

## Molecules and the Mind

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**\*\*please include a subject heading like NATS 1820 ...**

**Teaching Assistant** TBA

**Course schedule** Three lecture hours per week  
Lecture: Tuesday and Thursday 4:00 – 5:30

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### Course Description

If you think chemistry is nothing more than smelly liquids, toxic waste, math, moles, and equations then this course will open your eyes. During the year, we will romp through the molecules of the mind and look at the drugs that alter it. We will explore the components of cosmetics, perfumes, shampoos and soap, and discover how they work and why, who knows, this course may even save you money. Atomic structure and atomic bombs, weapons of mass destruction, nutrition, love, lust, and sex (even chocolate) - there is a connection and it's called chemistry. If you are what you eat, this course will show you what you're made of - molecules.

No experience necessary or desired.

### Required Textbook

None

### Evaluation Framework

#### Assessment and Evaluation:

##### *Fall Term:*

Test 1 – 20%

Test 2 – 20%

Test 3 – 20%

##### *Winter Term:*

Test 4 – 20%

Test 5 – 20%

Test 6 – 20%

**There are six 50-minute tests that will be held throughout the year. Of the six only the best five will count for your final grade. Therefore, if you miss one of the tests due to illness or personal reasons, there will be no need for a makeup test, simply the one you missed will be dropped – there are no makeup tests.**

## Outline of Topics

- 1) **Chemistry: The Science of Everything**
  - a) What isn't chemistry
  - b) I'm a little mad, you're Welcome!!
  
- 2) **The Forces of Nature**
  - a) Gravity
  - b) Electromagnetic
  - c) Nuclear Forces
  - d) Dark Energy
  
- 3) **The Birth of the Universe and the Beginning of Chemistry**
  - a) The Big Bang Theory
  - b) Expands and Cools – H<sub>2</sub> forms
  - c) H<sub>2</sub> => He in Stars
  - d) Towards Iron
  - e) Super Nova Iron and Beyond
  - f) Formation of Earth
  
- 4) **Nuclear Chemistry**
  - a) How protons stick together to make the elements
  - b) Naming the elements
  - c) Isotopes
  - d) Fusion of Atoms in Stars
  - e) Radioactivity – Curie et al.
  - f) Lise Meitner and Otto Hahn: A Science Drama
  - g) Nuclear Power and the Bomb
  - h) Radio-dating
  - i) PET Scans and Antimatter
  - j) Irradiation of Food – Gamma rays
  - k) Nuclear Medicine
  
- 5) **Quantum Mechanics**
  - a) Uncertainty
  - b) Wave/particle duality
  - c) What is real?
  - d) Allowed and Forbidden

**6) Light**

- a) “It’s a curious thing,” A. Einstein
- b) Visible and color perception
- c) Radio - Microwave – Visible - UV - X-rays - Gamma rays
- d) Blue Skies, Red Sunsets and Green Leaves
- e) Light bulbs – Incandescent
- f) Fluorescence
- g) Phosphorescence
- h) TVs, LCDs, and Plasma displays
- i) LEDs

**7) Thermodynamics and Cold Beer**

- a) On a winter’s day, do you let the heat out or the cold in?
- b) Refrigeration
- c) A thermos bottle keeps cold things cold and hot things hot – How does it know?
- d) Sweat cools, sleeping together warms
- e) Cans or bottles? Keeping and getting your beer cold

**8) Molecular Structure and Organic Chemistry**

- a) Basic Organic Nomenclature and Functional Groups
- b) Carboxylic acids, Alcohols, Esters, Amides, Amines, and Ketones

**9) Water – The Magical Molecule**

- a) Polar Molecules
- b) Hydrogen Bonds
- c) Acids, Bases and pH

**10) Biochemistry**

- a) Fats, oils and triglycerides
- b) Amino acids and proteins
- c) Carbohydrates, sugars, starches and fiber
- d) Hormones
- e) Food and digestion
- f) Vitamins and minerals
- g) Drugs
- h) Neurotransmitters
- i) Introduction to Drug Design

**11) Love, Lust and Sex**

- a) PEA Chocolate and strawberries
- b) Oxytocin – The hormone of touch and orgasms
- c) Vasopressin – The hormone of sensibility
- d) Dehydroxyepiandrosterone
- e) Chemistry of Semen
- f) NO and Viagra
- g) Testosterone and Aggression

**12) Hormones**

- a) Chemical email
- b) Regulation of all bodily functions
- c) Steroids
- d) Women's hormonal cycles
- e) Birth control
- f) RU 486 – Just allowed July 30, 2015
- g) NO – the smallest hormone and Viagra

**13) Laundry**

- a) Detergent
- b) Bluing agents
- c) Bleach
- d) Fabric Softener
- e) Soap is Spermicide

**14) Skin**

- a) Color – Race, Melanin
- b) Tanning
- c) Sunblock
- d) Wrinkles
- e) Creams, Lotions and Potions
- f) Burns
- g) Artificial skin
- h) Cleaning
- i) Germs

**15) The Science of Beauty**

- a) The Pursuit of Beauty
- b) Lipstick and lip gloss
- c) Blush
- d) Eye shadow
- e) Learning to Read Labels
- f) Ancient Psychology of Cosmetics
- g) Fingernails

**16) Hair**

- a) Proteins
- b) Blondes, Brunettes and Redheads
- c) Hair Coloring
- d) Blondes in Venetian Paintings
- e) Gray Hair
- f) Curling Iron
- g) Permanente Curls
- h) Hair straightening

**17) Sports: The Chemistry of Motion**

- a) How Molecules can Create Motion
- b) Body building
- c) Exercise and pain
- d) O<sub>2</sub>
- e) Injury and healing
- f) Food and Nutrition

**18) Pain**

- a) What is pain?
  - b) Aspirin
  - c) Ibuprofen
  - d) Acetaminophen
  - e) Morphine
  - f) Naproxen
  - g) Tynol3
  - h) Percocet
  - i) Heroin
  - j) The Opiate Receptor
  - k) Endorphins
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**19) Stress and Fear**

- a) Hippocampus
- b) Pituitary
- c) CRF
- d) ACTH
- e) Adrenal Cortex
- f) Feedback Loops
- g) How to Study for a Test

**20) Living Molecules**

- a) DNA RNA
- b) Evolution
- c) Rosalind Elsie Franklin – The Drama about X-Rays
- d) How replication could have started

**21) Bones**

- a)  $\text{CaCO}_3$ , Early clams the environment and Al Gore
- b) Living construction materials
- c) Add phosphorous
- d) Teeth

**22) Poop, Pee, Snot, Spit, Tears and Ear Wax**

- a) Every opening in the body is disgusting – isn't it great

**23) Gas and Petroleum**

- a) Methane through petroleum jelly
- b) Octane
- c) Lubricants
- d) Race cars
- e) Plastics
- f)  $\text{H}_2$  as an alternant

**24) Plastics**

- a) Polymers
- b) High density
- c) Low Density
- d) Bullet Proof Glass
- e) Cars
- f) Bottles
- g) Cooking – microwave
- h) Plumbing
- i) Toys
- j) Recycling

**25) Chemical Detectors**

- a) Smoke Detectors
- b) CO Detectors
- c) Bomb Detectors
- d) Drug Detectors
- e) Moths and sex

**26) Building Materials**

- a) Plastic
- b) Glass
- c) Wood
- d) Steel
- e) Why Things are Strong
- f) Why Bananas are Weak
- g) History of Tires, War, Gum and Rubber
- h) What is glue? Post-it notes
- i) Non-Newtonian fluids – silly putty
- j) Marble, slate stone fireplaces bricks and adobe

**27) Food**

- a) Four basic food molecules
- b) Milk and Dairy
- c) Eggs
- d) Meat
- e) Fish
- f) Vegetables and Fruit
- g) Spices
- h) Seeds
- i) Cereals
- j) Sweets

**28) Cooking Techniques**

- a) Denaturing Proteins
- b) Maillard Reactions
- c) Caramelization
- d) Trichinosis, Salmonella

**29) Flavor**

- a) How We Taste
- b) Sweet, Sour, Bitter, Salty, Umami and BBQ
- c) Stereochemistry of flavor
- d) Artificial flavor
- e) Maillard reactions
- f) Hot Spice

**30) Hunger**

**31) Metabolism**

**32) Beer**

- a) Masticated corn (McGee)
- b) Egypt – natural yeast
- c) Grains
- d) Ale, Lager, Pilsner, Stout, Honey, Malt Liquor
- e) Taste of CO<sub>2</sub>

**33) Wine**

- a) That delicate balance
- b) Ice wine

**34) Scents**

- a) How we smell
- b) Why good and bad
- c) Human Pheromones?
- d) Musk – Deer Butts
- e) Perfumes and vapor pressure
- f) Dinner Got to go.

**35) Medicine**

- a) QSAR
- b) NMR
- c) PET
- d) Pharmacology
- e) Bleeding
- f) Pneumonia
- g) Cancer
- h) Bacteria vs. Virus Antibiotics
- i) Chemotherapy
- j) Genetics
- k) Epigenetics

**36) Illegal Drugs- Mind Altering Drugs**

- a) Barbiturates
- b) Speed
- c) PCP
- d) Cocaine
- e) Marijuana
- f) LSD – The truth

**37) Fire**



- a) The ultimate expression of our souls
- b) Ionization
- c) Entropy
- d) Enthalpy

**38) Fireworks**

- a) Ionization
- b) Temperature
- c) Explosions and Kinetics
- d) Color
- e) Timing with Computers

**39) Viruses and Bacteria**

- Theory of illness
- Pasture
- Cow pox vs small pox
- Vaccines
- Aids/ HIV

**40) Electronics**

- a) Band theory
- b) Conductors
- c) Insulators
- d) Semiconductors
- e) Transistors
- f) Modern Electronic Components

**41) Color**

- a) Paint
- b) Lasers
- c) Dyes

**42) Geology**

- a) What atoms are rocks made of?

**43) Atmospheric**

- a) Ozone high and low
- b) PAN

- c)  $\text{NO}_x$   
d)  $\text{O}_2 \text{N}_2$

**44) Fossils**

- a) Jurassic Park and Amber  
b) Stromatolites  
c) Atomic Dating  
d) Darwin and Change

**45) Weapons**

- a) Gun powder  
b) Dynamite  
c) TNT  
d) Canons  
e) Guns  
f) Bombs  
g) The Bomb  
h) Jet fighters  
i) Laser Guided  
j) Satellite

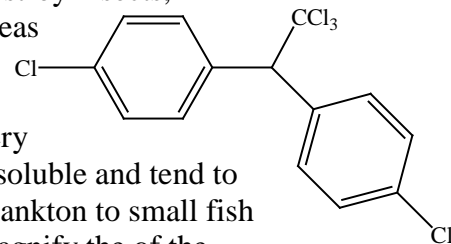
**46) Explosives**

**47) Nerve Gas**

**48) Poisons**

**49) Pesticides**

- a) DDT – Oops DDT was discovered in 1942 and was used to destroy insects, reducing the risk of disease (typhus and malaria) over large areas of the world. As time passed it became clear that the use of chlorinated hydrocarbons in large quantities, over vast areas had severe side-effects. These halogenated compounds are very stable and are not easily destroyed in nature; they are also fat soluble and tend to build up in most animals. The food chain which runs from plankton to small fish to large fish to birds to larger animals, including us, tend to magnify the of the chloroorganic in each step.



- b) Soft insecticides

**50) Personalities of the Molecules**

**51) Comets**

- a) Comets as the Source of Earth's Water
- b) Comets as a Source of Life

**52) Genetics**

**53) Genetically Altered Food**

**54) Fabrics and Textiles**

**55) Paper**

**56) Lightning and Heavy Weather**

**57) Planetary Chemistry**

**58) Jewels, Gems, Diamonds and Rubies**

**59) Life on Other Planets**

**60) Did You Know?**

**61) Less is More – the simpler the approach – The Real Secret – It's Like Life itself.**

**Add and Drop Deadlines**

Last date to enroll without permission of instructor - September 20, 2007

Last date to enroll with permission of instructor - October 19, 2007

Last date to drop without a grade - February 1, 2008

**Fall/Winter Holidays**

October

December 21 – January 1

February 11 – 15

Thanksgiving

Winter break

Reading week

**Important Policies, Procedures and Regulations**

Policies on grading and academic honesty in the York University are included in the student handbook. These policies will be strictly adhered to in this course. Please see the York University policy on academic honesty at:

<http://www.yorku.ca/secretariat/policies/>

Academic Honesty

<http://www.yorku.ca/secretariat/policies/document.php?document=69>

Grading Scheme and Feedback Policy

<http://www.yorku.ca/secretariat/policies/document.php?document=86>

<http://www.yorku.ca/secretariat/policies/document.php?document=87>

Reappraisals

<http://www.registrar.yorku.ca/services/policies/grade.htm>

Academic Accommodations for Students with Disabilities

<http://www.yorku.ca/secretariat/policies/document.php?document=68>

Deferred Standing

[http://www.registrar.yorku.ca/services/ds\\_faq.htm](http://www.registrar.yorku.ca/services/ds_faq.htm)