

Advanced Chemical Biology (Fall 2020)

Professors:

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Classroom: Department of Chemistry, NTU, Rm 121

Hours: Mon. 13:20 – 15:10, Thu. 13:20 – 15:10

Language: English (lectures, exams, and student presentations shall all be given in English)

Students must also answer exam questions in English

Grading: Midterm exam 35%; Final exam 35%; Presentation 15%; In-class quizzes 10%; Discussion 5%

Prerequisite: Everyone enrolled in this class should have taken undergraduate level biochemistry. Some background information from basic biochemistry will be provided in the lectures. Undergraduate students can enroll only if they have already taken (and passed) biochemistry.

Course Syllabus (check CEIBA website for updates)

#	Date	Day	Topic ^[1]	Note
1	09/23	Thu.	What is chemical biology?	
2	09/27	Mon.	Experiments relevant to understanding the origin of life	
3	09/30	Thu.	Guest Lecture: CRISPR technologies	Kurt Mou
4	10/04	Mon.	Nucleobase, nucleoside, and nucleic acid	Paper discussion
5	10/07	Thu.	Guest Lecture: CAR-T technologies	Kurt Mou
6	10/11	Mon.	National Day	No class
7	10/14	Thu.	Nucleic acid mimics + Quiz: nucleic acid structures ^[2]	
8	10/18	Mon.	DNA sequencing technologies	Discussion 1 ^[3]
9	10/21	Thu.	RNA, aptamers, ribozymes, and directed evolution	
10	10/25	Mon.	Classic directed evolution experiments and recent advances	Discussion 2 ^[3]
11	10/29	Thu.	Amino acids, peptides, and proteins	
12	11/01	Mon.	Ribosome and protein translation + Quiz: amino acid structures ^[2]	
13	11/04	Thu.	Protein degradation and misfolding	Discussion 3 ^[3]
14	11/08	Mon.	Mid-term week	No class
15	11/11	Thu.	MID-TERM EXAM ^[4]	No class
16	11/15	Mon.	Incorporate noncanonical amino acids into proteins	
17	11/18	Thu.	Carbohydrates and lipids	Discussion 4 ^[3]
18	11/22	Mon.	Carbohydrates and lipids	
19	11/25	Thu.	Secondary metabolites 1	
20	11/29	Mon.	Secondary metabolites 2	

21	12/02	Thu.	Please attend KT Wang Lectures (TBD) ^[5]	No class
22	12/06	Mon.	Bioconjugation chemistry	Discussion 5 ^[3]
23	12/09	Thu.	Fluorescent dyes and proteins	
25	12/13	Mon.	Super-resolution fluorescence imaging Electron microscopy	
26	12/16	Thu.	Analytical technologies for biomaterials	Discussion 6 ^[3]
27	12/20	Mon.	Student presentation 1 ^[6]	
28	12/23	Thu.	Student presentation 2 ^[6]	
29	12/27	Mon.	Student presentation 3 ^[6]	
30	12/30	Thu.	TBD	
32	01/03	Mon.	Final week	No class
16	01/06	Thu.	FINAL EXAM ^[4]	

Notes:

- [1] PowerPoint slides and assigned reading materials will be uploaded to CEIBA (ceiba.ntu.edu.tw) course website.
- [2] There will be a short quiz (no more than 5 questions) after each class. Quizzes on 10/14 and 11/11 will ask you the chemical structures of nucleic acids and amino acids, respectively.
- [3] Paper discussion sessions will be held about every 2 weeks. You should read the assigned papers *before* the discussion sessions.
- [4] You will be allowed to write notes on a piece of A4 paper and bring it to the mid-term and final exams.
- [5] KT Wang Bioorganic Chemistry Lecture (王光燦生物有機化學講座) usually features great talks; *content of the lecture will be included in the final exam.* The exact date has not been announced; we will move our class around for the lecture.
- [6] Student presentations have a *strict 5 min. limit.* You should *a)* make and present a 1-slide infographic and *b)* provide a short quiz about your presentation. *I will select a few questions to include in the final exam.* Check out the following link and examples.

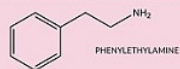
<http://www.compoundchem.com>

<https://www.foodprocessing.com/articles/2014/infographic-chemistry-of-food/>

<https://www.distillerytrail.com/blog/chemistry-inside-tiny-champagne-bubbles-infographic/>

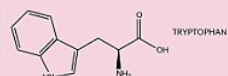
THE CHEMISTRY OF CHOCOLATE

IS CHOCOLATE AN APHRODISIAC?

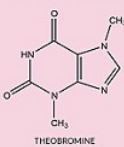


Phenylethylamine occurs naturally in the brain, and is dubbed 'the love drug' due to its ability to produce feelings of well-being and contentment. It is also present in significant concentrations in chocolate, but since it is broken down after ingestion, it has been ruled out as causing a significant aphrodisiac effect.

Tryptophan is a chemical in the brain linked to the production of serotonin, the neurotransmitter that produces feelings of elation. It is present in chocolate, but only in small quantities, and again is most likely not causing any aphrodisiac effect.



WHY IS CHOCOLATE TOXIC TO DOGS?

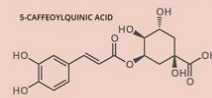


Theobromine is a mild stimulant, similar in effect to caffeine, found in chocolate. This compound is harmless to humans at the levels found in chocolate - a fatal dose would require eating tens of kilograms of milk chocolate!

On cats & dogs, however, theobromine has a much more potent effect; small doses can lead to vomiting & diarrhoea, whilst as little as 50g of dark chocolate could kill a small dog.

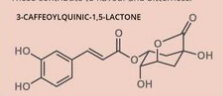
THE CHEMISTRY OF COFFEE

WHY IS COFFEE BITTER?

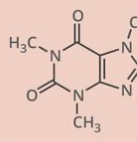


Chlorogenic acids account for up to 8% of the composition of unroasted coffee beans. More than 40 different varieties have been identified in green coffee beans, with 5-caffeoylquinic acid the most prevalent.

Chlorogenic acid content decreases when coffee beans are roasted, as they react to form quinolactones, phenylindanes & melanoidins. These contribute to flavour and bitterness.



THE CAFFEINE CONTENT OF COFFEE



The caffeine content of coffee is variable but is approximately 100mg in a cup.

Caffeine works by blocking the action of a group of brain chemicals called adenosines, which work to naturally trigger tiredness.

The amount of caffeine in your bloodstream peaks 15 to 45 minutes after ingestion.