

<b>Academic Year</b>	AY2021-22	<b>Semester</b>	1
<b>Course Coordinator</b>	Assoc Prof Francesc Xavier Roca Castella		
<b>Course Code</b>	CY1001		
<b>Course Title</b>	Cell		
<b>Pre-requisites</b>	None		
<b>No of AUs</b>	3		
<b>Contact Hours</b>	Technology-enhanced Learning: 33 hours; Tutorials: 22 hours		
<b>Proposal Date</b>	28 Dec 2020		

### Course Aims

This course aims to introduce biology at a basic molecular and cellular level and brings into perspective the unifying theme of all living things. It presents the relationship between the molecular principles and the macroscopic view of biology. Basic concepts such as the central dogma or evolution theory, and common biological processes such as cell division or cellular respiration, will be covered. Current advances in biology that have implications to our society and biology's interaction with other disciplines will be highlighted. This is an online course, with support provided via online discussion and face-to-face formal tutorials.

This course aims to contribute to the education of all the diverse CNYSP students, which have very different background on biology and very distinct academic interests. To do this, the multiple and deep connections between biology and other disciplines will be emphasized in detail. Ultimately, this course aims to develop an interest in biology to all students, especially targeting those taking other specializations on the science and engineering sectors, who could be taking up cross-disciplinary jobs related to biology in the future.

### Intended Learning Outcomes (ILO)

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

1. Distinguish between the components of the scientific method (observation, hypothesis-setting, experimental testing, conclusion); this is applicable to all sciences
2. Define the characteristics unique to living things and the properties of water and carbon that have impact on them; learn the basic chemical composition of life
3. Map various biological components to the appropriate level of complexity e.g. molecules, cells, tissues, organs
4. Name the 11 main human organ systems, their major components, and their general functions; learn the connection between biology and medicine
5. Recognize biological molecules in the categories of carbohydrates, nucleic acids, proteins and lipids; learn the basic chemical types of molecules in life
6. Recognize features that are common in cells, and those that distinguish a eukaryotic cell from a prokaryotic cell, an animal cell from a plant cell
7. Describe the flow of information from DNA to polypeptide as outlined in the central

dogma

8. Recognize the need for gene regulation and the levels at which such controls occur
9. Define mutation types and explain how they can be generated; chemistry and physics underlying mutations
10. Outline the process of DNA replication in prokaryotes and eukaryotes
11. Distinguish between asexual and sexual reproduction in unicellular organisms and in macroorganisms
12. Outline the concept of Mendelian inheritance and how molecular genetics is layered upon it
- 13 Describe the theory of evolution and concepts related to terms such as adaptation and natural selection; connect basic biology with environmental and earth sciences
14. Outline the general process of gene cloning, Polymerase Chain Reaction, generating transgenic animals and reproductive cloning; connection between biology and technology, biomedical engineering
- 15 Outline the stages in extracellular and cellular metabolism and cellular respiration; emphasis on diseases caused by disruption of these processes, medicine
- 16 Distinguish between autotroph and heterotroph and sub-categories of each; basic physics underlying bionenergetics
- 17 Recognize key molecules in metabolic integration and cellular signal transduction process; biochemistry as an 'old' interdisciplinary field across biology and chemistry
- 18 Identify how advances in biology such as holistic (-omic) approach impacts on personalized medicine and interfacing with other disciplines; entirely interdisciplinary
- 19 Present critical analyses of specific issues on some biology topics related to the course outline in a clear and logical manner; focus on connections across disciplines
- 20 Recognize and apply the interdisciplinarity of biology, with its connections to other sciences and engineering disciplines

### **Course Content**

(blue font, already existing interdisciplinary components)

1. Introduction to biological scaffolds: basic chemistry, biological diversity, human body
2. Macromolecules in living systems: carbohydrates, nucleic acids, proteins, lipids
3. Cells: Common features, prokaryotic, eukaryotic
4. Genetic basis of life: central dogma, gene regulation, mutations
5. Continuity of life: DNA replication, cell division (prokaryotes, eukaryotes), asexual and sexual reproduction, reproduction in macroorganisms
6. Genetic diversity (Mendelian and molecular genetics), evolution, molecular

biotechnology (genetic engineering)

7. Metabolism (bioenergetics, extracellular metabolism, cellular metabolism, cellular respiration, metabolic integration)

8. Current advances in biology: the era of -omics (genomic, transcriptomic etc), personalized medicine, biology collaborating with other disciplines

**Assessment (includes both continuous and summative assessment)**

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
<b>Continuous assessment</b>					
Tutorial oral presentation, including Readiness Assessment Test (RAT) quizzes	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20.	NTU graduate attributes: -communication -competence -creativity -character -civic mindedness	50%	<u>20%</u> Team <u>and</u> <u>30%</u> Individual	See Appendix 1
<b>Final Examination Paper</b>					
Multiple choice questions	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20.	NTU graduate attributes: -competence	30%	Individual	Nil
Short answer question (choose 1 among 2)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.	NTU graduate attributes: -competence	10%	Individual	See Appendix 2
Short answer question on interdisciplinarity (1 fix question)	1, 2, 4, 5, 9, 13, 14, 15, 16, 17, 18, 19, 20.	NTU graduate attributes: -competence -creativity	10%	Individual	See Appendix 2
<b>Total</b>			100%		

## Formative feedback

**Online courseware feedback:** As you answer the quizzes embedded in the courseware, you will immediately be informed whether your answer was correct or incorrect. Along with this information, you will also be provided with an explanation of why your answers were incorrect. This will help you to achieve learning outcomes 1 to 18. Whole-class reports on performance will also be provided in a timely manner for students to improve their performance.

**Analysis of tutorial oral presentations:** You will be provided with general pointers on how to perform the class presentations in the tutorial sessions, with dos and don'ts of these presentations, early and midway through the semester. This will help you to achieve learning outcomes 1 to 20 and especially 19.

**Whole class analysis of final exam:** After the semester, you will be provided with an overview of how the class performed with respect to each question, and the ones found to be challenging for more than 40% of the class will be highlighted, and a detailed explanation provided. This will help you to achieve all learning outcomes, 1 to 20.

## Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
<b>Technology-enhanced Learning</b> (33 hours)	<p>The following learning and teaching approach applies to all (1-18, 20) learning outcomes:</p> <p>The course is structured into 8 modules comprising of 34 units in total. The units are partitioned such that one or two units focus on a specific learning outcome, providing clarity regarding the theme of study.</p> <p>Each unit has a few segments of knowledge delivery components with animation and audio voice-over, pop-ups and interactive activities to allow you to capture facts and concepts with sufficient visual engagement.</p> <p>Each knowledge delivery segment is followed by a few quizzes that provide immediate feedback. Printable notes are not provided during the immediate 2 weeks of release of each unit so that you will not rely on printed notes to answer the quizzes but challenge themselves in recall and application.</p>
<b>Tutorials</b>	The class will be divided into teams consisting of approximately six

(22 hours)	<p>students. In the tutorial session for group presentation, each team is randomly assigned one question related to the video topic of the week. Then each team works on an answer presentation for an hour, and at the end one team member presents it for 5-min aided by PowerPoint slides made by the group. A different student presents each week so every student will talk once.</p> <p>Course instructor(s) will also present in tutorials, to help understand the main concepts and the interdisciplinarity of biology.</p>
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### Reading and References

*Essentials of the Living World*, 4th edition, George B Johnson  
 Chapters 1-16, 23-31; ISBN-13: 978-0073525471

*Biology*, 12th edition, Sylvia S Mader and Michael Windelspecht  
 Chapters 1, 3, 6, 8, 14, 18, 27, 31, 33, 37, 41; ISBN-13: 978-1259296482

### Course Policies and Student Responsibilities

1. This lecture material is delivered entirely online while the tutorials are conducted physically in a classroom / tutorial room.
2. You are expected to go through each package of online lecture courseware (released weekly) before the tutorial of the week.
3. Any queries you have about the online lessons should be posted in the online Discussion Forum, so your classmates may also view your questions and benefit from the discussion provided by the course coordinator online. Emailed questions will be moved to the Discussion Forum.
4. If you need to consult the course coordinator face-to-face, you may do so during the one-hour consultation session set aside each week (except the 1-week recess), or at any time agreed by email.
5. In the tutorial sessions, you will be placed in a team of approximately six students. All groups are interdisciplinary as their integrants will be mixed by their specialization, also accounting for the same or similar numbers of students enrolled in Biology, to enforce balance and fairness. Each team will be given a particular question to work on as an oral presentation aided by PowerPoint slides, aligned to the courseware video of the week. During the team work you need to search for additional information from online sources and textbooks. Each presenter and team will be graded on their presentations by coordinator and the other students. Each student marks are computed individually by their presentation, and by group in which the marks for all six presentations are added. These marks will contribute to your final grade for this course, with a 20% coming from coordinator with half individual and half for group, and 20% coming from peer (student) evaluation, with half individual and half for group.

6. In the tutorials, you will learn about the connections between biology and other CNYSP taught disciplines, directly by the instructor(s). This will complement and expand the interdisciplinary components embedded in the video lectures. You will be assessed on this in the final exam.

7. You will sit for the final examination paper.

8. Your marks from the tutorial oral presentation and the final examination paper will contribute to your final grade in this course. Also the Readiness Assessment Test (RAT) quizzes are marked (see Appendix 1).

### 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
Assoc Prof Francesc Xavier Roca Castella	SBS 02N 18	6592 7561	xroca@ntu.edu.sg

### Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to biological scaffolds (overview, basic chemistry, biological diversity)	1,2	Complete interactive courseware with embedded quizzes
2	Human Body: anatomy and physiology.	3,4	Complete interactive courseware with embedded quizzes. Tutorial: Course Introduction and

			Assessment.
3	Macromolecules in living systems (nucleic acids, proteins, lipids)	5	Complete interactive courseware with embedded quizzes. Tutorial: Mock group presentation (practice, ungraded).
4	Cells (Common features, prokaryotic, eukaryotic)	6	Complete interactive courseware with embedded quizzes. Tutorial: Tips on oral presentations, plus coordinator presentation. Interdisciplinary briefing 1, Intro.
5	Genetic basis of life (The central Dogma)	7	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 1.
6	Genetic basis of life (gene regulation, mutations)	8,9	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 2.
7	Continuity of life (DNA replication, cell division (prokaryotes, eukaryotes)	10	Complete interactive courseware. Tutorial: Midterm Q&A Quiz (ungraded), comments on oral presentations. Interdisciplinary briefing 2.
8	Continuity of Life (Asexual/Sexual Reproduction and Reproduction in macroorganisms)	11	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 3.
9	Genetic diversity (Mendelian and molecular genetics)	12	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 4.
10	Genetic Diversity (evolution, molecular biotechnology (genetic engineering)	13,14	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 5.
11	Metabolism (bioenergetics, extracellular	15	Complete interactive

	metabolism)		courseware with embedded quizzes. Interdisciplinary briefing 3 (full session).
12	Cellular metabolism, Metabolism (cellular respiration, metabolic integration)	15, 16,17	Complete interactive courseware with embedded quizzes. Tutorial: Group presentations 6.
13	Current advances in biology: the era of - omics (genomic, transcriptomic etc), personalized medicine, biology collaborating with other disciplines	18	Complete interactive courseware with embedded quizzes. Tutorial: Last Q&A Quiz (ungraded), general comments and clarifications. Interdisciplinary briefing 4, summary.

<sup>1</sup> Please note that Oral Presentations are mapped to the topics of the week, covering Learning Outcomes 5 (practice), 6 (coordinator presentation), 7, 8, 9, 11, 12, 13, 14, 15, 16, 17 and mainly 19.

### Appendix 1: Assessment Criteria for the tutorial oral presentations

Readiness Assessment Tests (RATs): The purpose of this is to make sure students watch the videos of the week and come to the tutorial prepared for the team work.

At the beginning of tutorials, 5 Multiple Choice Questions will be asked to students, with 5 possible answers and only one correct. Students need to answer all questions. To pass a RAT students need a minimum of 4 correct answers. At the end of semester, students are expected to pass a minimum number of RATs, and then will be given all marks (10% of total grade). Those students that fail more than 4 RATs will be given 0 marks.

The group presentations are graded both individually and in group, by coordinator and by the whole class excluding members of the same team for obvious reasons. This is the breakdown of marks:

- Coordinator evaluation, total 20%.
  - o 10% individual mark: the mark awarded to the student only.
  - o 10% group mark for each student: the average of all marks for the six presentations by each group.
- Student peer evaluation, total 20%:
  - o 10% individual mark: the mark awarded to the student only.
  - o 10% group mark for each student: the average of all marks for the six presentations by each group.

For each of the four mark components, the marks entered by Coordinator and Student Peers as in the table below are added up, and then the total is rescaled to a maximum of 10 marks or 10% of the final grade (0-10 + 0-10 + 0-10 + 0-10).

<b>Trait</b>	<b>Far Below Average 1 mark</b>	<b>Below Average 2 marks</b>	<b>Average 3 marks</b>	<b>Above Average 4 marks</b>	<b>Far Above Average 5 marks</b>
<b>Concept depth, quality</b>	Missed the topic, lack of explanation and understanding, completely off focus. Casual effort largely insufficient.	Topic understood yet unclearly presented and unfocused. Major ideas not given accurately. Insufficient Information and irrelevant or inaccurate examples.	Topic clearly presented, somewhat focused. Major points given with some details that could be improved.	Major facts clearly presented with sufficient, relevant information and good examples.	All facts clearly presented with sufficient and relevant information, plus great examples. Logical, accurate and very clear major points.
<b>New Concepts beyond Video Content</b>	No additional information above video content, lack of effort and/or understanding.	Small amount of new information and not clearly delivered. Critical analysis weakly presented or confusing.	Some new information that is relevant and pertinent as expected, not more. Critical analysis presented yet could be more clear or insightful.	New info exceeds expectations in amount, depth of knowledge and impact. Some critical analysis of the topic with logic and clear understanding.	Very insightful presentation with lots of new concepts well stitched together. Critical analysis of high quality with insightful and inspiring opinions.
<b>Clarity of Presentation Speech</b>	Very poor presentation mostly by lack of effort or interest. Below any minimal standard.	Awkward speech, too fast or too slow beyond normal levels. Hard to understand and follow, or by reading straight off the slides without knowing much about it.	Speech of an acceptable level, improvable with experience. Concepts could be followed and understood.	Good presentation with with good articulation and intonation, with a bit of room for improvement.	Very clear presentation with good eye contact with audience. Superb communication, no reading off slides, no rushing or slowing, with good emphasis on important points.
<b>Quality of Slide Design</b>	Completely casual effort in slides, super crowded or too simplistic, unclear, not meaningful, etc.	Slides were suboptimal, with unclear headings, too wordy, unattractive, without diagrams or images, hard to look at, with repetitions, or several critical errors in scientific terminology,	Slides ok with some room for improvement, ok information, with somehow useful headings, statements, images, etc. A few errors.	Slides ok, helpful and well worked, with good design that makes the content easy to follow, informative.	Slides of very high quality, insightful and inspired design that helps communication, with creative items.

		typos, grammar, etc.			
<b>Overall Rating of Presentation</b>	Utter lack of effort.	Insufficient effort or quality.	Average presentation for an average group work.	Good presentation with room for improvement.	Great presentation, great delivery and team work to put it together.

## Appendix 2. Rubric for Final Examination Paper: Short Answer Question (20%)

Q1: Students choose one out of two short answer questions. The question is marked as follows, for a total mark of 10%.

**0-2 marks:** Unable to recall any factual information.

**3-4 marks:** Able to recall some factual information but unable to construct logical reasoning.

**5-6 marks:** Able to recall most factual information and to construct logical reasoning at the basic level, with incorrect conclusion.

**7-8 marks:** Able to recall most factual information and to construct logical reasoning to derive the correct conclusion to some extent.

**9-10 marks:** Able to recall all factual information and to construct logical reasoning to derive the correct conclusion and demonstrate creative perspective.

Q2: Students must answer this one question about interdisciplinarity. The question is marked as follows, for a total mark of 10%.

**0-2 marks:** Unable to recall any factual information.

**3-4 marks:** Able to recall some factual information but unable to construct logical reasoning to connect biology with other disciplines.

**5-6 marks:** Able to recall most factual information and to construct logical reasoning at the basic level, with incorrect interdisciplinary connections.

**7-8 marks:** Able to recall most factual information and to construct logical reasoning to derive the correct interdisciplinary conclusion to some extent.

**9-10 marks:** Able to recall all factual information and to construct logical reasoning to derive the correct conclusion and demonstrate creative perspective on interdisciplinarity.