CHM209H
The Chemistry of Molecular Gastronomy
2018

Lecture: Wednesdays, 1-3 pm, LM155

Instructor: Prof. D. B. Zamble
LM 443
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Office hours: 1 h after class, or email to schedule a meeting

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Course Content: In this course we will examine the chemical and physical processes that occur during cooking, and how these transformations produce different flavours and textures. We will focus on the modern practices of molecular gastronomy. Some of the chemical principles that are applied by practitioners of modernist cuisine include macromolecular structure and interactions, physical chemistry, and chemical reactivity. Lectures will include in-class demonstrations. This course is intended for students with no science background, to serve as a breadth requirement.

Grading Scheme:

Independent project	
Topic outline (due **Feb. 7**)	5 %
Story board (due **March 2**)	10 %
Peer-to-peer critiques (due **March 9**)	5 %
Finished story board (due **April 3**)	5 %
Video (due **April 3**)	20 %
Mid-term (in class, **Feb. 14**)	15 %
Final exam (Exam period)	40 %

Penalty for late course work: 10 % per day
Bonus: for proven mistake in notes or text (one time): 2 %

Prerequisites: There are no prerequisites for this course.

Text and notes: There is no required text for this course. Lecture notes will be posted to the class Blackboard site, as well information about the in-class demonstrations and other information of interest. Make every effort to attend all lectures because it is here that the fundamental content of the course will be presented and discussed. An introductory chemistry text would be useful, a suggested text is '*Chemistry*, 7th Edition, by McMurray, Fay & Robinson, Pearson'. This book is used in our first year chemistry courses, so there are lots of copies around. Another nice reference is '*The Science of Cooking*, by Provost, Colabroy, Brenda & Wallert, Wiley'. This is available online through the utlib catalogue. Some guided assignments from this text will be recommended as practice problems.

Course Outline:

Week		*Molecular Gastronomy Topic*	*Chemical Topics*
1	*Jan. 10*	**Introduction**	• Atoms & molecules • Covalent bonds • Non-covalent H-bonds • States of matter • Food molecule: Water
2	*Jan. 17*	**Flavour Molecules**	• Origins of taste and smell • Drawing molecular structures • Stereochemistry • Receptors • Food molecules: Odorants
3	*Jan. 24*	**Emulsions**	• Non-covalent dipole interactions • Hydrophobic vs hydrophilic • Emulsifiers and stabilizers • Food molecules: Fats & Oils
4	*Jan. 31*	**Gels/Thickeners**	• Ionic interactions • Polymers • Hydrocolloids • Food molecules: Carbohydrates
5	*Feb. 7*	**Sous-Vide**	• Energy and enthalpy • Cooperativity • Protein folding and stability • Food molecules: Proteins
6	*Feb. 14*	**Mid-term test** **Acids & Bases**	*In-class test (50 min)* • Chemical equilibria • Concentration • Food molecules: Acids, CO_2
7	*Feb. 28*	**Maillard & Caramelization Reactions**	• Molecular reactions • Chemical kinetics • Food molecules: Amino Acids & Sugars
8	*March 7*	**Color and Foams**	• Valence bond theory • Electronic conjugation • Acid/ Base indicators • Food molecules: Minerals

9	*March 14*	**Antioxidants**	• Redox reactions • Food molecules: Vitamins
10	*March 21*	**Food Enzymes**	• Enzyme catalysis • Physiological role • Food molecules: Enzymes
11	*March 28*	**Fermentation**	• Microbiology • Cellular metabolism • Ideal gas law • Food molecules: Microorganisms
12	*Apr. 4*	**CHM209 movies**	*Student Videos* Student choice

Turnitin: "Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site".

Absence: If you miss a test or a significant period of class work through illness or a related reason, you should request consideration by submitting a completed University of Toronto Student Medical Certificate, which is available at the Faculty of Arts and Science web site.
http://www.artsandscience.utoronto.ca/current/forms.shtml
The document must be presented within one week of the date of the absence. Only serious illness (or equivalent reason) will be accepted as justification for absence (note: the UofT Medical Certificate, filled out by your doctor, stating that you saw him/her on a given day is not adequate. Your doctor must certify that you were too sick to attend the test, etc.) The form of consideration extended for a particular item of missed term work will be explained to you when you submit the certificate.

Email Policy: **For a response…**
-All emails must contain a full student name and student number.
-Short questions only. Detailed questions, especially those referring to chemical structures should be saved for office hours. These are very difficult to answer over email.

All efforts will be made to return emails within 24 hrs.

Accessibility Needs
The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible:
disability.services@utoronto.ca or http://studentlife.utoronto.ca/accessibility .

IUPAC Periodic Table of the Elements

1																	18
1 H hydrogen 1.008 [1.0078, 1.0082]	2		Key: atomic number **Symbol** **name** conventional atomic weight standard atomic weight										13	14	15	16	17	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122												5 B boron 10.81 [10.806, 10.821]	6 C carbon 12.011 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12		13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.948
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.38, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson

57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

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For notes and updates to this table, see www.iupac.org. This version is dated 28 November 2016.