Please Specify GE basket

Life Appreciation

Global Citizenship

Critical Thinking

■ Leadership

Digital Literacy

GE and Course's CLOs Alignment

Leadership	Course Learning Outcomes (CLOs)
PLO7 Demonstrate the ability to take initiatives that bring about change for the well-being of the community	CLO1 Conduct an original research project based on information and data collected from the local region and then present and defend results CLO2 Understand the scientific process though participation in the process at a local level CLO3 Demonstrate team-work and collaboration skills through working in a group to search for relevant scientific journal articles that support community research

	CLO4 Publicly present finding about the community as an initial step in developing district-level solutions

TQF3 Course Specification

Section 1 General Information

1. **Course Code and Title**

In Thai ICGN 114 วิธีการทางวิทยาศาสตร์กับสังคม

In English ICGN 114 The Scientific Approach and Society

2. Number of Credits 4 (4-0-8)
(Theory 4 hrs. Self-study 0 hrs Practice 8 hrs. / week)

3. Curriculum and Course Type

3.1 Program of Study International Bachelor's Degree

3.2 Course Type General Education

3.3 Please Specify Course's Literacy

MU Literacy (Core Values, SEP, GE for Human Development)

Health Literacy (Health, Sport)

Digital Literacy (ICT, Applied Mathematics)

Social and Humanity Literacy (Social, Humanity, Law, Ethics, Arts)

Communication Literacy (language, Academic Communication)

■ Science and Environmental Literacy (Applied Science for Life, Environmental Responsibility)

Finance and Management Literacy (Finance, Management, Entrepreneur)

3.4 Please Specify Relationship between course and corporate culture

M - Mastery	รู้แจ้ง รู้จริง สมเหตุ สมผล
A - Altruism	มุ่งผลเพื่อผู้อื่น
■ H - Harmony	กลมกลืนกับสรรพสิ่ง
I - Integrity	มั่นคงยิ่งในคุณธรรม
D - Determination	แน่วแน่ทำ กล้าตัดสินใจ
O - Originality	สร้างสรรค์สิ่งใหม่
■ L - Leadership	ใฝ่ใจเป็นผู้นำ

4. Course Coordinator and Instructor

4.1 Course Coordinator Brian J. Phillips, Science Division, (662) 700-5000 Ext. 3520, brian.phi@mahidol.ac.th

4.2 Instructor Brian J. Phillips

5. Trimester/Class Level

5.1 Trimester All trimesters/ Class Level For all students at an International College

5.2 Number of Students Allowed Approximately 30 Students

6. Pre-requisite None

7. Co-requisites None

8. Study Site Location MUIC, Salaya Campus

Section 2 Aims and Objectives

1. Course Goals

1.1 Students will better understand the scientific values and ways of knowing, and the limitations of the scientific method

1.2 Understand different methods of collecting, analyzing and classifying information and how this is integrated science with other disciplines

1.3 Understand how science knowledge and methodology influences institutions and society

2. Objectives of Course Development/Revision

2.1 Course Objectives

2.1 Understand the life-cycle of knowledge: the process of developing new CLO knowledge and how scientific knowledge becomes obsolete

2.2 Be able to discuss the issue of what should be considered and science and what should not be.

2.3 Using scientific methodology to organize, analyze and interpret data collected and draw conclusions through analysis and by doing so, generate new knowledge

2.2 Course-level Learning Outcomes (CLOs)

1. CLO1 Conduct an original research project based on information and data collected from the local region and then present and defend results
2. CLO2 Understand the scientific process though participation in the process at a local level
3. CLO3 Demonstrate team-work and collaboration skills through working in a group to search for relevant scientific journal articles that support community research
4. CLO4 Publicly present finding about the community as an initial step in developing district-level solution

Section 3 Course Description and Implementation

1. Course Description

องค์ความรู้ด้าน

วิทยาศาสตร์ ขั้นตอนการค้นพบทางวิทยาศาสตร์ การตรวจสอบ ข้อจำกัด และการมีอิทธิพลในหลากหลายสาขาวิชา การวิจัยด้านจริยธรรมกับมนุษย์และ

สัตว์ การวิเคราะห์แบบมีวิจารณญาณตามหลักวิทยาศาสตร์ในปัจจุบัน ความรู้ด้านวงจรชีวิต การสร้างต้นแบบทางวิทยาศาสตร์

(In English) Scientific literacy; the process of science discovery; verification, its limitation, and the influence in various disciplines; human research and animal research ethics; the critical analysis of current scientific articles; life cycle of scientific knowledge; modeling in science

2. Number of Hours Per Trimester

Theory (hours)	Practice (hours)	Self-study (hours)
48	0	96

3. Number of Hours per Week for Individual Advice

4 hours per week set aside for student advice and another 4 hours available during office hours. Schedule posted publicly by Science Division at the beginning of term. Students can email or chat online any time.

Section 4: Development of the expected learning outcomes

1. A brief summary of the knowledge or skills expected to develop in students; the course-level expected learning outcomes (CLOs)

By the end of the course, students who successfully complete the course will be able to:

1. CLO1 Conduct an original research project based on information and data collected from the local region and then present and defend results
2. CLO2 Understand the scientific process though participation in the process at a local level
3. CLO3 Demonstrate team-work and collaboration skills through working in a group to search for relevant scientific journal articles that support community research
4. CLO4 Publicly present finding about the community as an initial step in developing district-level solutions

2. How to organize learning experiences to develop the knowledge or skills stated in number 1 and how to measure the learning outcomes

Course Code	Teaching and learning experience management	Learning outcome measurements
CLO1	Group projects, inquiry-based learning	Midterm, final, graded presentations
CLO2	Active lecturers, mlearning, game-based learning	Midterm, final
CLO3	Computer demonstration in searching, flipped class	Graded presentations
CLO4	inquiry-based learning	Group presentation

Section 5 Lesson Plan and Evaluation

1. Lesson Plan

Class	Topics	Number of hours		Online Sessions	On-Campus	Instructors	Note
		In-Class sessions	Lab sessions				
1	Class orientation Scientific method	2	0		X	BP	
2	Project topics	2	0		X	BP	
3	Scientific methods	2	0		X	BP	
4	Searching for scientific literature	2	0		X	BP	
5	Logic in Science/Measurement	2	0		X	BP	
6	Field lab-Recording data	2	0		X	BP	
7	Experimental method-Observation	2	0		X	BP	
8	Qualitative Analysis	2	0		X	BP	
9	Experimental method-Experiments	2	0		X	BP	
10	Group presentation-Research methods	2	0		X	BP	
11	Sampling & Quantitative	2	0		X	BP	
	Midterm	2	0		X	BP	
12	Ethics of human research	2	0		X	BP	

13	Group presentation: Unethical research	2	0		X	BP	
14	Ethics of human research/Animal research ethics	2	0		X	BP	
15	Holiday	0	0		X	BP	
16	Excel and data	2	0		X	BP	
17	Main Presentations	2	0		X	BP	
18	Main Presentations	2	0		X	BP	
19	Life cycles of Facts/Simulations	4	0		X	BP	
20	Evolution Game	4	0		X	BP	
21	Demarcation in Science	2	0		X	BP	
22	Lab visit	2	0		X	BP	
23	Group presentation: Pseudoscience	2	0		X	BP	
24	Makeup Presentations	2	0		X	BP	

2. Evaluation of the CLOs

2.1 Measurement and Evaluation of learning achievement

- Peer presentation evaluation: students give themselves and their peers grade and comment.
- Graded presentation
- Midterm exam

b. Summative assessment

(1) Tool and weight for measurement and evaluation

Learning Outcomes	Measurement Method	Weight (Percentage)	
CLO1 Conduct an original research project based on information and data collected from the local region and then present and defend results	Major project presentation	10	20
	Final	10	
CLO2 Understand the scientific process through participation in the process at a local level	Midterm	15	25
	Final	10	
CLO3 Demonstrate team-work and collaboration skills through working in a group to search for relevant scientific journal articles that support community research	Group assignments	15	20
	Peer evaluation	5	
CLO4 Publicly present finding about the community as an initial step in developing district-level solutions	Major project presentation	10	35
	Final	25	
		100	100

(2) Measurement and evaluation

Grade	Achievement	Final Score (% range)	GPA
A	Excellent	90-100	4.0
B+	Very good	85-89	3.5
B	Good	80-84	3.0
C+	Fairly good	75-79	2.5
C	Fair	70-74	2.0
D+	Poor	65-69	1.5

D	Very poor	60-64	1.0
F	Fail	Less than 60	0.0
O	Outstanding	100-90, 80% attendance	
S	Satisfactory	89-65, 80% attendance	
U	Unsatisfactory	64-0, less than 80% attendance	

(3) Re-examination (if the course allows any)

Not applicable to MUIC

3. Students' Appeal

Not applicable to MUIC

Section 6 Teaching Resources

1. **Required Texts**

Class materials and current journal articles will be provided via class BaseCamp account

2. **Suggested Materials**

3. Agar, J. (2012). *Science in the 20th Century and Beyond*. Cambridge, UK: Polity Press.

4. Ambrose, J., Livitz, M., Wessels, D., Kuhl, S., Lusche, D. F., Scherer, A., . . . Soll, D. R. (2015). Cancer riddle, solved: Researchers reveal how cancer cells form tumors. *Medical Press, 5*(11), 3485-3504.

5. Arbesman, S. (2012). *The Half-Life of Facts: Why Everything We Know Has an Expiration Date*. New York, NY, USA: Penguin Group.

6. Bauer, S. W. (2015). *The Story of Western Science*. New York, NY, USA: W.W. Norton & Company.

7. Chen, M., Shelton, A., & Ye, G.-y. (2011). Insect-resistant genetically modified rice in China: from research to commercialization. *Annual Review of Entomology, 56*, 81-101. doi:10.1146/annurev-ento-120709-144810

8. Cohen, J. (2016). Patient Zero no more. *Science, 351*(6277), 1013.

9. DeWitt, R. (2010). *Worldviews: an introduction to the history and philosophy of science*. Malden, MA, USA: Wiley-Blackwell.

10. Gauch, H. G. (2014). *Scientific Method in Brief* (3rd ed.). Cambridge, UK: Cambridge University Press.

11. Giere, R. N. (1990). *Explaining science: a cognitive approach*. Chicago, IL, USA: University of Chicago Press.

12. Gimbel, S. (2011). *Exploring the scientific method: cases and questions* (S. Gimbel Ed.). Chicago, IL, USA: University of Chicago Press.

13. Goldacre, B. (2010). *Bad Science: Quacks, Hacks, and Big Pharma Flacks*. New York, NY, USA: Faber and Faber, Inc.

14. Gravetter, F. J., & Wallnau, L. B. (2013). *Statistics for behavioral sciences* (9th ed.). Belmont, CA, USA: Wadsworth Cengage Learning.

15. Hanahan, D., & Weinberg, R. A. (2011). Hallmarks of cancer: the next generation. *Cell, 144*, 646-674. doi:10.1016/j.cell.2011.02.013

16. Kennefick, D. (2009). Testing relativity from the 1919 eclipse—a question of bias. *Physics Today*, 37-42.

17. Livio, M. (2014). *Brilliant blunders: from Darwin to Einstein - colossal mistakes by great scientists that changed our understanding of life and the universe* (Reprint ed.). New York, NY, USA: Simon & Schuster.

18. Phillips, B. J. (2017). *Cooperative use of mobile computing devices for answering mCpath questions in class to improve information literacy of undergraduates.* (Ph.D., Education in Science and Technology), Mahidol University, Nakornpathom, Thailand.

19. *Philosophy of pseudoscience: reconsidering the demarcation problem*. (2013). (M. Pigliucci & M. Boudry Eds.). Chicago, IL, USA: University of Chicago Press.

20. Pickover, C. (2008). *Archimedes to Hawking: Laws of Science and the Great Minds Behind Them* New York, NY, USA: Oxford University Press.

21. Popper, K. (2005). *The Logic of Science Discovery* (J. Freed & L. Freed, Trans. 3rd ed.). London, UK: Routledge Classics.

22. Thagard, P. R. (1978). Why astrology is a pseudoscience. *Proceedings of the Biennial Meeting of the Philosophy of Science Association, 1*, 223-234.

23. Wilson, E. B. (1991). *An Introduction to Scientific Research*. New York, NY, USA: Dover Publications.

24. Woodford, C. (2015). *Atoms Under the Floorboards: The Surprising Science Hidden in Your Home* Bloomsbury Sigma.

25. Wootton, D. (2015). *the invention of science: a new history of the scientific revolution* (1st ed.). London, UK: Penguin Random House UK.

26. **Other Resources (if any)**

Not applicable

Section 7 Evaluation and Improvement of Course Implementation

1. Strategy for Course Effectiveness Evaluation by Students

1. 1 Peer evaluation

Feedback on what students would like to learn and suggestion for improvements collected

1.3 Formal MUIC Student evaluation system

2. Strategy for Teaching Evaluation

2.1 Peer evaluation

Feedback on what students would like to learn and suggestion for improvements collected

2.2 Peer evaluation of teaching by other MUIC lecturers

2.3 Feedback from GE Program Director

3. Teaching Improvement

3.1 Review of Student Peer Evaluation

3.2 Review of student grade results

3.3 Open discussion with other GE lecturers at the end of the term

3.3 Attend, organize Science Division teaching educational workshop during summer

4. Verification of Standard of Learning Outcome for the Course

4.1 Pass the course with a minimum of 60 percent or a D

5. Revision Process and Improvement Plan for Course Effectiveness

5.1 Open discussion with other GE lecturers at the end of the term

5.2 Attend, organize Science Division teaching educational workshop during summer

Appendix

Relations between the course and the General Education

Table 1 Relations between CLOs and MU-GE Module LOs (numbers in the table = Sub LOs)

ICGN 114	MU-GE LOs								
	MLO1	MLO2	MLO3	MLO4	MLO5	MLO6	MLO7	MLO8	MLO9
CLO1 Conduct an original research project based on information and data collected from the local region and then present and defend results		2.1	3.1	4.2	5.1				
CLO2 Understand the scientific process though participation in the process at a local level	1.1					6.1	7.1		
CLO3 Demonstrate team-work and collaboration skills through working in a group to search for relevant scientific journal articles that support community research	1.2 1.3					6.3 6.4	7.2 7.3		9.1 9.2
CLO4 Publicly present finding about the community as an initial step in developing district-level solutions	1.4	2.2	3.2	4.1		6.2	7.1	8.1 8.2 8.3	

Table 2 LOs that the course is responsible for

MU-GE LOs	Sub LOs
MLO1 Create & construct an argument effectively as well as	1.1 Identify concepts related to the context of learned issues/topics

identify, critique and evaluate the logic & validity of arguments	
	1.2 Demonstrate ICT literacy: use appropriate technology to find, evaluate, and ethically used information
	1.3 Collect, analyze, synthesize data, & evaluate information and ideas from multiple sources relevant to issues/problems
	1.4 Synthesize information to arrive at logical reasoning
MLO2 Select & use techniques and methods to solve open-ended, ill-defined and multistep problems	2.1 Connect, synthesize and/or transform ideas or solutions within a particular framework
	2.2 Make judgement & decision through correct analysis, inferences, and evaluations on quantitative basis and multiple perspectives
MLO3 Acquire specific strategies & skills within a particular discipline and adapt them to a new problem or situation	3.1 Connect, synthesize and/or transform ideas or solutions within a particular framework
	3.2 Integrate alternative, divergent, or contradictory perspectives or ideas in the solution of a problem or question
MLO4 Create a novel or unique ideas, question, format, or product within a particular framework	4.1 Create an original explanation or solution to the issues/problems
	4.2 Articulate the rationale for & consequences of his/her solution- identify opportunities & risk
MLO5 Explore and situate oneself in a new physical environment and intellectual perspectives	5.1 Demonstrate cultural competencies and adaptabilities in different working environments

MLO6 Act autonomously within context of relationships to others, law, rules, codes, and values	6.1 Demonstrate an understanding of the principles upon which sustainable ecosystems and societies are built
	6.2 Identify the national & global challenges associated with current economic, political, and social systems
	6.3 Exhibit characteristics of responsible citizenship
	6.4 Work effectively in diverse team (and multi-cultural settings)
MLO7 Apply ethical frameworks or principles and consider their implications in his/her decision-making and interacting with others	7.1 Identify ethical issues and recognize different viewpoint and ideologies
	7.2 Guide & lead others
	7.3 Apply principles of ethical leadership, collaborative engagement, and respect diversity
MLO8 Use a variety of means/ technologies to communicate effectively and purposefully; e.g., share information/ knowledge, express ideas, demonstrate or create individual & group product, etc.	8.1 **C**ommunicate/present ideas effectively both oral & written forms to appropriate audience, such as verbal discussion with peers, and written project reports.
	8.2 **P**repare a purposeful oral presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors.
	8.3 Prepare written documents to express ideas/solutions using different writing technologies, and mixing texts, data, and images.
MLO9 Collaborate and work effectively as part of a student group/team member to arrive at the team shared-goals in time	9.1 Collaborate effectively with others as a responsible team member to achieve team goals in time
	9.2 Interact with others respectfully, either as a team member or leader, to create a productive teamwork

MU-GE Module LOs: At the end of studying MU-GE Module, successful students will be able to

Competences	LOs:	Sub LOs:

1. **Critical thinking & Analysis**: Use various sources and methods to collect and manage data & information and make a logical judgement and decision to arrive at a solution or problem solving relevant to real-world issues/ problems	1. Create & construct an argument effectively as well as identify, critique and evaluate the logic & validity of arguments	1. Identify concepts related to the context of learned issues/topics 2. Demonstrate ICT literacy: use appropriate technology to find, evaluate, and ethically used information 3. Collect, analyze, synthesize data, & evaluate information and ideas from multiple sources relevant to issues/problems 4. Synthesize information to arrive at logical reasoning
	2. Select & use techniques and methods to solve open-ended, ill-defined and multistep problems	1. Apply simple mathematical methods to the solution of 'real-world' problems 2. Make judgement & decision through correct analysis, inferences, and evaluations on quantitative basis and multiple perspectives 3. Apply concept of process management to solve problems
2. Creativity & Innovation: Show capability to initiate alternative/ new ways of thinking, doing things or solving problems to improve his/her or team solutions/ results by applying the evidence-based process management concepts	3. Acquire specific strategies & skills within a particular discipline and adapt them to a new problem or situation	1. Connect, synthesize and/or transform ideas or solutions within a particular framework 2. Integrate alternative, divergent, or contradictory perspectives or ideas in the solution of a problem or question
	4. Create a novel or unique ideas, question, format, or product within a particular framework	1. Create an original explanation or solution to the issues/problems 2. Articulate the rationale for & consequences of his/her solution- identify opportunities & risk 3. Implement innovation through process management approach
	5. Explore and situate oneself in a new physical environment and intellectual perspectives	1. Demonstrate cultural competencies and adaptabilities in different working environments 2. Resort to multi-dimensional settings and tools to acquire knowledge and skills relevant to the problems or situation at hand

3. Global perspectives & Ethics: Express one's own ideas, interact with others, guide or lead team, as proper, as an ethically-engaged and responsible member of the society	6. act autonomously within context of relationships to others, law, rules, codes, and values	1. Demonstrate an understanding of the principles upon which sustainable ecosystems and societies are built 2. Identify the national & global challenges associated with current economic, political, and social systems 3. Exhibit characteristics of responsible citizenship 4. Work effectively in diverse team (and multi-cultural settings)
	7. Apply ethical frameworks or principles and consider their implications in his/her decision-making and interacting with others	1. Identify ethical issues and recognize different viewpoint and ideologies 2. Guide & lead others 3. Apply principles of ethical leadership, collaborative engagement, and respect diversity
4. Communication: Communicate effectively and confidently using oral, visual, and written language	8. Use a variety of means/ technologies to communicate effectively and purposefully; e.g., share information/ knowledge, express ideas, demonstrate or create individual & group product, etc.	1. **C**ommunicate/present ideas effectively both oral & written forms to appropriate audience, such as verbal discussion with peers, and written project reports. 2. **P**repare a purposeful oral presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors. 3. Prepare written documents to express ideas/solutions using different writing technologies, and mixing texts, data, and images. 4. Demonstrate competence in a second or additional language
5. Collaboration and Working with team: Collaborate and work effectively with team to arrive at team goals	9. Collaborate and work effectively as part of a student group/team member to arrive at the team shared-goals in time	1. Collaborate effectively with others as a responsible team member to achieve team goals in time 2. Interact with others respectfully, either as a team member or leader, to create a productive teamwork