# SCBI 372 I SCBE 411 Molecular Biology Applications

## วทชว ๓๗๒ I วททส ๔๑๑ การประยุกต์ใช้ในชีววิทยาระดับโมเลกุล

## Department of Biology, Faculty of Science, Mahidol University

Second Semester, Academic Year 2020 - 2021

**Class Time: SCBI 372 Thursday 1:30 - 4:30 pm (Online* or Phayathai N-516)**

**SCBE 411 Friday 9:30 – 12.30 pm (Online* or Phayathai R-503)**

*This course strictly follows COVID-19 health and safety regulations. I will try my best to accommodate students who may be affected by the pandemic. Please do not hesitate to contact me and check Google Classroom and your @student.mahidol.edu regularly.

### Course Coordinator

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### Prerequisite

SCBI 270 or SCBE 207

### Course Description

การประยุกต์นำชีววิทยาระดับโมเลกุลมาใช้ในการทดลอง วิธีการทดลองทางชีววิทยา หัวข้อทันสมัยในการทดลองเพื่อตอบปัญหาทางวิทยาศาสตร์ได้อย่างถูกต้อง ตัวอย่างและวิเคราะห์ตัวอย่างการทดลองตามความสนใจของนักศึกษา

The methodology to biological research; current topics in biological research with focus on the methodology aiming to answer specific questions; current scientific literature.

### Course Goals

SCBI 372 I SCBE 411 Molecular Biology Applications provides students with the upper-level concepts in molecular biology and the techniques that lead to advancements in understandings and applications for environmental biology, agriculture, and medicine. The course format intends to integrate class lecture and scientific paper discussions and presentations with individual and collaborative writing assignments on contemporary and current molecular biology application topics. This aims to equip students with analytical skills to critically evaluate results/claims/news with scientifically-sound judgements. In addition, the course will touch upon the topics of genetically modified organisms (GMOs), gene therapy, gene editing by CRISPR-Cas9 system, or human gene editing, which are of global interest and raise many bioethical debates.

## Class Schedule

| Week | SCBI 372 Thu 13.30 (N-516) | SCBE 411 Fri 9.30 (R-503) | Topic | Assignment |
|---|---|---|---|---|
| 1 | Jan 21 | Jan 22 | Course Introduction, Model Organisms | |
| 2 | Jan 28 | Jan 29 | Structure and Function of Nucleic Acids<br>**Techniques & Applications:** Gel electrophoresis, restriction endonuclease, gene cloning, Southern blotting, *in situ* hybridization, karyotype, and fluorescent *in situ* hybridization (FISH) | HW1 out |
| 3 | Feb 4 | Feb 5 | Regulation of Gene Expression: Transcription and Post-transcription Regulation<br>***Dr. Sittinan Chanarat***<br>*(Department of Biochemistry, Faculty of Science)* | |
| 4 | Feb 11 | **Chinese New Year** (Lecture Clip) | Genome Structure, Chromatin, and Nucleosome<br>**Techniques & Applications:** Polymerase Chain Reaction (PCR), Sanger DNA sequencing, DNA barcoding, and Human Genome Project | HW2 out |
| 5 | Feb 18 | Feb 19 | **Techniques & Applications:** Chromatin immunoprecipitation, ChIP-Seq, Microarray, qRT-PCR, RNA interference (RNAi)<br>- HW2 discussion | |
| 6 | Feb 25 | **Makabucha** (Lecture Clip) | Gene Therapy | HW3 out |
| 7 | Mar 4 | Mar 5 | Functional Genomics and Systems Biology<br>**Application:** Next-generation sequencing, RNA sequencing, single-cell sequencing | |

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| | | | ***Dr. Varodom Charoensawan*** *(Department of Biochemistry, Faculty of Science)* | |
| 8 | Mar 11 | Mar 12 | Regulation of Gene Expression: Epigenetic Regulation<br>**Application:** iPS Cell<br>***Dr. Patompon Wongtrakoongate*** *(Department of Biochemistry, Faculty of Science)*<br>- Midterm Revision | |
| 9 | **Midterm Exam: Mar 15 – Mar 19** | | | |
| 10 | Mar 25 | Mar 26 | Structure, Domain, and Modification of Protein<br>***Dr. Puey Ounjai*** *(Department of Biology, Faculty of Science)*<br>**Techniques & Applications:** Crystallography and Cryo-EM | HW4 out |
| 11 | Apr 1 | Apr 2 | Molecular Biology for Forensic Science<br>***Dr. Achirapa Bandhaya*** *(Forensic Science Unit, Faculty of Science)* | |
| 12 | Apr 8 | Apr 9 | **Techniques & Applications:** Western blotting, protein purification, co-immunoprecipitation, immunoassay, mass spectrometry**,** protein sequence alignment, and reporter gene | |
| 13 | Apr 15<br>No class | Apr 16<br>No class | **Songkran Holiday Apr 12 – Apr 15** | |
| 14 | Apr 22 | Apr 23 | Precision Medicine<br>***Dr. Somponnat Sampattavanich*** *(Siriraj Laboratory for Systems Pharmacology, Faculty of Medicine Siriraj Hospital)* | Draft due |

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| 15 | Apr 29 | Apr 30 | Genome Repair and Genome Editing **Techniques and Applications:** PCR-based mutagenesis, homologous recombination, knock-out mice, CRISPR-Cas9 technology | HW5 out |
| 16 | May 6 | May 7 | Synthetic Biology ***Dr. Chayasith Uttamapinant*** (School of Biomolecular Science and Engineering, VISTEC) | |
| 17 | **Final Exam Week: May 10 – May 21** | | | |

**Guest Lecturers**

Dr. Sittinan Chanarat ดร.สิทธินันท์ ชนะรัตน์ (sittinan.cha@mahidol.edu)
Department of Biochemistry, Faculty of Science, Mahidol University

Assoc. Prof. Dr. Varodom Charoensawan รศ. ดร.วโรดม เจริญสวรรค์ (voradom.cha@mahidol.ac.th)
Department of Biochemistry, Faculty of Science, Mahidol University

Asst. Prof. Dr. Patompon Wongtrakoongate ผศ. ดร.ปฐมพล วงศ์ตระกูลเกตุ (patompon.won@mahidol.ac.th) Department of Biochemistry, Faculty of Science

Asst. Prof. Dr. Puey Ounjai ผศ. ดร.ป่วย อุ่นใจ (puey.oun@mahidol.edu)
Department of Biology, Faculty of Science, Mahidol University

Dr. Achirapa Bandhaya ดร.อจิรภาส์ พันธัย (achirapa.ban@mahidol.ac.th) Programme Director
Forensic Science Graduate Programme, Forensic Science Unit, Faculty of Science, Mahidol University

Dr. Somponnat Sampattavanich ดร.สมพลนาท สัมปัตตะวนิช (somponnat.sam@mahidol.ac.th)
Co-director, Siriraj Laboratory for Systems Pharmacology, Department of Pharmacology, Faculty of Medicine Siriraj Hospital, Mahidol University

Asst. Prof. Dr. Chayasith Uttamapinant ผศ. ดร.ชยสิทธิ์ อุตมาภินันท์ (chayasith.u@vistec.ac.th)
School of Biomolecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology (VISTEC)

## Class Format

Each 3-hr class will be generally divided into 2 sections: 2-hr of PowerPoint lecture and 1-hr of activity (class activity, paper discussion, or student presentation).

## Class Readings

- Recommended Textbook: Watson JD, Baker TA, Bell S, Gan A, Levine M, and Losick R, **Molecular Biology of the Gene**. 7th ed. Pearson Education; 2014.
- Class materials are posted at **Google Classroom**

## Evaluation

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| Assignments[a] | 30 points |
| Attendance[b] | 10 points |
| Midterm Exam | 25 points |
| Term assignment | 10 points |
| Final Exam | 25 points |
| **Total** | **100 points** |

[a]Each assignment (HW 1-5) or term project draft is worth 5 points.

[b]Attendance is mandatory. Each unexcused absence will result in **1-point** subtraction.

## Office Hour

Appointment can be made by e-mail at pagkapol.pon@mahidol.edu