**Chemistry I**
**Pacing Guide**

## Unit 1: Essentials of Chemistry

This unit contains a vast array of introductory topics essential to passing the class, such as the 6 branches of chemistry, macro & microscale, lab safety and equipment, significant figures and accuracy, scientific notation, and various mathematical principles. Students will conduct multiple labs while collecting data in a lab notebook.

- Experimental design
- Lab equipment and safety
- Significant figures (finding and calculating with addition and multiplication)
- Micro & Macroscale
- Density calculations (how to re-arrange formulas) → percent error
- Dimensional analysis
- Branches of chemistry
- Early history of chemistry (Beginning →1500)

I acknowledge that some of this is not in the standards. However, if students cannot do this (specifically significant figures when collecting and analyzing data in my lab), they will fail the first test and all after. Colleges do not cover this material because they expect them to know it.

**Standards Covered in Part: CHEM1.PS1.11, Math Fundamentals**

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First week (T, R, and F): Introduction, syllabus, Google Classroom, branches of chemistry.

Week 1: Microscopic vs. macroscopic world, lab safety, lab equipment, lab on safety and equipment, early history of chemistry, and significant figures.

Week 2: Finish significant figures and calculations, introduce scientific notation, density mathematical calculations, and various POGIL activities.

Week 3: Finish scientific notation, metric system, and dimensional analysis.

Week 4: Finish dimensional analysis and chapter wrap-up. Practice Exam and Exam 1.

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**Unit 2: All about atoms**

This chapter covers the beginnings of chemistry up to developments around 1900. Integrated to the core concepts (such as parts of the atom, atomic and molar mass, isotopes, basic stoichiometry, molecules, compounds, nuclear energy, etc.) are the experiments and research that led to their discovery. This enriches the content and makes it a story line. We will also explore how the events leading up to the Enlightenment period created a scientific method, which was the catalyst for these new discoveries.

- Famous scientists and discoveries/methods and research used to discover
- Enlightenment period
- Scientific method
- Isotopes
- Parts of the atom
- Molecules
- Compounds
- Chemical equations+ (setting up, law of conservation, getting familiar with elements)
- Nuclear energy and radiation
- Basic stoichiometry (grams and moles)
- Average atomic mass and molar mass
- Periodic table, arrangement, properties

**Standards Covered in Part: CHEM1.PS1.1, CHEM1.PS1.2, CHEM1.PS1.3, CHEM1.PS1.11, CHEM1. PS1. 12, CHEM1.PS3.4**

**Standards Covered: CHEM1.PS1.9, CHEM1.PS1.10**

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Week 4: Enlightenment period

Week 5: Scientific method, atomic theory, nuclear energy.

Week 6: Finish radiation and nuclear energy, isotopes, discoveries of parts of the atom, cathode ray tube demonstration, molar and atomic mass, basic stoichiometry

Week 7: Elements and compounds, mixtures, chemical equations, basic stoichiometry (applying concepts from Ch. 1), periodic table

Week 8: Periodic table, practice exam, exam 2.

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## Unit 3: Electronic Structure of Atoms

This chapter introduces students to quantum mechanics. First, we will cover waves, what light is, how light and electrons both behave as waves and particles, and the scientists behind these theories. Students will apply dimensional analysis concepts from previous units to compare wavelength, frequency, and energy. Next, we will cover orbitals and electron configurations. Students will draw on their knowledge of the Periodic Table to apply this new information. The goal is for students to see how particles on the microscale interact to explain what we see and how things work on the macroscale. The laws of physics are not sufficient to explain how the world works.

- Waves
- Light/Particle Duality
- Wavelength, frequency, and energy conversions
- Quantum Mechanics W/ Scientists
- Electromagnetic Spectrum
- Bohr Model
- Orbitals
- Electron Configurations

**Standards Covered in Part: CHEM1.PS1.11, CHEM1.PS1.12**
**Standards Covered: CHEM1.PS4.1**

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Week 8: Waves, electromagnetic spectrum, light-particle duality

Week 9: Calculations, Bohr model, orbitals

Week 10: Electron configurations

Week 11: Famous scientist project, periodic trends

Week 12: Finish periodic trends, practice exam, exam 3.

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## Unit 4: Chemical Bonding

This unit shows how every topic covered so far leads to chemical bonding and chemical reactions. More specifically, students will apply knowledge of the electronic structure of atoms and periodic trends to visible substances and reactions. We will cover ionic, covalent, and metallic bonding and how to name each of these types of compounds. Students will also learn how bonding affects the shape of molecules, how to draw them, and how they attract. Finally, students will apply these concepts in writing proper chemical equations (with chemical equations, proper subscripts, coefficients, etc.)

- Ionic, covalent, and metallic bonding
- Naming ionic and covalent compounds and writing formulas
- Writing and balancing chemical equations
- Lewis Structures
- Molecular Geometries
- Formal charges
- Electronegativity

**Standards Covered: CHEM1.PS1. 2, CHEM1.PS1.4, CHEM1.PS1.12, CHEM1.PS1.13, CHEM1.PS1.14, CHEM1.PS2.1, CHEM1.PS2.2, CHEM1.PS2.3**

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Week 12: Metallic bonds, ionic bonds, properties

Week 13: Ionic Lewis dot structures, chemical formulas, covalent bonds, properties

Week 14: Covalent naming, chemical formulas, Lewis structures

Week 15: Lewis structures, formal charges, polarity

Week 16: Polarity, molecular geometries, bond angles, writing chemical equations

Week 17: Types of chemical equations, writing chemical equations

Week 18: Writing and balancing equations, equilibrium, practice exam, exam 4.

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**Christmas Break**
**Standards Covered in Chemistry "A"**

*In Part*

CHEM1.PS1
1, 2, 3

*In Full*

CHEM1.PS1
2, 4, 9, 10, 11, 12, 13, 14

CHEM1.PS2
1, 2, 3

CHEM1.PS3.4

CHEM1.PS4.1

Some labs will have procedures that cover standards on *solutions* but will not formally be covered until Chemistry B.

*Standards Covered in Part Explanation: The new TN Chemistry standards are written in a way that cannot be completely covered in an individual unit. For example, in order for CHEM1.PS1.12 to be covered in one unit I would have to start with the basics of the Periodic Table and go all the way through Lewis structures. Any traditional chemistry book has these topics divided into at least 3-5 different chapters.*

*Chemistry B completes the rest of the TN Chemistry I standards. Those are written in a way that 3-4 standards are covered per unit. For example, there are 4 standards on solutions/solubility, which will be covered in roughly a week plus a lab.*

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## Unit 5: Stoichiometry

Students will learn about the relationship between grams, moles, and atoms via dimensional analysis. The concept of the limiting and excess reagent will be introduced to coincide with the previous unit's idea of reactants turning in to products. The end goal is for the student to properly apply the rules of stoichiometry in order to predict which reactant will run out first and how much product can be made as a result (percent yield). Students will conduct a stoichiometry lab to prepare for this unit exam.

- Grams, moles, and atoms (dimensional analysis)
- Limiting and excess reagents
- Percent yield

**Standards Covered: CHEM1.PS1.1, CHEM1.PS1.2, CHEM1.PS1.3**

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Week 19: Review unit 4 (writing equations and balancing), basic stoichiometry problems,

Week 20: Basic grams, moles, and atoms dimensional analysis problems, limiting and excess reagent problems w/ percent yield

Week 21: Limiting and excess reagent problems w/ percent yield, stoichiometry lab, review

Week 22: Practice exam, exam 5.

## Unit 6: Properties of Solutions and Acid-Base Chemistry

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Students will apply ideas from the previous 2 units (chemical reactions and stoichiometry) by determining the concentration, energy changes, and solubilities of solutions. It is important to know how strong (concentrated) your chemicals have to be to have the desired reaction, and you must know how much chemical you need (stoichiometry) to make them. Students will also learn how adding solute changes the boiling and freezing temperatures of solutions. Students will conduct a lab at the end of the unit. Students will also learn the other way molecules attract (intermolecular forces). The acid/base unit covers the basics of what acids and bases are using molecular models. Students will learn acids donate protons ($H^+$) while bases accept them. Students will learn the reasoning behind the pH scale and calculate basic PH problems. Students will utilize a virtual lab for this unit.

- Solutes and solvents
- Solubility
- Concentrations
- Entropy
- Dilutions
- Colligative properties
- Intermolecular forces
- Acids & Bases
- Conjugates
- pH scale and calculations

**Standards Covered: CHEM1. PS1.7, CHEM1.PS1. 15, CHEM1.PS2. 3, CHEM1.PS2.4, CHEM1.PS1.8**

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Week 22: Intermolecular forces, viscosity, surface tension.

Week 23: Entropy, solubility, molarity, molality, and dilutions

Week 24: Colligative properties and lab

Week 25: Acids & bases, conjugates, pH Scale

Week 26: Acid-Base lab, pH of weak acids, buffer chemistry

Week 27: Buffers, practice exam, exam 6

**Unit 7: Thermodynamics and Gas Laws**

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This unit will cover energy changes in light of solutions, chemical reactions, and in our world. Students will obtain a microscale understanding of heat, phases, the law of conservation of energy, calorimetry, endo and exothermic reactions, and heating curves. Three labs will be conducted for this unit, one will be comprehensive for everything covered thus far. Students will apply these concepts while discovering the relationship between pressure, volume, number of moles, and temperature on ideal gases in confined spaces.

- Heat flow
- Phase diagrams
- Law of conservation of energy
- Laws of Thermodynamics
- Calorimetry, heating curves, and phase diagrams
- Endo and exothermic reactions
- Boyles' Law
- Charles' Law
- Avogadro's Law
- Ideal Gas Law
- STP

**Standards covered: CHEM1.PS3.1, 2, 3, 4, CHEM1.PS1.5, CHEM1.PS1.6**

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Week 28: Heat and work, types of energy, laws of Thermodynamics

Week 29: Endo and exothermic RXNs, Calorimetry (with lab)

Week 30: Phase diagrams, heating curves, Boyle's & Charles' law

Week 31: Avogadro's Law, STP, gas law applications, practice exam, exam 7

***Week 32: Wrap-up, Final comprehensive exam.***

**CHEM B Standards Covered (in order)**

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CHEM1.PS1.14
CHEM1.PS1.2, CHEM1.PS1.4
CHEM1.PS1.1, CHEM1.PS1.2, CHEM1.PS1.3, CHEM1.PS1
CHEM1. PS1.7, CHEM1.PS1. 15, CHEM1.PS2. 3, CHEM1.PS2.4
CHEM1.PS1.8
CHEM1.PS3.1, 2, 3, 4
CHEM1.PS1.5, CHEM1.PS1.6

***All chemistry 1 standards have been met.***