COURSE OUTLINE

Course Title	**Principles of Heredity and Ecological Genetics**		
Course Code	**ES2301**		
Offered	Study Year 2, Semester 2		
Course Coordinator	Kim Hie Lim (Asst Prof)	HLKIM@ntu.edu.sg	6592 3078
Pre-requisites	ES2003, CM1021, CM1031 (CM1021 or CM1031 will be accepted)		
AU	4		
Contact hours	Lectures: 39, Tutorials: 13		
Approved for delivery from	AY 2018/19 semester 2		
Last revised	20 Feb 2019, 12:54		

Course Aims

In this course, you will understand the genetic inheritance which is the transmission of genetic information across molecules, cells, and individuals. You will develop the concepts through studying basic molecular biology and genetics to understand the principles of each level of transmission: first, how to transmit genetic information across molecules in cells, from DNA to RNA, and from RNA to protein, second, how to transmit them between cells, third, how to transmit them between individuals, which is the transmission between generations and eventually populations. You will learn not only classical genetics but also the most advanced techniques to generate and analyze the genomic data since the current genomics became to be significantly important to study ecological genetics. Finally, you will have opportunities to develop your idea on how to apply genetics to ecology through the last part of lectures.

Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Describe the characteristics of genetic materials and mechanisms of the inheritance of the genetic information over molecules, cells, and individuals over generations.
2. Explain the biological mechanisms of generating and maintaining the genetic diversity in a population during the evolutionary process.
3. Associate the genetic information with phenotypic traits in various living organisms.
4. Analyze DNA sequence data, identify genetic variants, and estimate the extent of the genetic diversity.
5. Evaluate the status of a population in terms of their genetic diversity and estimate the future of the population.
6. Develop the ability to apply genetic knowledge and techniques to study the ecosystem.

Course Content

1. the law of inheritance and DNA

2. The central dogma: DNA replication, transcription, and translation

3. Consequences and mechanisms of occurrence of mutations

4. Crossover and recombination

5. Structural changes in genome

6. The genetics of bacteria and viruses

7. Genomes and current genomics

8. Gene regulation and omics

9. Population genetics: genetic variations, genetic drift and demography

10. Molecular evolution: The Neutral theory and natural selection

11. Applied ecological genetics

Assessment

Component	Course ILOs tested	ASE Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment					
Lectures					
Participation	1, 2, 3, 5, 6	**3.** b **10.** a	20	individual	See Appendix for rubric
Tutorials					
Assignment	1, 2, 3, 4, 6	**3.** a **5.** a, b **7.** a **10.** a	20	individual	See Appendix for rubric
Presentation	1, 2, 3, 5, 6	**3.** a, b **5.** a, b **7.** a, b **10.** a	10	team	See Appendix for rubric
Mid-semester Quiz					

Short Answer Questions	1, 2, 3, 4, 5	**3.** a **5.** a **7.** b	20	individual	See Appendix for rubric
Final Quiz					
Short Answer Questions	1, 2, 3, 4, 5, 6	**2.** a **3.** a **5.** a **7.** a, b	30	individual	See Appendix for rubric
		Total	**100%**		

These are the relevant ASE Graduate Attributes.

2. Demonstrate intellectual flexibility and critical thinking

a. Demonstrate intellectual flexibility to view environmental issues from multiple perspectives

3. Demonstrate passion and use advanced communication skills to share that passion

a. Effectively communicate environmental concepts in writing

b. Effectively communicate environmental concepts in speech

5. Conduct research

a. Search for relevant scientific literature

b. Synthesize findings from scientific literature into laboratory reports, presentations, written assignments and field reports

7. Synthesize interdisciplinary approaches to solving problems

a. Apply techniques from diverse disciplines to solve environmental problems

b. Explain how a certain problem-solving approach may impact the environment or human society

10. Demonstrate collaboration and leadership skills

a. Learn collaboratively and be willing to share expertise with peers

Formative Feedback

Most tutorials will give you exercise questions which will be relevant to the week's lecture. You will receive feedback as comments/corrections about your answers to each tutorial exercise by email. The tutorial exercise will help you to achieve the learning outcomes 1~6.
After the mid-term quiz and final exam, you can review your answer sheet for a limited time. You can ask

questions to the instructor. The quiz and exam will evaluate your learning outcomes 1~6.
After you give a team presentation, you can feel your accomplishment by audiences' response and instructor's comments. The process of preparation of your presentation as a team project will help you to achieve the learning outcomes 1, 2, 5, and 6.

Learning and Teaching Approach

Lectures (39 hours)	In the first half of the course, you will learn basic knowledge of genetics and molecular biology (learning outcomes, LO- 1, 2, and 3) to understand further science fields, such as current genomics, population genetics, -omics, and ecology (LO- 4, 5, and 6). During the course, you will have opportunities to meet with guest lecturers who are conducting the most advanced science in their field and can hear their ongoing research (LO- 5 and 6). Various type of media will help you to understand the complicated biological process and concepts (LO- 1, 2, 4, and 6). Some hands-on exercise will be carried on during the class to understand the genetic theory (LO- 4 and 5).
Tutorials (13 hours)	Tutorials will be utilized for a further understanding of the lectures in several approaches. Tutorial exercise will ask you many drawings because visualization of the biological process will help you a lot to understand it (LO- 1 and 2). Some exercise will be a very practical estimation based on real data (LO- 3 and 4), while some exercise will be for your interdisciplinary, logical and creative thinking (LO- 5 and 6). One of the guest lecturers will guide you to the state-of-the art laboratory of genomic sequencing to actually show you the most advanced technologies (LO -4, 5, and 6). If available, you will have a chance to perform some laboratory experiment of handling DNA (LO- 4 and 6).

Reading and References

Anthony J.F. Griffiths et al. Introduction to Genetic Analysis, 11th Edition ISBN-13: 978-1464109485
Daniel L. Hartl, Essential Genetics A genomics perspective, 6th Edition ISBN-13: 978-1449686888

Course Policies and Student Responsibilities

You are strongly encouraged to attend the lectures and tutorials punctually and actively participate in all class. You are expected to take responsibility to follow up with course notes, assignments and course-related announcements for lectures/tutorial sessions you may have missed. You must give notice to the instructor for your absence. You are expected to complete all assigned activities and take the assessment seriously. You are expected to mind your manners to lecturers and your peers in the class.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU’s shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you

are uncertain of the definitions of any of these terms, you should go to the Academic Integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Kim Hie Lim (Asst Prof)	N2-01c-52	6592 3078	HLKIM@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	The law of inheritance and DNA	1, 2, 3	
2	The central dogma: DNA replication, transcription, and translation	1, 2, 3	
3	Consequences and mechanisms of occurrence of mutations	1, 2, 3	
4	Crossover and recombination	1, 2, 3, 4	
5	Structural changes in genome	1, 2, 3, 4	
6	The genetics of bacteria and viruses	1, 2, 3, 4	
7	Genomes and current genomics	1, 3, 4, 6	
8	Gene regulation and omics	1, 2, 3, 6	
9	Population genetics: genetic variations, genetic drift and demography	1, 2, 3, 4, 5, 6	
10	Molecular evolution: the Neutral theory and natural selection	1, 2, 3, 4, 5, 6	
11	Applied ecological genetics_1	5, 6	
12	Applied ecological genetics_2	5, 6	
13	Review and preparation of exam	1, 2, 3	

Appendix 1: Assessment Rubrics

Rubric for Lectures: Participation (20%)

Your attendance and motivation will be the most important driving force for accomplishing the learning object. I strongly encourage to participate actively in the class. Your participation will be evaluated by the attendance and attitude in the class.

Rubric for Tutorials: Assignment (20%)

Each assignment will indicate marks for each question. Your answer will be assessed totally based on accuracy and logic.

Rubric for Tutorials: Presentation (10%)

Total marks (out of 20 points) will be scaled to 10%.

Score / Criteria	5	3	1
Content	Most comprehensive, accurate and clear contents. Key points are well chosen and explained.	Incomprehensive but accurate and clear enough contents. Key points are stated and supported.	Incomprehensive or incomplete contents. Key points are addressed, but not supported.
Logic	Well organized and scientifically logical	Mostly reasonable	Scientifically not logical
Presenting skill	Great visualization and good speech. Easy to follow. Great feedback from peers.	Understandable materials and speech	Difficult to follow. Speech is not well prepared.
Teamwork	Equal workload, a great conclusion from enough background and discussion	Unequal workload, enough effort to prepare the presentation.	Unfair workload, no evidence of discussion.

Rubric for Mid-semester Quiz: Short Answer Questions (20%)

You will be asked to answer very shortly, usually a word or sentence, sometimes a number from a calculation.

Rubric for Final Quiz: Short Answer Questions (30%)

You will be asked to answer very shortly, usually a word or sentence, sometimes a number from a calculation.

Appendix 2: Intended Affective Outcomes

As a result of this course, it is expected you will develop the following "big picture" attributes:

1. develop scientific logic for understanding the evolutionary process of living organisms and even their society.

2. evaluate the status of a population in the viewpoint of population genetics and infer the future of the population.

3. raise and solve a scientific issue using genetic and ecological concepts.

4. collaborate with team-mates to discuss and solve such issues.