Instructor: Prof. Rory Waterman
Cook A-129
656-0278
rory.waterman@uvm.edu
@rwluddite

Lecture: MWF 12:00 12:50, Waterman 413

Office hours: M 1:00 2:00 and R noon 1:30 or feel free to make an appointment.

Course description: A general overview of inorganic chemistry. Topics include bonding, molecular structure, periodic properties, symmetry, main-group and transition-metal (including organometallic) chemistry, and bioinorganic systems.

Course objective: My goal is that students who complete this course should be able to use some basic inorganic concepts, broadly defined, to enable problem solving in other fields. To address that goal, one should have a basic idea about the bonding across inorganic systems, the interplay of symmetry and physical properties, transition metals, and main group elements. To meet that goal, we should investigate the inorganic chemistry in biological systems and applied fields like catalysis and energy conversion.

Learning outcomes: The course is broken into several parts (up to five, if all goes well see outline below). Each section will have a set of specific objectives associated with it. Those documents form a roadmap for the course. If you *understand* what the content of

Text: *Inorganic Chemistry* by Miessler, Fischer, and Tarr (ISBN-13: 978-0-321-81105-9). Some supplementary readings and resources will be distributed in class, available in the library, and/or posted on the course Web page. An i>clicker is also required.

The i>clicker is how I will administer many quizzes and award any in-class credit. You should obtain this and register it ASAP on Blackboard. We will test them on January 20, and they will be used on the following week. Bring your clicker daily; I have no mechanism to account for clickers left home.

Grading: Grades will be based on three exams (10%, 20%, and 20%, respectively), a final exam (25%), written work (10%), quizzes (10%), and homework/in- or pre-class work (5%).

Quizzes: Short quizzes will be given at the beginning of a class most weeks. Because we shod cover a few days of material, the day of the week may change. The format of the quiz (written vs. clicker) is variable as well. The quizzes are based on fundamental material covered in lectures over the previous classes and thus intended to help you see what topics are important.

Problem Sets: Problem sets will be given approximately weekly. Solutions will be provided, and these will not be graded completely. Only one question per problem set will be graded. Completing the problem sets is the best way to review course material and practice key skills in the course.

Outline

I. The basics of inorganic chemistry
- A. Recap of Lewis structure & VSEPR
- B. Point symmetry
- C. Molecular orbital theory
- D. Periodic trends
- E. Lewis acids, hard-soft concept, and frustration

II. Transition-metal chemistry
- A. Metals: Who they are and what they do
- B. Electronic structure of metals
- C. Reactions at transition metals
- D. Moving electrons/metals doing work

III. Catalysis
- A. Catalysis, chemistry that affects all of us
- B. Taming the organometallic beast
- C. Solid-state: oil processing and catalytic converters
- D. Homogeneous catalysis: reactions to make drugs and useful things

IV. Energy
- A. Solar cell technology
- B. Solid-state refrigerant
- C. Making hydrogen

V. Grand challenges
- A. Nitrogen fixation
- B. C H functionalization
- C. Water oxidation

Key skills

Identify point symmetry of molecules
Interpret MO diagrams for simple molecules
Identify d-orbital splitting in various metal coordination geometries
Assign formal oxidation state and d-electron count to metal complexes
Predict or identify ligand exchange reactions
Assign electronic spectra of metal complexes
Determine $_{o}$ from spectral data
Apply appropriate dopant to change semiconductor electronic properties
Determine valence electron count for a metal complex and relate to possible organometallic reactions
Sequence fundamental organometallic reaction mechanisms into a catalytic cycle to produce a product
Use kinetic data to determine mechanism
Predict rates of electron transfer from barrier and driving force data