化学概论报告思路

# The basic components of the chemistry

The whole object of chemistry is the observe and build up theories for the interaction and changes of matter

Theories of interaction: Quantum mechanics, Chemical Kinetics and dynamics, Standard model, radioactivity and nuclear chemistry

Concepts of matter: Atoms and Molecules, Ions and Free radicals, fundamental particles, electrons neutrons and photons, supermolecule, isomers(structural, stereoisomer, chiral(optical))

Theories of matter: Standard Model, Matter wave

Observation: Spectroscopy, accelerator, observatories

# Another division of Chemistry based on the kind of matter studied

## Considering properties of different matter:

Chemistry of earth:

Inorganic Chemistry (and Material Chemistry)

Organic Chemistry (and Bio Chemistry)

Chemistry of universe: Astrochemistry

GPT Prompts:

This is a perspective to understand Chemistry as a whole. Follow this framework, write an essay to illustrate the logic behind this framework and guide the readers to understand the idea. The purpose of this essay is to provide a personal perspective for the reader about "how to understand chemistry"

Emphasize the interconnectedness and the collective existence.

# Important Concepts and Techniques

These are the important concepts and techniques of in the filed of . Find a way to organize them and write an introductory Phrase to illustrate their connections. Don’t make a list of concepts, write them in a phrase, instead.

Quantum Mechanics:  
Bohr Model, Matrix Mechanics, Wave-Particle Duality, Matter Wave(of Electrons), Uncertainty Principle, Lamb Shift, Quantum Electrodynamics, Schrodinger Equation(BO approximation, Quantum dot), wave-function of Hydrogen, Spin, NMR, Aufbau Principle, intermolecular force(Van der Walds force, Keesom Force, Debye Force, London dispersion force)

Chemical Kinetics and Dynamics:  
The law of Mass Action, the elementary reaction and reverse reaction, the Arrehenius equation; The transition state theory; Chemical Equilibrium; the detailed balance principle; The collision theory and Marcus Theory;

Radioactivity and nuclear Chemistry:  
Three types of decay: alpha decay, beta decay(plus / minus), gamma decay; Electron capture; Cluster decay and nuclear fission, neutron emission; Nuclear binding energy and nuclide stability; Stable Nuclides; Positron emission, antimatter Consecutive decay, decay rate and half-life; Radiation exposure and effective dose; environmental radioactivity; Nuclear Medicine and Nuclear Imaging(PET-CT); Nuclear Fission and Nuclear Chain Reaction(Atomic Bomb); Critical mass; Nuclear Fusion(Hydrogen Bomb); Nuclear safety and Nuclear energy; Tokamak device;

Atoms, Molecules, Ions and free radicals:  
Atomism, atoms, molecules, covalent, ionic, organic, Chemical Bond (Valence bond theory, molecular orbital theory, molecular Hamiltonian). Antibonding, Woodward-Hoffmann rules, DFT, Photon absorption photochemistry, photosynthesis, CFCs and O3 layer, Radical polymerization, Superoxide free radical biologic injury, electron spin resonance, solution and solubility(polarity);

Inorganic and Material Chemistry:  
MSE(Material science and engineering), Scale of materials, Material classification(Metals and alloys, Ceramics, Glasses, Glass-Ceramics, Polymers(Plastics), Semiconductors, Composite Materials, Soft matters), Solid Materials(Crystals, Polycrystallines, Amorphous, Organic Solids, Composites), Unit Cells, Crystal family and lattice system, Polyalkenes & Substituted Polyalkenes, Alcohol/Acetate Polymers, Polyamide, Polymeric Materials, Elastomers(Rubber)

Organic and Biochemistry:  
Biological Molecules and Macromolecules, Proteins, Carbohydrates, Lipids, Nucleotides, Nuclei acid, protein structure(folding, dynamics, primary structure and amino acids, secondary structure(alpha helix, random coil, beta-pleated sheets), Tertiary structure, Quaternary structures, Enzyme, AlphaFold, Epigenetics, The central Dogma, Reversible RNA methylation, Transmembrane Equilibrium, Contrast agent for MRI, Elements in Medicine and Diagnosis

Astrochemistry  
Matter and energy, Baryons, Dark Matters & Energy, Big Bang Theory, Interstellar Mater, Interstellar Chemistry

# History of Chemistry (From Alchemy to Modern Chemistry)

Ancient Chinese Alchemy and the Ancient Greek Alchemy

Although following different epitomes, the chemistry and alchemy have the same goals: Wealth and Health(While European alchemy focus on wealth, and the Chinese alchemy focus on immortality)

The last western Alchemist(as origin of modern chemistry): Issac Newton and Robert Boyle

The achievements of Chinese Alchemy: black powder, The Book of Change

Modern Chemistry: 3M(Make, Measure, Model)

Synthesis：Organic/Inorganic/Macromolecule/Composite Materials

Mechanism：Thermochemistry/Structure/Reaction Dynamics

Matter：Gas/Liquid/Solids/Colloids/Interfaces/Biological

Techniques：Spectroscopy/Vacuum/NMR/X-Ray/SPM/Mass Spectroscopy/Chromatography/Computation/AI

Galileo is regarded as the father of modern science since his research is the epitome of 3M.

The Conservation law of Mass offered by Antoine Lavoisier

Make: New tool is new science

Measure: Quantitative

Model: Atomism, elements, the conservation law of mass

Developments of nowadays science:

Spectroscopy is the most precise measurement(frequency measurements)

Physics makes the models based on the chemistry

# Why Chemistry is the central science?

Modern Chemistry: 3M(Make, Measure, Model)

Scale: atoms and molecules

Science (from Latin scientia ‘knowledge’) is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.

Intermediate study scale

Wide and fundamental study field(with intersection with other disciplines)

Strong demand for new technologies and tools

(The methodology of chemistry that involve all key aspects of natural science and its intermediate study scale determines its centric role)

# Some view points by Prof. Wang

Physics and Chemistry shouldn’t be divided

Personal Knowledge is what the scientists are seeking for

Material and level of civilization

Material Scientists should stay in the industry or institutions instead of universities

Family Tree of knowledge and scientists

There shouldn’t be too much theoretic physicists

Chinese science community is lack of understanding of what is science, that may count for our insufficient scientific discoveries

Many important scientists aren’t appropriately publicized by the Chinese government

New tool is new science

# Summary

Overall, the introductory Chemistry course gives us a comprehensive overview about the modern Chemistry, about how it develops, how it is organized and what’s the current frontier of research with an emphasis on chemistry history throughout, along with professor’s profound thought on science related questions. At the beginning, the brief introduction of the Chemistry’s history is given, following by introductions about the most fundamental theories in Chemistry: the Chemical kinetics and dynamics, the atomic and intermolecular interaction, and the basics classification of matter along with their basic properties. At the other part of the course, chemistry’s intersection and applications in the other disciplines are introduced, including astronomy, biology, material and nuclear science.