Spring 2024 Location: CLB 414 MWF 10:40–11:30AM

Instructor:	Leslie Murray		
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Office Hours:	by appointment		

Course Description and Objective

To introduce contemporary aspects of structure, bonding, and reactivity in the *s* and *p* block elements, relying on a strong understanding of the fundamental electronic structure of the atom.

Recommended Texts

Albright, T. A., Burdette, J. K., and Whangbo, M.-H. Orbital Interactions in Chemistry, 2nd Ed.

<u>Literature</u>

The course will be supplemented with assigned primary and secondary literature.

<u>Grades</u>

Grades will be based on

Mid-term Exam:	100 points	(Oct 10, 2024 in-class)
Final Exam:	100 points	(Dec 4, 2024 in-class)
Participation:	50 points	
Presentation:	50 points	
Total:	300 points	

For information on UF's Grading Policy, see: http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html and http://www.isis.ufl.edu/minusgrades.html

Course Participation

Class participation is graded on a scale from 0 (lowest) through 4 (highest), with the criteria below as a guide. To be awarded all 50 points for participation, the average daily score for the semester must be > 2. The running participation daily average will be provided monthly by email to inform students of course progress.

Grade	Criteria
0	Does not participate
1	Present, not disruptive.
	Tries to respond when called on but does not offer much.
	Demonstrates very infrequent involvement in discussion.
2	Demonstrates adequate preparation: knows basic facts from reading but does not show evidence of trying to
	interpret or analyze them.
	Reproduces the information from the reading without elaboration or very infrequently (perhaps once a class).
	Does not offer to contribute to discussion.
	Demonstrates sporadic involvement.
3	Demonstrates good preparation: has demonstrated command of the reading.
	Offers interpretations and analysis of reading material (more than just facts).
	Contributes well to discussion in an ongoing way: responds to other students' points, thinks through own points,
	questions others in a constructive way, offers and supports suggestions that may be counter to the majority
	opinion.
	Demonstrates consistent ongoing involvement.
4	Demonstrates excellent preparation: has analyzed reading exceptionally well, relating it to readings and other
	material (e.g., readings, course material, discussions, experiences, etc.).
	Offers analysis, synthesis, and evaluation of reading, e.g., puts together pieces of the discussion to develop new
	approaches that take the class further.
	Contributes in a very significant way to ongoing discussion (e.g., keeps analysis focused, responds very
	thoughtfully to other students' comments).
	Demonstrates ongoing very active involvement.

Presentation

Each student will be required to give one 15-minute presentation as part of the *Special Topics*. These presentations will draw on high-impact recent literature (< 2 y old) related to that Special topic. For example, a student who is responsible for the presentation on Group 13 may present on recent work from Braunschweig's group on N₂ activation by Boron compounds or from Ingo Krossing's group on the design and synthesis of super Lewis acids or weakly coordinating anions. Students are expected to get approval from the instructor and then provide to their classmates their special topic papers at least two weeks prior to the presentation date. Students will be graded on the clarity of the presentation, command/understanding of material, and on moderating discussion/answering questions from peers. Specific dates for each Special Topic will be provided as the course approaches the end of the first module (*Something old, something new: refresher, reminder, reacquaintance*).

<u>Exams</u>

Exams cover all course content (reading, in-class discussion, lecture material). It is the student's responsibility to ask questions if they do not understand lecture or reading materials. Exams will be in-class and held regular class meeting time. Make-up exams will only be provided in the event of an approved absence (*e.g.*, conference attendance) or under extraordinary circumstances (e.g., medical emergencies). See the university guidelines on absence for more information. The mid-term exam will be held on **October 10th in-class** and the Final exam on **Dec 4th in-class**.

Attendance and Absence Policy

Attendance will not be recorded and is not explicitly included in student assessment. However, student attendance is required insofar as earning credit for Course Participation necessitates being present.

Academic Honesty

Students are required to be honest in their coursework. Any act of academic dishonesty will be reported to the Dean of Students and may result in failure of the assignment in question and/or the course. For University of Florida's honor code, see http://www.dso.ufl.edu/sccr/honorcodes/honorcode.php.

Accommodations for Students with Disabilities

Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation. Contact the Disability Resources Center (http://www.dso.ufl.edu/drc/) for information about available resources for students with disabilities.

Other Resources: U Matter, We Care

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Course Outline (subject to change)

I Something old, something new: refresher, reminder, reacquaintance Basic objective: Know electronic structure fundamentals of s and p block elements.

Concepts covered (hopefully): atomic structure, nuclear charge, ionization energy, electron affinity, radii, electronegativity, relativistic effects, oxidation state, valence and inert pair effect, bond energy, σ bonding (dative/covalent), cluster bonding and Wade's rules, 1 electron bonds, double and triple bonds, charge shift bonds, hypervalent bonding, σ -hole interactions, (group 11)-philic interactions, isolobal analogy, natural bond order, atoms in molecules (AIM and QTAIM)

Rough literature reading guide: The periodic table and the physics that drives it http://doi.org/10.1038/s41570-020-0195-y Understanding the Uniqueness of 2p Elements in Periodic Tables http://doi.org/10.1002/chem.202003920 Relativistic effects on the chemical bonding properties of the heavier elements ... http://doi.org/10.1016/j.ccr.2022.215000 Covalent versus Dative Bonds to Main Group Metals, a Useful Distinction http://doi.org/10.1002/anie.198909921 Dative Bonds in Main-Group Compounds: A Case for Fewer Arrows! http://doi.org/10.1002/anie.201300461 Polyhedral skeletal electron pair approach http://doi.org/10.1021/ar00105a003 Are one electron bonds any different from standard two electron covalent bonds? http://doi.org/10.1021/acs.accounts.7b00260 Natural Bond Orbital Analysis of Chemical Structure, Spectroscopy, and Reactivity: How it Works http://doi.org/10.1016/B978-0-12-821978-2.00077-5 The QTAIM Perspective of Chemical Bonding (8.1-8.4) http://doi.org/10.1002/9783527664696.ch8 Charge-Shift Bonding: A New and Unique Form of Bonding https://doi.org/10.1002/anie.201910085 Not Only Hydrogen Bonds: Other Noncovalent Interactions http://doi.org/10.3390/cryst10030180 σ -Hole Bond vs π -Hole Bond: A Comparison Based on Halogen Bond http://doi.org/10.1021/acs.chemrev.5b00527 The Bright Future of Unconventional σ/π -Hole Interactions http://doi.org/10.1002/cphc.201500314 The aurophilicity phenomenon: A decade of experimental findings... http://doi.org/10.1007/BF03215477 Building Bridges Between Inorganic and Organic Chemistry (Nobel Lecture) http://doi.org/10.1002/anie.198207113 π -Bonding and the Lone Pair Effect in Multiple Bonds between Heavier Main Group Elements http://doi.org/10.1021/cr9408989 Chemical Bonding and Bonding Models of Main-Group Compounds http://doi.org/10.1021/acs.chemrev.8b00722 An Update on Multiple Bonding between Heavier Main Group Elements http://doi.org/10.1021/acs.organomet.0c00200

Special topics

- III Group 13
- IV Group 14
- V Group 15
- VI Group 16
- VIII Main group elements in the coordination spheres of transition metals (LJM)