

[BIO]ORGANIC CHEMISTRY — CHEMISTRY 235 — FALL 2024

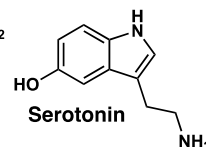
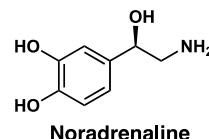
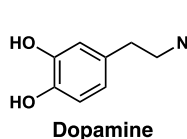
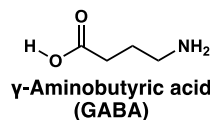
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Some Neurotransmitters of Learning



OPEN OFFICE HOURS

Please stop by 323 Caputo Hall, anytime *on...*

1. Wednesdays (9:00 am to 10:00 am).
2. Thursdays (9:00 am to 12:00 noon).
3. Fridays (9:00 am to 10:00 am).

Please arrive with questions of curiosity or clarification (germane to homework, lecture, or laboratory); no appointment needed—just stop by.

REQUIRED CLASS MEETINGS

Please plan to attend and *actively participate* in all class meetings:

1. Lecture (CRN 4338): MWF 11:00 – 11:50 am, 149 Roddy Hall.
2. And Laboratory 01A (CRN 4339): Tuesday 1:10 – 4:00 pm, 331 Caputo Hall, or Laboratory 01B (CRN 4340): Tuesday 5:00 – 7:50 pm, 331 Caputo Hall.

If you are unable to attend a class meeting, then *please email me*.

HOW IS CHEM 235 DIFFERENT FROM CHEM 231 & 232?

Chemistry 235 is a surface level exploration, language development, and fundamental skill development course focused on helping learners gain a basic level understanding of organic chemistry concepts relevant to general biology applications and health related applied science occupations. Whereas Chemistry 231 & 232 are a more traditional organic chemistry sequence designed for longer-term learning and retention, deeper problem-solving skills development, and transferable ability acquisition in preparation for chemistry, biochemistry, and biology related research, biotechnology, molecular biology, genetics, and applied science fields related to medicine and pharmacology.

Chemistry 235 is *not* Chemistry 231 & 232 crammed into one semester. Chemistry 235 is a unique course with close similarities to Chemistry 231 & 231 during the first half of the semester as rudimentary fundamentals are learned (Chapters 1 – 6 and 17). During the second half of the semester Chemistry 235 drastically deviates from Chemistry 231 & 232 in three major ways: **in CHEM 235, 1)** Chapters 19 – 21 & 24 – 26 (Biochemistry introduction topics) are covered at a surface level; and **2)** only selected portions of each chapter are discussed in preparation for CHEM 326; **3)** laboratory experiments are focused more on purification and analysis techniques with *no* NMR.

EXPECTATIONS, PARTICIPATION, & CLASSROOM NORMS

The value of actively taking part in class activities is hard to exaggerate. Research has consistently shown, students who actively participate learn more, and retain learning for longer than students who do not.¹ You won't learn well by passively listening to someone lecture at

you. Therefore, this class will ask a lot of you. Through timely completion of all required readings and practice problems, you are expected to prepare for all class meetings. And you are expected to come to class ready to focus, take good notes, and engage with me and your fellow students on the topics of the day. You will practice skills through in-class exercises, often in groups. And you will play a vital role in your peer's education—you'll help them learn more, and they will, in turn, help you.

A small portion of your participation will be evaluated based on your demonstrated ability to contribute to class activities, discussions, and informal group work in ways that raise the level of dialogue. Talking all the time is not necessarily the same thing as great participation; indeed, talking too frequently can even lead to imbalance and discomfort for others. Actively listening to classmates, responding with relevance to others' comments, reflecting on, building on, and generating questions related to your classmates' ideas lead to authentic and meaningful participation.

I am serious about helping to create a classroom environment in which anyone feels free to ask questions, raise concerns, and so on. This classroom is your classroom. Please don't keep yourself from asking a question because you fear it will sound silly or unsophisticated or obvious. And becoming fluid in the art of asking questions (of clarification or curiosity) is one of the best ways to increase your learning and critical thinking.²

Although I am committed to classroom activities and dialogue in which students exert a great measure of control, I recognize that I have bureaucratic institutional authority as the instructor. I choose to use that authority to forbid any behavior that would make anyone else in the class feel uncomfortable or the subject of ridicule. You are expected to behave courteously and respectfully to your classmates and to me. All students need to feel that this is their classroom; I am committed to protecting those conditions. People first, learning second, bureaucracy last.

LANGUAGE, CRITICAL THINKING, & LECTURE COURSE DESCRIPTION

"The limits of my language mean the limits of my world." – Ludwig Wittgenstein.³ This course is designed to strengthen your use of a sophisticated graphic, textual, and verbal *scientific language*; and [Bio]Organic Chemistry—an active field of study, research, and scholarship—provides molecular level foundational knowledge and skills for better communication, deeper comprehension, better questioning, and better problem-solving in biochemistry, green chemistry, environmental chemistry, molecular biology, genetics, pharmaceuticals, medicine, biotechnology, toxicology, and numerous related fields. Organic and organometallic chemicals are everywhere and make up over 90% of the more than 273 million (and counting) known chemical substances.⁴

In this course, we will all work together—to increase your ability to ask elucidating questions & to think critically, albeit at an introductory surface level. We will accomplish this through deliberate practice, making lots of mistakes, questioning and adjusting your thinking (based on self-reflection), utilizing appropriate learning strategies, improving metacognition, generating more questions, and timely feedback (from student to instructor and from instructor to student).

LECTURE COURSE LEARNING GOALS

As your learning progresses, you should be able to confidently demonstrate your ability to...

1. Recognize, name, and draw bioorganic compounds and bioorganic functional groups.
2. Estimate, explain, and draw the attractive forces within and between molecules; and describe simple relationships between molecular structure, reactivity, and physical properties.
3. Apply acid and base chemistry concepts — ARIO (atom, resonance, induction, orbital) conjugate base stability method and the acid pKa value method — to analyze, draw, and explain a wide variety of reactions.
4. Analyze, explain, and draw structural conformations, configurations, and isomers.
5. Analyze reactants to propose and draw plausible reaction mechanisms (using curved-arrow notation to represent electron flow); and describe reaction mechanism steps with elementary reaction names.
6. Name, describe, compare, and evaluate carbonyl related organic functional group reactions; and then predict plausible products, reactants, or reagents (based on an understanding of— and application of—acid-base chemistry and functional group reactivity analysis).
7. Apply learning goals 1 – 9 to common classes of biological molecules (e.g., carbohydrates, amino acids, peptides, proteins, lipids, etc.).

FOUR CHARACTER TRAITS OF INCREASED SUCCESS⁵

1. Proactive
2. Prosocial
3. Disciplined
4. Determined

SEVEN EFFECTIVE LEARNING STRATEGIES⁶

1. Spaced Practice (well-timed daily reading with problem-solving)
2. Concrete Examples
3. Recall Practice
4. Interleaving
5. Dual Coding
6. Elaboration
7. Deliberate Questioning (curiosity & clarification)

GRADE DISTRIBUTION (in percentage points)

| | | | | | | | |
|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| A | 100 – 92.0 | B | 87.9 – 82.0 | C | 77.9 – 72.0 | D | 67.9 – 62.0 |
| A- | 91.9 – 90.0 | B- | 81.9 – 80.0 | C- | 71.9 – 70.0 | D- | 61.9 – 60.0 |
| B+ | 89.9 – 88.0 | C+ | 79.9 – 78.0 | D+ | 69.9 – 68.0 | F | < 59.9 |

LECTURE & LABORATORY COURSE EVALUATION SCHEME:

| | |
|---|---------------------|
| Lecture & textbook reading pop-quizzes, participation, & practice (50 points) | 5.0 % |
| Required practice problems for Chapters 1 – 6 (150 points) | 15.0 % |
| Exam 1 (100 points) | 10.0 % |
| Exam 2 (125 points) | 12.5 % |
| Exam 3 (175 points) | 17.5 % |
| Exam 4 & Final (200 points) | 20.0 % |
| Laboratory (200 points) | 20.0 % |
| | $\Sigma = 100.0 \%$ |

LECTURE COURSE & EXAMS SCHEDULE OVERVIEW

Wednesday Midterm Exams 1, 2, & 3 (18-SEPT, 9-OCT, & 13-NOV): exam questions are closely aligned to course learning goals. And exam questions will be closely related to required homework problems, lecture participation and practice problems, laboratory practice problems, and lecture discussion examples.

| Textbook | Chapter Topic (see reading schedule for more detail) | Exam Schedule |
|-------------------|--|--------------------------|
| Chapter 1 | Relevant General Chemistry (26-AUG – 30-AUG) | |
| Chapter 2 | Functional Groups & Resonance (4-SEPT – 9-SEPT) | |
| Chapter 3 | Acid-Base Reactions (9-SEPT – 16-SEPT) | EXAM 1 (18-SEPT) |
| Chapter 4 | Alkane Naming & Conformations (23-SEPT – 27-SEPT) | |
| Chapter 5 | Stereoisomer Concepts (30-SEPT – 2-OCT) | |
| Chapter 6 | Reaction Mechanism Basics (4-OCT – 7-OCT) | EXAM 2 (9-OCT) |
| Chapter 17 | Aromaticity & Acid-Base Reactions (16-OCT – 18-OCT) | |
| Chapter 19 | Aldehydes, Ketones, & Derivatives (21-OCT – 25-OCT) | |
| Chapter 20 | Carboxylic Acid Derivatives (28-OCT – 1-NOV) | |
| Chapter 21 | Enols & Enolates (4-NOV – 8-NOV) | EXAM 3 (13-NOV) |
| Chapter 24 | Carbohydrates (18-NOV – 20-NOV) | |
| Chapter 25 | Amino Acids (22-NOV – 25-NOV) | EXAM 4 (9-DEC) |
| Chapter 26 | Lipids (2-DEC – 6-DEC) | FE (12-DEC; 8 am) |

Chapters 1 – 6 help you gain the foundational fundamentals necessary for success in CHEM 231, 232, 235, Biochemistry and many related biology and applied science courses. Chapters 17 – 21 help you explore some of the most common functional group transformation reactions seen in nature and many work-related areas of applied science (technology, toxicology, medicine, etc.). And Chapters 24, 25, & 26 are an introduction to some Biochemistry.

REQUIRED LECTURE MATERIALS

1. Daily access our D2L course site and your Millersville email account, lab notebook, safety goggles or glasses.
2. Klein's Organic Chemistry 4th Edition (1) textbook & (2) study guide & solutions. See Millersville's textbook site for details: <http://millersville.textbookx.com/classes/4338-202460>

REQUIRED READING, Due date → chapter sections; **required & due by 9:50 am M, W, or F.**

- 28-AUG** → 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, & 1.8.
- 30-AUG** → 1.9, 1.10, 1.11, 1.12, 1.13, & 1.14.
- 4-SEPT** → 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, & 2.8.
- 6-SEPT** → 2.9, 2.10, 2.11, 2.12, & 2.13.
- 9-SEPT** → 3.1, 3.2, 3.3, & 3.4.
- 11-SEPT** → 3.3 re-read, 3.4 re-read, 3.5, & 3.6.
- 13-SEPT** → 3.7, 3.8, 3.9, & 3.10.
- 16-SEPT** → 3.10 re-read.
- 23-SEPT** → 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, & 4.8.
- 25-SEPT** → 4.8 re-read, 4.9, 4.10, 4.11, 4.12, & 4.13.
- 30-SEPT** → 5.1, 5.2, 5.3, 5.4, 5.5, & 5.6.
- 2-OCT** → 5.5 re-read, 5.7, 5.9, 5.10, & 5.11.
- 4-OCT** → 6.6, 6.7, 6.8, 6.9, & 6.10.
- 7-OCT** → 6.9 re-read, 6.10, 6.11, & 6.12.
- 16-OCT** → 17.1, 17.2, 17.3, 17.4, & 17.5.
- 21-OCT** → 19.1, 19.2, 19.3 & 19.4.
- 23-OCT** → 19.4 re-read, 19.5, & 19.6.
- 25-OCT** → 19.6 re-read, 19.7, 19.8, & 19.9.
- 27-OCT & beyond** → **for CHAPTERS 20, 21, 24, 25, & 26** → Reading optional, yet *strongly recommended (at the very least, please try to read the chapter introductions and first few sections to get a general idea of the basics for each chapter as our discussions begin).*

REQUIRED FOUNDATIONAL PRACTICE PROBLEMS — 25 POINTS POSSIBLE PER CHAPTER
(Due dates for uploaded work into D2L)

- Must draw out all structures and write keywords to earn full credit.
 - Please use study guide and solutions manual to check your work before turning it in.
 - Late required work accepted—up to one-week late, for 70% of total points possible.
- CHAPTER 1 (11:59 pm on Tuesday, 3-SEPT)**
1.1d, 1.3de, 1.4, 1.5, 1.6, 1.7, 1.8bc, 1.9, & 1.10, 1.12, 1.13, 1.14, 1.19, 1.21, 1.22, 1.24, 1.25, 1.26, 1.27, 1.28bcfg, 1.29, 1.30, 1.31, 1.32 – 1.38all, 1.45, 1.46 – 1.50all, 1.53, 1.54, 1.55, 1.56, 1.62, 1.63 – 1.72all, 1.73, 1.82, & 1.83.
 - CHAPTER 2 (11:59 pm on Monday, 9-SEPT)**
2.1 – 2.2, 2.4 – 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 2.18, 2.19, 2.20, 2.25, 2.26, 2.28, 2.31, 2.32, & 2.33, 2.37, 2.40, 2.45, 2.46 – 2.48, 2.53, 2.54, 2.55, 2.57, 2.58, 2.59, 2.60, 2.61, 2.63, 2.64 – 2.72, 2.74, 2.87, & 2.89.
 - CHAPTER 3 (11:59 pm on Monday, 16-SEPT)**
3.1 – 3.84; and I suggest working them all.
 - CHAPTERS 4 & 5 (11:59 pm on Thursday, 3-OCT)**
4.1, 4.4 – 4.10, 4.12, 4.13, 4.16, 4.19cd, 4.20 – 4.23, 4.24, 4.25bc, 4.26, 4.28cd, 4.29, & 4.30c.
And 5.1, 5.4, 5.7, 5.9, 5.10, 5.11, 5.15, 5.19, 5.24, 5.27, 5.28ad, 5.29, & 5.30.
 - CHAPTER 6 (11:59 pm on Tuesday, 8-OCT)**
6.8 – 6.10, 6.11, 6.13, 6.15, 6.17, & 6.18, 6.42 – 6.49, 6.54, 6.60, 6.62, & 6.64.

LABORATORY — CHEMISTRY 235 — [BIO]ORGANIC CHEMISTRY — FALL 2024

All weekly handouts will be provided in lab.

AT THE COMPLETION OF CHEM 235 LABORATORY, YOU SHOULD BE ABLE TO...

1. Demonstrate proper laboratory safety & waste disposal when working in the lab.
2. Keep a neat and organized record of laboratory data in a notebook.
3. Set up apparatus for experimental techniques: reactions, distillations, filtrations, etc.
4. Purify organic products by recrystallization (solids) and distillation (liquids).
5. Characterize organic products by physical, chemical, and IR spectroscopic properties.

LABORATORY SCHEDULE

| Week | Activity |
|------|---|
| 1 | Safety, check-In, pre-test, & core concepts |
| 2 | Resonance practice & acid-base ARIO introduction (or Labor Day) |
| 3 | Functional group review & IR Spectroscopy with ARIO problems |
| 4 | Recrystallization, melting point, & IR with PXFR & ARIO problems |
| 5 | Conformational analysis, chirality, & stereochemistry |
| 6 | Solvent extraction (acid-base reactions & extractions) |
| 7 | Thin layer chromatography (TLC) |
| 8 | Fall Break |
| 9 | Gold Cat. Alkyne Hydration Reaction & Thin-Layer-Chromatography (TLC) |
| 10 | Steam Distillation |
| 11 | Beta-Elimination (E1 Dehydration) and Fractional Distillation |
| 12 | Acid cat. cyclic acetal formation from benzaldehyde and pentaerythritol |
| 13 | Imine formation from an aldehyde (multi-step synthesis – step 1 only) |
| 14 | Aspirin Synthesis |
| 15 | Post-test, clean-up, & check-out |
| 16 | Optional reaction review (or Finals) |

CHEMISTRY 235 LABORATORY ATTENDANCE STATEMENT

Make-up labs are not possible—due primarily to scheduling and space limitations. If you are planning to miss a lab due to an official Millersville University event, or due to a foreseeable life event absence, or if you miss a lab due to an emergency, please email and also stop by during office hours, as soon as possible, to begin discussing options; failure to begin discussing options within a timely manner will lead to this course policy: missing one lab equals a zero for the lab activity, missing a second lab equals a zero for the second lab activity, *missing three or more labs equals failure of the entire course (lecture and lab)*.

OUR EPPICC VALUES

Exploration, Professionalism, Public Mission, Inclusion, Integrity, and Compassion.⁷

ADDITIONAL COURSE POLICIES

University approved class attendance policy: Students are expected to attend all classes [and lab meetings]. It is the student's responsibility to complete all course requirements even if a class is missed. If a student misses a class for an officially excused reason, then they are entitled to make up the missed work but only at the convenience of the faculty member. Responsibility for materials presented in, assignments made for, and tests/quizzes given in regularly scheduled classes lies solely with the student.

1. The University policy is that faculty will excuse absences for the following reasons: personal illness, bereavement or critical illness in the family, participation in a university-sponsored activity, jury duty, military duties, or religious holidays.
2. Faculty judge the validity of student absences from class within the University's approved guidelines and may require documentation for excused absences. Faculty will evaluate any reason, other than those listed above, for a student missing class and determine whether the absence is justified. In these circumstances, a student may make up missed work at the discretion of the instructor.
3. In the case of foreseeable absences, students are encouraged to notify the faculty member in advance. A student who will miss class due to participation in an official University activity must notify the instructor well in advance of the activity to assure that the absence is excused.

Inclusion Policy: This course is a judgement free learning environment. Our class includes students from a wide variety of social identities and life circumstances. Everyone will always treat one another with respect and consideration or be asked to leave the classroom.

Americans with Disabilities Act: Millersville University is committed to equality of opportunity and freedom from discrimination for all students, employees, applicants for admission or employment, and all participants in public University-sponsored activities. In keeping with this commitment, and in accordance with the Americans with Disabilities Act (ADA) the University will make every effort to provide equality of opportunity and freedom from discrimination for all members of the University community and visitors to the University, regardless of any disability an individual may have. Accordingly, the University has taken positive steps to make University facilities accessible to individuals with disabilities and has established procedures to provide reasonable accommodations to allow individuals with disabilities to participate in programs. The University administration and management are obligated to report any allegation of discrimination to the appropriate office as defined in this policy. If you have a condition that may impact your ability to perform laboratory exercises, to exit lab safely from the premises in an emergency, or which may cause an emergency during class, or lab, please discuss this in confidence with your instructor, as soon as possible; appropriate accommodations may then be provided.

Additional Resources & Counseling Reminder: Additional resources include Health Services (717-871-5250), Center for Health Education and Promotion (717-871-4141), Campus Ministries, and Learning Services (717-871-5554). Students sometimes face mental health or drug/alcohol challenges in their academic careers that interfere with their academic performance and goals. Millersville University is a caring community and resources are available to assist students who are dealing with problems. The Counseling Center (717-871-7821) is an important resource for both mental health and substance abuse issues.

Title IX Statement: Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment, comply with Title IX of the Education Amendments of 1972, 20 U.S.C. §1681, et seq., and act in accordance with guidance from the Office for Civil Rights, the University requires faculty members to report to the University's Title IX Coordinator incidents of sexual violence shared by students. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report to the person designated in the University Protection of Minors policy incidents of sexual violence or any abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is available at www.millersville.edu/titleix.

¹ David Gooblar, *The Missing Course: Everything They Never Taught You About College Teaching* (Cambridge: Harvard University Press, 2019).

² Paul Hanstedt, *Creating Wicked Students: Designing Courses for a Complex World* (Sterling, Virginia: Stylus Publishing, 2018).

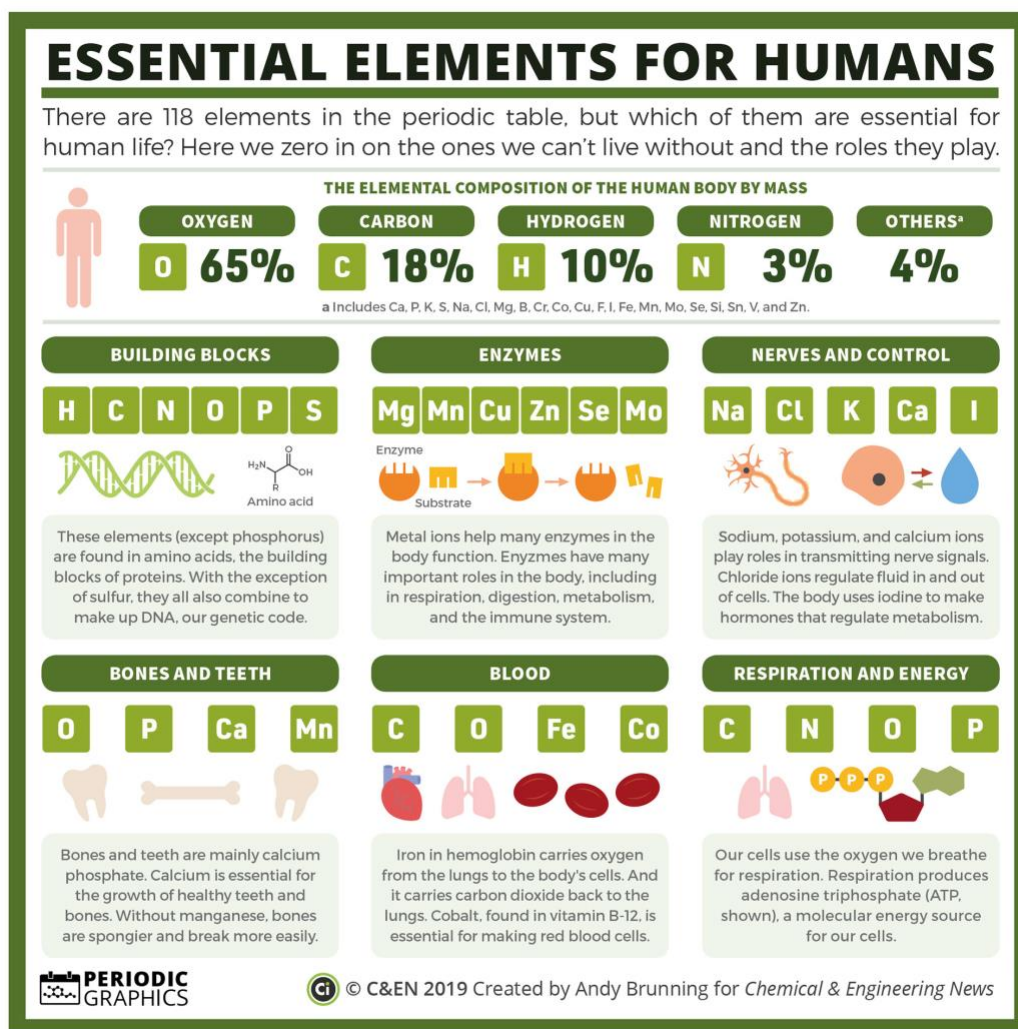
³ Brené Brown, *Atlas of the Heart: Mapping Meaningful Connection and the Language of Human Experience* (New York: Random House, 2021).

⁴ Chemical Abstract Services (CAS) website, accessed June 14th, 2024, <https://www.cas.org/about/cas-content>.

⁵ Adam Grant, *Hidden Potential — The Science of Achieving Greater Things* (New York: Viking, 2023).

⁶ Yana Weinstein & Megan Sumeracki, *Understanding How We Learn* (Routledge, New York, 2019).

⁷ Millersville University website, accessed June 14th, 2024, <https://www.millersville.edu/about/eppiic-values/>.



Chemical and Engineering News website, accessed June 14th, 2024, <https://cen.acs.org/physical-chemistry/periodic-table/IYPT-Periodic-Graphics-Essential-elements-humans/97/i13>.