

Course Syllabus
MBMB 645 Prime Editing Technique
Academic year 2026

Course ID and Title	MBMB 645 Prime Editing Technique ชมชม ๖๔๕ เทคนิคไพรม์อีดิติง
Course coordinator	Asst. Prof.Natee Jearawiriyapaisarn, Ph.D. Institute of Molecular Biosciences, Mahidol University Tel: 0-2441-9003 to 7 Ext. 1313, 1357 Email: natee.jea@mahidol.ac.th
Instructors:	Asst. Prof.Natee Jearawiriyapaisarn, Ph.D.
Support Staff:	Miss Pirut Thongngam Mr. Theptharin Charuraksa
Credits:	1 (0-2-1)
Curriculum:	Master of Science Program in Molecular and Integrative Biosciences (elective course) Doctor of Philosophy Program in Molecular and Integrative Biosciences (elective course)
Semester offering:	First semester
Pre-requisites:	None

Course learning outcomes (CLOs) and their alignment with PLOs:

CLOs By the end of the course, student should be able to:	PLO1	PLO2	PLO3	PLO4
1. Apply knowledge of prime editing to achieve precise genome modifications in research (Knowledge).	✓			
2. Design and conduct experiments utilizing prime editing technology, analyze data, and interpret findings to advance genome engineering research (Skills).		✓		
3. Adhere to scientific integrity, implement safety practices, and demonstrate responsibility in experimental work and assignments (Ethics).			✓	
4. Demonstrate leadership, teamwork, effective research communication, and strong interpersonal skills in collaborative scientific environments (Characters).				✓

Alignment of Teaching and Assessment Methods to Course Learning Outcomes:

Course Learning Outcomes	Teaching Method	Assessment Method
1. Apply knowledge of prime editing to achieve precise genome modifications in research.	1. Participation/ discussion 2. Problem-based project 3. Hands-on lab practice 4. Lab report	1. Discussion performance 2. Assignment 3. Laboratory performance 4. Lab report
2. Design and conduct experiments utilizing prime editing technology, analyze data, and interpret findings to advance genome engineering research.	1. Participation/ discussion 2. Problem-based project 3. Hands-on lab practice 4. Lab report	1. Discussion performance 2. Assignment 3. Laboratory performance 4. Lab report
3. Adhere to scientific integrity, implement safety practices, and demonstrate responsibility in experimental work and assignments.	1. Problem-based project 2. Hands-on lab practice 3. Lab report 4. Presentation	1. Assignment 2. Laboratory performance 3. Report and assignment submission 4. Plagiarism detection 5. Presentation performance
4. Demonstrate leadership, teamwork, effective research communication, and strong interpersonal skills in collaborative scientific environments.	1. Problem-based project 2. Presentation 3. Lab report	1. Discussion performance 2. Presentation performance 3. Lab report

Course description:

Prime editing technology; design of prime editing components; plasmid construction for expressing prime editing components; basic cell culture techniques and DNA transfection; genome editing analysis by PCR; next-generation sequencing and web-based programs

เทคโนโลยีไพรม์อีดิติง การออกแบบส่วนประกอบของไพรม์อีดิติง การสร้างพลาสมิดสำหรับการแสดงออกของส่วนประกอบของไพรม์อีดิติง เทคนิคการเลี้ยงเซลล์ขั้นพื้นฐานและการนำส่งดีเอ็นเอเข้าสู่เซลล์ การตรวจสอบการแก้ไขจีโนมด้วยเทคนิคพีซีอาร์ เทคนิคการวิเคราะห์หาลำดับนิวคลีโอไทด์ยุคใหม่และโปรแกรมบนเว็บ

Course Schedule (Tentative):

(Classroom and Laboratory room D408, Institute of Molecular Biosciences, Mahidol University)

	Activities	Description	Time	Instructors and Assistants
Day 1: November 30, 2026				
1	Active discussion: Prime editing mechanism and workflow (1) Lab: Design of epegRNAs and nicking sgRNAs Lab: Preparation of epegRNA constructs (1)	To introduce/review the concept and workflow of prime editing. - Lab safety orientation - To design epegRNAs and nicking sgRNAs for precise genome editing. - To digest plasmid vector. - To generate oligo duplexes of epegRNA.	9.00 – 12.00	NJ
2	Lab: Preparation of epegRNA constructs (2)	- To purify the digested vector. - To perform ligation reactions. - To transform plasmid DNA into E. Coli.	13.00 – 17.00	NJ
Day 2: December 1, 2026				
1	Lab: Genome correction by prime editing in HEK293T cells (1)	- To seed cells into a culture plate.	9.00 – 12.00	NJ
2	Lab: Preparation of epegRNA constructs (3)	- To inspect and pick up bacterial colonies and culture in a liquid medium.	13.00 – 14.00	NJ
3	Active discussion: Prime editing mechanism and workflow (2)	To discuss the concept and workflow of prime editing.	14.00 – 16.00	NJ
Day 3: December 2, 2026				
1	Lab: Preparation of epegRNA constructs (4)	- To isolate plasmid DNA. - To measure plasmid DNA concentration and purity.	9.00 – 10.30	NJ
2	Lab: Genome correction by prime editing in HEK293T cells (2)	- To transfect the plasmid into HEK293T cells.	10.30 – 12.00	NJ

	Activities	Description	Time	Instructors and Assistants
3	Active discussion: Prime editing mechanism and workflow (3)	- To demonstrate and discuss how to screen positive clones by colony PCR. - To demonstrate and discuss how to confirm correct clones by DNA sequencing. - PBL: Mock-up plasmid sequencing results - Brief lab: cell harvesting, flow cytometry, DNA extraction, and allele-specific PCR for analysis of genome correction.	13.00 – 16.00	NJ
Day 4: December 3, 2026				
1	Lab: Analysis of genome correction (1)	- To collect cells for flow cytometry analysis to assess transfection efficiency. - To extract DNA and measure DNA concentration.	13.00 – 17.00	NJ
Day 5: December 4, 2026				
1	Lab: Analysis of genome correction (2)	- To perform allele-specific PCR for analysis of genome correction. - To demonstrate and discuss how to analyze and quantify genome editing efficiency by Sanger DNA sequencing and web-based tools (TIDER and ICE analysis).	9.00 – 12.00	NJ
2	Lab: Analysis of genome correction (3)	- To perform agarose gel electrophoresis. - Data interpretation	13.00 – 15.00	Nj
3	Presentation, discussion, reflection, and after-action review	- To present the results achieved in the class. - To discuss the techniques and applications of prime editing. - To provide students with opportunities to describe their learning experiences received from this course and how they can be applied to their future learning.	15.00 – 17.00	NJ

	Activities	Description	Time	Instructors and Assistants
		- To collect comments and suggestions from students for further improvements of the course.		

Assessment Criteria: (Please see attached for details)

Assessment method		Performance criteria	Scoring rubric
1	Class attendance & participation (10%)	Attendance and punctuality (5%)	Punctually (4) 5 minutes late (3) 10 minutes late (2) 15 minutes late (1) > 20 minutes late or absent (0)
		Participation (5%)	Frequently participates (4) Moderately participates (2-3) Seldom participates (1) Never participates (0)
2	Assignment (15%)	Punctual assignment submission (1%)	On-time (4) 1 day late (3) 2 days late (2) 3 days late (1) 4 days late or later (0)
		Creativity (3%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Organization (2%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Content accuracy (5%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Supporting evidence (2%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)

		Grammar and originality (2%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
3	Presentation/Discussion (15%)	Participation and performance (5%)	Active (4) Fairly active (2-3) Inactive (1)
		Professional and interpersonal skills (responsibility, teamwork, and leadership) (5%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Creative and high-order thinking skills (5%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
4	Lab performance (30%)	Safety practice (5%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Lab skills (10%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Time management (5%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Troubleshooting skills (10%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
5	Lab report (30%)	Punctual submission (2%)	On-time (4) 1 day late (3) 2 days late (2) 3 days late (1) 4 days late or later (0)
		Report organization: intro, methods, results, discussion, and conclusion (10%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)

		Data presentation, analysis, and interpretation (15%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)
		Grammar and originality (3%)	Excellent (4) Above average (3) Average (2) Needs improvement (1)

Student's achievement will be graded using symbols: A, B+, B, C+, C, D+, D, and F, based on the criteria as follows:

Percentage range	Grade	Description
80-100	A	Excellent
75-79	B+	Very Good
70-74	B	Good
65-69	C+	Fairly Good
60-64	C	Fair
55-59	D+	Poor
50-54	D	Very Poor
0-49	F	Fail

Date of Revision: July 19, 2026

Rubric Score for Class Attendance & Participation (10%)

Criteria	4	3	2	1	0
Attendance and punctuality (5%)	Punctual	5 minutes late	10 minutes late	15 minutes late	More than 20 minutes late or absent
Participation (5%)	Frequently participates; actively asks/answers questions and contributes to class/lab discussion	Regularly participates with relevant comments	Occasionally participates when prompted	Seldom participates; limited engagement	Never participates

Rubric Score for Assignment (15%)

Criteria	4	3	2	1	0
Punctual assignment submission (1%)	Submitted on time	1 day late	2 days late	3 days late	4 days late or later
Creativity* (3%)	Highly creative, original, and demonstrates independent thinking	Shows good creativity and some original ideas	Acceptable but mostly follows standard ideas	Limited creativity or little originality	Not applicable / not submitted
Organization* (2%)	Clearly organized, logical flow, easy to follow	Mostly organized with minor issues	Adequate organization but some parts unclear	Poorly organized and difficult to follow	Not applicable / not submitted
Content accuracy* (5%)	Scientifically accurate, complete, and well explained	Mostly accurate with minor errors	Generally acceptable but contains some misunderstandings	Several inaccuracies or superficial understanding	Not applicable / not submitted
Supporting evidence* (2%)	Uses strong and appropriate evidence, references, or examples	Uses relevant evidence with minor limitations	Some evidence provided but insufficient	Minimal or weak evidence	Not applicable / not submitted
Grammar and originality* (2%)	Clear writing, good grammar, original work	Minor grammatical errors; mostly original	Some grammatical problems but understandable	Many language problems or originality concerns	Plagiarism or not submitted

*For assignments, where appropriate, especially when the assignment is not written in an essay format, the criteria of **creativity, organization, content accuracy, supporting evidence, grammar, and originality** may be evaluated together as an overall assessment of the submitted work.

Rubric Score for Presentation/Discussion (15%)

Criteria	4	3	2	1	0
Participation and performance (5%)	Active, confident, and contributes meaningfully to discussion	Fairly active and provides relevant input	Participates occasionally but needs prompting	Minimal contribution	Inactive / absent / no contribution
Professional and interpersonal skills: responsibility, teamwork, and leadership (5%)	Excellent teamwork, responsibility, respect, and leadership	Good teamwork and responsibility	Acceptable teamwork but limited leadership or engagement	Weak teamwork or low responsibility	No evidence of teamwork, responsibility, or professional behavior
Creative and higher-order thinking skills (5%)	Excellent critical thinking, integration, interpretation, and problem-solving	Good analytical thinking and reasonable interpretation	Basic understanding but limited depth of analysis	Limited critical thinking; mostly descriptive or unclear reasoning	No evidence of critical thinking or understanding

Rubric Score for Lab performance (30%)

Criteria	4	3	2	1	0
Safety practice (5%)	Consistently follows lab safety rules and works responsibly	Usually follows safety rules with minor reminders	Follows basic safety but needs repeated reminders	Poor safety awareness or unsafe practice	Serious unsafe practice / absent / no performance
Lab skills (10%)	Performs techniques accurately and independently	Performs most techniques correctly with minor assistance	Performs basic techniques but needs frequent guidance	Limited technical skill; unable to perform procedures properly	Unable to perform the task / absent / no performance
Time management (5%)	Completes tasks efficiently within the assigned time	Usually completes tasks on time	Some delays or inefficient workflow	Poor time management; unable to complete tasks on time	Did not complete the task / absent / no performance
Troubleshooting skills (10%)	Excellent ability to identify problems, explain possible causes, and propose solutions	Good troubleshooting with some guidance	Basic troubleshooting but limited explanation	Unable to identify problems or suggest appropriate solutions	No evidence of troubleshooting / absent / no performance

Rubric Score for Lab report (30%)

Criteria	4	3	2	1	0
Punctual submission (2%)	Submitted on time	1 day late	2 days late	3 days late	4 days late or later
Report organization: introduction, methods, results, discussion, conclusion (10%)	Excellent structure, logical flow, complete sections	Well organized with minor issues	Acceptable structure but some sections incomplete or unclear	Poor organization; missing important sections	Not applicable / not submitted
Data presentation, analysis, and interpretation (15%)	Excellent data presentation; accurate analysis; strong interpretation linked to prime editing outcomes	Good data analysis and interpretation with minor weaknesses	Basic data presentation and interpretation, but limited depth	Weak or incorrect analysis; unclear interpretation	Not applicable / not submitted
Grammar and originality (3%)	Clear scientific writing, good grammar, original work	Minor grammatical errors; mostly original	Understandable but with several writing problems	Poor grammar or originality concerns	Plagiarism or not submitted