality to effectively collaborate with others 8.2 Display ability to effectively collaborate with others