

Academic Year	2022/2023	Semester	1
Course Coordinator	KIM Hie Lim		
Course Code	ES9003		
Course Title	The Genome and Society		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39 (1.5 hr lecture x 11 weeks + 1.5 hr x 11 group activities + 3 hr student presentation + 3 hr in class quiz)		
Proposal Date	15 August 2022		

Course Aims

This course will provide an introductory level of knowledge in Genomics, human genetics, and more focus on their implications and impacts on humans and society. You should take this course, first, if you would like to learn why we study Genomes and Genomics, and why the field has been exponentially grown since the human genome project completed in 2010. Genomics and sequencing technology have driven various fields of science and significantly affected human life. Second, you should take this course if you would like to learn what is genetic differences between individuals and how it expresses as traits, disease symptoms, and responses to pathogens. Besides, you will learn about how Genomics can contribute to the identification and treatment of diseases by analyzing personal genomes.

If you are interested in your future careers in public health, life science, medicine, insurance, risk assessment, and big data, this course should be helpful. You will learn how the technology of genome sequencing, has affected human social structure or system, for instance, marriage and pregnancy by obtaining person genome information. You will think about your identity by disclosing your genetic ancestry and how it affects society and politics sometimes. You will learn the current trend of that government actively generate population genome data along with medical records from their citizen. This is closely related to developing public health policy, medical facility, and system, insurance policy, storing and analyzing of the big data, which all effects economics. Ultimately, the accumulation of genome data will impact your life, especially for your lifetime health.

By the end of this course, you will obtain knowledge and your own value on life technology, which something you cannot learn from textbooks. In addition, you should be able to predict how humans will evolve in near future in terms of genetics and society. The human genome will evolve in a unique way, not only under nature's law but also by technology which can change genes or reduce risks. This can be essential knowledge for everyone during this pandemic. The course will have also shed a light on Asian populations which have been relatively understudied. You can learn about Asian population genomics directly from scientists who are currently conducting research for Asians.

Intended Learning Outcomes (ILO)

By the end of this course, you should be able to:

- LO1. Describe how the Genomics and related technology are useful to assess risks in your health.
- LO2. Evaluate advantages and concerns on development of the life science technology and generating genome information.
- LO3. Explain how life science technology change or impact human society.
- LO4. Describe genetic differences between individuals and ethnicities and why it's importance to study them.

Course Content

The course content covers: 1) Introductory Genomics and Human Genetics, 2) The process of generation and implications of human genome data, and 3) Various impacts of the data or research using the data on human societies. Course readings and activities will include knowledge and theory as well as development of logical and critical thinking.

Assessment (includes both continuous and summative assessment)

Component	ILO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
1. Final essay	1, 2, 3, 4	Care for Society, Creative Thinking, Decision Making, Global Perspective, Project Management	24%	Individual	Appendix 1
2. Continuous Assessment (CA): biweekly short essay or quiz or participation for tutorial activity	1,2,3,4	Care for Society, Collaboration, Communication, Decision Making, Problem Solving	8% x 7 times = 56% in total	Individual	Appendix 2
3. Team presentation	1,2,3, 4	Care for Society, Collaboration, Communication, Creative Thinking, Global Perspective, Influence, Project Management	20%	Team	Appendix 3
Total			100%		

Formative feedback

You will receive written feedback from me about your essays you will submit to the NTU blackboard. My feedback will be about your writing, flow, content, and logic in the essay, as comments in the blackboard. For quiz, you will receive the scores and marks in the blackboard, and I will upload the answer sheet at the same time. You will receive verbal feedback about your team presentation in the class. You will also receive feedback from your peer. I will collect comments and evaluation anonymously from your peer for each presentation.

Learning and Teaching approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Lectures will directly convey fundamental knowledge and key concepts (LO 1-4) and will give a guide to raise issues and questions in the topic of each week. The instructor or guest lecturers will give an hour of lecture using lecture slides, video, or online materials. Q&A time will be given to students after the lecture.
Tutorial activity	After the lecture with given reading materials, the instructor will present single or multiple issues or questions to solve in-class. Students will be randomly assigned into groups and have separate sessions to discuss and search for addressing answers or solutions (LO 1-4). Within a half hour, each team has to develop single slide to present their answers to the class. Each team will have a short presentation. This approach will help students to develop critical thinking and communication skills. The tutorial activity is a part of process for finding each student's topic of final essay.
Short essay or quiz	Biweekly, depending on the topic of the weeks, home assignment of a short essay or quiz will be performed in class. The essay is for training for writing the final essay (LO 1-4), and the quiz is for checking the student's understanding level of the basic knowledge (LO 1-4).
Essay	This course will bring various issues and problems broadly about Genomics and Society and cannot take care every single issue. Students will select any current topic/issue/problem to research by themselves and suggest what would be a way to resolve the problem or improve the status. Students need to write a 500 words essay (except for figures and tables) and submit by the next course. The essay will include introduction, topic (issue/problem) statement, solutions or suggestion, and conclusion. The process of this essay will provide opportunities for student to explore social issues, think logically and critically, develop idea for problem-solving and scientific and logical writing. During the process, students can think what their future roles could be in society (LO 1-4).
Team presentation	A team of students will prepare a presentation under a broad topic of 'future of human society' in the context of this course, Genomics and Societies. Students need to collaborate to research and discuss to get an agreement for the presentation with civic-minded. They will be asked to show their creativity and competency in the presentation (LO 1-4).

Reading and References

Human Evolutionary Genetics, 2nd, Mark Jobling, Edward Hollox, Toomas Kivisild, Chris Tyler-Smith, 2013. ISBN 9780815341482

Genomics and Society: Ethical, Legal, Cultural and Socioeconomic Implications, Dhavendra Kumar and Ruth Chadwick, 2016. ISBN 9780127999210

<https://www.sciencedirect.com/remotexs.ntu.edu.sg/book/9780124201958/genomics-and-society> (NTU library accessible)

Genomic Citizenship: The molecularization of identity in the contemporary Middle East, Ian McGonigle, 2021. ISBN: 9780262542944 <https://mitpress.mit.edu/books/genomic-citizenship> (NTU library accessible)

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned readings and activities, attend all lectures and tutorial activities punctually and take all scheduled assignments by due dates. You are expected to take responsibility to follow up with course notes, team project, assignments and course related announcements. You are expected to participate in all discussions and activities.

(2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

(3) ASE Diversity and Inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science. It is our goal to create an inclusive and collaborative learning environment that supports a diversity of thoughts, perspectives, and experiences, and that honours your identities (including ethnicity race, gender, socioeconomic status class, sexual orientation, religion or, ability., etc.).

To help accomplish this:

- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with one of the instructors or an ASE faculty member. We want to be a resource for you.*
- Your classmates and instructors (like many people) are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to the instructors or an ASE faculty member about it.*
- As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: (e.g., using preferred pronouns and names; being respectful of others opinions and actively, making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions., etc.).*

We expect all members of the class to adhere to the NTU Anti-harassment policy

(<https://ts.ntu.edu.sg/sites/policyportal/new/Documents/msrf%20included%20NIE%20staff/Anti-Harassment%20Policy.pdf>), if you witness something that goes against this or have any other concerns, please speak to your instructors or an ASE faculty member.

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	N2-01C-52	8123 2015	HLKIM@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
1	Introduction of Genomics and Human Genetics : what are gene and genome; what is genome sequencing technology; past and current genome projects; aims of genome projects	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 2 Discussion: How much you need to pay for sequencing your genome?; Estimate the cost for running sequencing instruments, computing resources, and manpower to analyze the big data
2	Genetic differences in human populations : human evolution and uniqueness; what is genetic variation; roles of the variations on genome functions; human population history and shaping of population structure; relationships of the history with genetic characteristics; The extent of genetic diversity within humans	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 3, 8 Complete Khoisan and Bantu genomes from southern Africa, Nature, Schuster et al, 2010 Discussion: Genome information will impact on your marriage?; Will you consider genetic profile or background of your partner?, anthropologically humans always consider them for many reasons, will you ask the genetic test results from your partner to avoid any mismatch?

3	Asian population Genomics: Population history of Asians; genetic characteristics of Southeast Asians and Singaporeans; aging and growing population in Asia; admixture; lack of Asian genome data in human genetic studies	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 10,11,14 The GenomeAsia 100K project enables genetic discoveries across Asia, Nature, 2019 Discussion: What are risks from lack of Asian genetic studies? What are benefits of large-scale of ongoing Asian genome projects for public?
4	Genetic ancestry and Identity: Impacts of accumulated genome data and revealing the difference between populations on identity; identity of individuals, identity of ethnicity; related issues in history, culture, and politics; different impacts and perception across different ethnicities or societies	1, 2, 3, 4	Readings: Genomic Citizenship. By Ian McGonigle, Ethnicity, Inc. by John L. and Jean Comaroff Human Evolutionary Genetics, Chapter 14 Discussion: what is your ethnicity? Do you want to do genetic test to find genetic ancestry? Does it effect on your identity?
5	Legal issues in Genomic data and usage: Collecting and storage of bio-samples and data for research; IRB; privacy concerns; IP issue for using the research results; academic research vs. ethnic community	1, 2, 3, 4	Readings: Genomics and Society, Chapter 6, 7 Discussion: will you provide your samples voluntarily for research project? What would be your concerns to provide your samples? What efforts scientists should put on this matter?
6	Environmental Genomics: Metagenomics; Microbiome of various environments and surrounding factors of humans; Interactions between humans and environmental microbiome	1, 2, 3	Readings: Human Evolutionary Genetics, Chapter 15 Discussion: develop an idea for a business using metagenome sequencing technology and microbiology.
7	Human vs pathogens: Pandemic in history; evolution of pathogens; human immunity; development of medicine and vaccines	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 15 Discussion: Human can defeat COVID-19? Genomics can play a role in that?
8	Environment and human genome: Impact of environment on genome; environmental changes and human history; natural selection; lifestyle and genome; personality and genes; environmental metagenomics	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 15 Discussion: environmental pollution can change human genome? Interactions between humans and environment?
9	Genetic disease, test, and therapy: Why human are sick?; what genetic test can tell you; genetic ancestry and disease; meaning of carriers; Precision medicine; aging; genetic disease can be cured? How we deal with rare or common disease?	1, 2, 3, 4	Readings: Human Evolutionary Genetics, Chapter 16, 17 Genomics and Society, Chapter 2, 4 Discussion: What are scientists' and government's role for aging population and preparing the long life? What would be medical insurance's strategy? What technology or study will practically contribute to develop the policy?

10	Biodiversity: The concept and importance of biodiversity; the role of genetics to describe ecosystem; the biodiversity in Asia and Singapore; conservation	1, 2, 3, 4	Discussion: Why we need biodiversity? What is the risk human facing if we failed to maintain biodiversity?
11	Gene drive and bio hacking: DIY biology; Common knowledge is so advanced; biolab in your garage; DTC genetic test	1, 2, 3, 4	Readings: Burningham, Grant (October 24, 2019). "The Price of Insulin Has Soared. These Biohackers Have a Plan to Fix It". Time. Discussion: Human become God?; humans can change own genes, restore and synthesize life organism.
12	What would be the future humans with this technology?	1, 2, 3, 4	Review
13	Student presentation	1, 2, 3, 4	Discussion and review

Appendix 1: Assessment Criteria for Final Essay

Writing 30%: Sentences are clearly and accurately written. Easy flow to the paragraph. Simply understandable and no errors. Paragraphs have great structure. No plagiarism.

Contents 30%: The question/topic is clearly stated. Motivations are explained. Key knowledge/background is explained in the introduction. Aims of the essay are well described. Technical terms and Genetic principles are accurately and properly used and explained. Citations are accurate.

Logic 40%: Paragraphs are well structured to resolve the question and address the conclusion. Sentences are expressed based on scientific logic. Conclusion or suggestion are well supported and demonstrated by evidence. Discussion focuses on resolving the question.

Appendix 2: Assessment Criteria for biweekly short essay or quiz or participation for tutorial activity

Score for each question (10 points):

Proficient (8-10 points): Students exactly catch the point of a question and answer it correctly with accurate terms.

Competent (5-7 points): Students properly catch the point of a question and answer it correctly but miss some minor points or include errors.

Novice (1-4 points): Students do not understand a question exactly and answer it partially.

No answer (0 points)

*The attendance in the weekly tutorial activity will be counted to evaluate the participation.

Appendix 3: Assessment Criteria for Teams Presentation

Contents 20%: Comprehensive and accurate background and scientific supports. Question/issue are clearly shown. Key points are well chosen and explained.

Logic 20%: Well organized and scientifically logical problem solving and conclusion. Good answers to the questions from audience. Easy to follow.

Presenting Skill 20%: Good visualization and speech. Great feedback from audience. Balanced and well-structured slides.

Teamwork 20%: Equal workload. Good agreements and problem-solving process with the team members. Enough background/research and discussion in the team. Answer questions from audiences well and with equal chances across team members.

Peer review 20%: After the presentation, peer freely ask questions to understand the presentation correctly and discuss with the presenters. Peer will be asked to submit their evaluation (an example score table shown below) anonymously for each presentation except for their own presentation. The instructor will average the scores for each team.

Criteria	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6
Contents (10 points)						
Logic (10 points)						
Presenting skill (10 points)						
TOTAL (30 points)						
Comments, if any						

* Please note that in principle you would receive the same score as your teammates. However, your score may vary should there be evidence that you did not contribute to your team.