

# Chemistry, Semester A

## Course Overview

Chemistry is the study of how a set of substances with particular physical properties—like solid paper and the oxygen in the air—can react with each other to form different substances with entirely different properties—like gaseous water and carbon dioxide. In most cases, these chemical changes result in an energy change as well, either giving off energy or absorbing energy.

Chemistry is considered one of the core scientific disciplines because it is so practical and widely useful in the modern world. The development of new types of materials, new methods of producing or storing energy, or new methods of interacting with genetic material all depend upon knowledge of chemistry.

In Chemistry A, you will learn some of the “basics” of chemistry: the atomic and molecular structures that result in different chemical properties and the concepts and tools that will enable you to predict chemical properties and chemical reactions.

## Course Goals

By the end of this course, you will be able to do the following:

- Understand the difference between a chemical change and a physical change and understand the basics of atomic theory, which underlies the study of chemistry.
- Be able to use the periodic table to understand atomic structure and predict the chemical behavior of substances.
- Understand the different types of chemical bonding and how they may result in different molecular structures and different chemical properties.
- Understand how quantitative chemical results in the “real world” are based on reactions that occur on the atomic and molecular scale.
- Carry out activities used in real-world chemistry, including predicting the products of a chemical reaction and predicting the amounts of products you would expect from an initial quantity of chemical substances.
- Investigate the relationships between energy and matter, including phase changes and the effects of changing the volume, pressure, or temperature of a gas.

## **Math and Science Skills**

Successful completion of Algebra 1 provides the mathematical skills you'll need for Chemistry A.

In addition, you should have a good working understanding of inquiry science methods, including:

- Experimental design, including the importance of experimental controls.
- Basic data analysis skills, including the ability to interpret mathematical patterns from data tables and graphs.
- The ability to use experimental results and/or real data sets to propose general rules.

## **General Skills**

To participate in this course, you should be able to do the following:

- Complete basic operations with word processing software, such as Microsoft Word or Google Docs.
- Perform online research using various search engines and library databases.
- Communicate through email and participate in discussion boards.

*For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Plato Student Orientation document, found at the beginning of this course.*

## **Credit Value**

Chemistry A is a 0.5-credit course.

## **Course Materials**

- Computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Test and Study References found at the end of this syllabus. They include a periodic table for testing purposes and a periodic table for student study.
- Notebook

# Course Pacing Guide

This course description and pacing guide is intended to help you keep on schedule with your work. Note that your course instructor may modify the schedule to meet the specific needs of your class.

## Unit 1: Matter and Atomic Structure

### Summary

In this unit, you will be introduced to the concept of chemical change as opposed to physical change and you will review atomic theory, which underlies the study of chemistry.

Day	Activity/Objective	Type
1 day: 1	<b>Syllabus and Plato Student Orientation</b> <i>Review the Plato Student Orientation and Course Syllabus at the beginning of this course.</i>	Course Orientation
2 days: 2–3	<b>Types of Matter</b> <i>Learner will identify different types of matter.</i>	Lesson
2 days: 4–5	<b>Physical Changes Versus Chemical Changes</b> <i>Learner will identify physical and chemical properties and changes.</i>	Lesson
2 days: 6–7	<b>Models of the Atom</b> <i>Learner will describe the experimental basis for the atom and identify the parts of the atom.</i>	Lesson
2 days: 8–9	<b>Isotopes and Atomic Mass</b> <i>Learner will calculate average atomic mass from isotopic information.</i>	Lesson
2 days: 10–11	<b>Unit Activity and Discussion—Unit 1</b>	Unit Activity Discussion
1 day: 12	<b>Posttest—Unit 1</b>	Assessment

## Unit 2: The Periodic Table

## Summary

In this unit, you will explore the periodic table which helps us understand atomic structure and predict the chemical behavior of substances.

Day	Activity/Objective	Type
2 days: 13–14	<b>The Periodic Table</b> <i>Learner will use the periodic table to identify information about an element and to predict element properties.</i>	Lesson
2 days: 15–16	<b>Electron Configurations</b> <i>Learner will write electron configurations.</i>	Lesson
2 days: 17–18	<b>Periodic Trends</b> <i>Learner will identify and compare periodic trends from the periodic table.</i>	Lesson
2 days: 19–20	<b>Electromagnetic Radiation</b> <i>Learner will describe electromagnetic radiation and perform appropriate calculations.</i>	Lesson
2 days: 21–22	<b>Spectral Lines</b> <i>Learner will identify spectral lines for elements.</i>	Lesson
2 days: 23–24	<b>Unit Activity and Discussion—Unit 2</b>	Unit Activity Discussion
1 day: 25	<b>Posttest—Unit 2</b>	Assessment

## Unit 3: Bonding

### Summary

In this unit, you will learn about chemical bonding and explore how different types of bonds result in different molecular structures and different chemical properties.

Day	Activity/Objective	Type
2 days: 26–27	<b>Ionic, Covalent, and Metallic Bonds</b> <i>Learner will identify ionic, covalent, and metallic substances and describe their bonding.</i>	Lesson
2 days: 28–29	<b>Compound Names</b> <i>Learner will use rules for naming compounds.</i>	Lesson
2 days: 30–31	<b>Lewis Structures</b> <i>Learner will draw Lewis structures.</i>	Lesson

2 days: 32–33	<b>Electronegativity</b> <i>Learner will differentiate between ionic, polar covalent, and nonpolar covalent bonds.</i>	Lesson
2 days: 34–35	<b>Three-Dimensional Molecules</b> <i>Learner will predict the three-dimensional bond shape of a molecule.</i>	Lesson
3 days: 36–37	<b>Molecular Polarity</b> <i>Learner will predict molecular polarity.</i>	Lesson
2 days: 38–39	<b>Intermolecular Forces</b> <i>Learner will identify intermolecular forces.</i>	Lesson
3 days: 40–42	<b>Unit Activity and Discussion—Unit 3</b>	Unit Activity Discussion
1 day: 43	<b>Posttest—Unit 3</b>	Assessment

## Unit 4: The Mole Concept

### Summary

In this unit, you will learn about how quantitative chemical results in the “real world” are based on reactions occurring on the atomic and molecular scale.

Day	Activity/Objective	Type
2 days: 44–45	<b>Moles and Molar Mass</b> <i>Learner will identify a mole and calculate molar mass.</i>	Lesson
2 days: 46–47	<b>Mole Calculations</b> <i>Learner will calculate representative particles, mass, volume, and moles from given data.</i>	Lesson
2 days: 48–49	<b>Percent Composition</b> <i>Learner will calculate percent composition.</i>	Lesson
2 days: 50–51	<b>Empirical and Molecular Formulas</b> <i>Learner will determine empirical and molecular formulas.</i>	Lesson
2 days: 52–53	<b>Unit Activity and Discussion—Unit 4</b>	Unit Activity Discussion
1 day: 54	<b>Posttest—Unit 4</b>	Assessment

## Unit 5: Chemical Reactions

### Summary

In this unit, you will carry out activities used in real-world chemistry, including predicting the products of a chemical reaction and predicting the amounts of products you would expect from an initial quantity of chemical substances.

Day	Activity/Objective	Type
2 days: 55–56	<b>Balancing Chemical Equations</b> <i>Learner will balance chemical equations.</i>	Lesson
2 days: 57–58	<b>Types of Reactions</b> <i>Learner will identify different types of chemical reactions.</i>	Lesson
2 days: 59–60	<b>Predicting Chemical Products</b> <i>Learner will predict products for simple chemical reactions.</i>	Lesson
2 days: 61–62	<b>Mole Ratios and Stoichiometry</b> <i>Learner will determine mole ratios from balanced chemical equations and perform mole to mole stoichiometry problems.</i>	Lesson
2 days: 63–64	<b>Mass and Volume Stoichiometry</b> <i>Learner will calculate stoichiometry problems involving mass and volume.</i>	Lesson
2 days: 65–66	<b>Percent Yield</b> <i>Learner will calculate percent yield for chemical reactions.</i>	Lesson
3 days: 67–69	<b>Unit Activity and Discussion—Unit 5</b>	Unit Activity Discussion
1 day: 70	<b>Posttest—Unit 5</b>	Assessment

## Unit 6: Kinetic Molecular Theory and Gas Law

### Summary

In this unit, you will investigate the relationships between energy and matter, including phase changes and the effects of changing the volume, pressure, or temperature of a gas.

Day	Activity/Objective	Type
2 days: 71–72	<b>Energy and Chemical Reactions</b> <i>Learner will identify different forms of energy and how they relate to chemical reactions.</i>	Lesson
2 days: 73–74	<b>Endothermic and Exothermic Reactions</b> <i>Learner will differentiate between endothermic and exothermic processes.</i>	Lesson
2 days: 75–76	<b>Kinetic Theory</b> <i>Learner will describe the kinetic theory.</i>	Lesson
2 days: 77–78	<b>States of Matter</b> <i>Learner will differentiate between the states of matter.</i>	Lesson
2 days: 79–80	<b>Heating Curves and Phase Changes</b> <i>Learner will understand a heating curve and describe heat changes during phase changes.</i>	Lesson
2 days: 81–82	<b>Gas Law Calculations</b> <i>Calculate problems using gas laws.</i>	Lesson
2 days: 83–84	<b>Ideal Gas Law</b> <i>Learner will identify an ideal gas and use the ideal gas law.</i>	Lesson
2 days: 85–86	<b>Dalton's Law and Graham's Law</b> <i>Learner will use Dalton's law of partial pressures and Graham's law of effusion to describe gases.</i>	Lesson
2 days: 87–88	<b>Unit Activity and Discussion—Unit 6</b>	Unit Activity Discussion
1 day: 89	<b>Posttest—Unit 6</b>	Assessment
1 day: 90	<b>End of Semester Test</b>	Assessment

# Test and Study References

**Periodic Table of the Elements**  
**TESTING AND ASSESSMENT Reference**

1 <b>H</b> 1.008																	2 <b>He</b> 4.00		
3 <b>Li</b> 6.941	4 <b>Be</b> 9.01															9 <b>F</b> 18.998	10 <b>Ne</b> 20.18		
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.30															17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95		
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.956	22 <b>Ti</b> 47.867	23 <b>V</b> 50.942	24 <b>Cr</b> 51.996	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.64	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.8		
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> 98	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.6	53 <b>I</b> 126.91	54 <b>Xe</b> 131.293		
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	71 <b>Lu</b> 174.97	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.94	74 <b>W</b> 183.84	75 <b>Re</b> 186.207	76 <b>Os</b> 190.23	77 <b>Ir</b> 192.217	78 <b>Pt</b> 195.078	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.38	82 <b>Pb</b> 207.2	83 <b>Bi</b> 208.98	84 <b>Po</b> 209	85 <b>At</b> 210	86 <b>Rn</b> 222		
87 <b>Fr</b> 223	88 <b>Ra</b> 226	103 <b>Lr</b> 262	104 <b>Rf</b> 261	105 <b>Db</b> 262	106 <b>Sg</b> 266	107 <b>Bh</b> 264	108 <b>Hs</b> 277	109 <b>Mt</b> 268	110 <b>Ds</b> 271	111 <b>Rg</b> 272									
																		69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04
																		101 <b>Md</b> 258	102 <b>No</b> 259
																		67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26
																		99 <b>Es</b> 252	100 <b>Fm</b> 257
																		66 <b>Dy</b> 162.5	65 <b>Tb</b> 158.93
																		98 <b>Cf</b> 251	97 <b>Bk</b> 247
																		64 <b>Gd</b> 157.25	63 <b>Eu</b> 151.964
																		96 <b>Cm</b> 247	95 <b>Am</b> 243
																		62 <b>Sm</b> 150.36	61 <b>Pm</b> 145
																		94 <b>Pu</b> 244	93 <b>Np</b> 237
																		60 <b>Nd</b> 144.24	59 <b>Pr</b> 140.91
																		92 <b>U</b> 238.03	91 <b>Pa</b> 231.04
																		58 <b>Ce</b> 140.12	57 <b>La</b> 138.91
																		90 <b>Th</b> 232.04	89 <b>Ac</b> 227.03



# Periodic Table of the Elements

## Student Study Reference

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# Chemistry, Semester B

## Course Overview

Chemistry is the study of how a set of substances with particular physical properties—like solid paper and the oxygen in the air—can react with each other to form different substances with entirely different properties—like gaseous water and carbon dioxide. In most cases, these chemical changes result in an energy change as well, either giving off energy or absorbing energy.

Chemistry is considered one of the core scientific disciplines because it is so practical and widely useful in the modern world. The development of new types of materials, new methods of producing or storing energy, or new methods of interacting with genetic material all depend upon knowledge of chemistry.

In Chemistry B, you will learn about key types of chemical relationships and reactions, including solutions, reversible reactions, acid-base reactions, thermochemical systems, and electrochemical systems. You will use your knowledge to analyze new situations and make qualitative and quantitative predictions. Finally, you will extend your chemical knowledge into the areas of nuclear chemistry, organic chemistry, and biochemistry.

## Course Goals

By the end of this course, you will be able to do the following:

- Describe the dissolving process and be able to apply your understanding of the mechanisms, variables, and calculations associated with chemical solutions.
- Describe the variables that affect reaction rates and apply your understanding quantitatively for reactions in one direction as well as reversible reactions and systems in chemical equilibrium.
- Describe acids and bases by their properties and from a theoretical perspective and be able to make quantitative calculations and predictions about acids, bases, and the reactions between them.
- Analyze and use key thermochemical values (heat, entropy, enthalpy, and free energy) to make predictions about chemical interactions.
- Apply your knowledge of oxidation and reduction to analyze and make predictions about potential chemical interactions.
- Apply your knowledge of nuclear reactions and nuclear forces to solve real-world problems. You will also learn to recognize, name, and understand the properties of basic organic and biochemical structures and molecules.

## Math and Science Skills

Successful completion of Algebra 1 provides the mathematical skills you'll need for Chemistry B.

Successful completion of Chemistry A (or its equivalent) is required for Chemistry B. This includes an understanding of the atomic and molecular structures of matter and the concepts and tools that enable you to predict chemical properties and chemical reactions.

You should also have a good working understanding of inquiry science methods, including:

- Experimental design, including the importance of experimental controls.
- Basic data analysis skills, including the ability to interpret mathematical patterns from data tables and graphs.
- The ability to use experimental results and/or real data sets to propose general rules.

## General Skills

To participate in this course, you should be able to do the following:

- Complete basic operations with word processing software, such as Microsoft Word or Google Docs.
- Perform online research using various search engines and library databases.
- Communicate through email and participate in discussion boards.

*For a complete list of general skills that are required for participation in online courses, refer to the Prerequisites section of the Plato Student Orientation document, found at the beginning of this course.*

## Credit Value

Chemistry B is a 0.5-credit course.

## Course Materials

- Computer with Internet connection and speakers or headphones
- Microsoft Word or equivalent
- Test and Study References found at the end of this syllabus. They include a periodic table for testing purposes and a periodic table for student study.
- Notebook

# Course Pacing Guide

This course description and pacing guide is intended to help you keep on schedule with your work. Note that your course instructor may modify the schedule to meet the specific needs of your class.

## Unit 1: Solutions

### Summary

In this unit, you will be able to describe the dissolving process and be able to apply your understanding of the mechanisms, variables, and calculations associated with chemical solutions.

Day	Activity/Objective	Type
1 day: 1	<b>Syllabus and Plato Student Orientation</b> <i>Review the Plato Student Orientation and Course Syllabus at the beginning of this course.</i>	Course Orientation
2 days: 2–3	<b>The Dissolving Process</b> <i>Learner will Describe the dissolving process.</i>	Lesson
2 days: 4–5	<b>Rate of Dissolution</b> <i>Learner will identify factors that affect rate of dissolution.</i>	Lesson
2 days: 6–7	<b>Degrees of Saturation</b> <i>Learner will identify different types of solutions based on degrees of saturation.</i>	Lesson
2 days: 8–9	<b>Molarity of a Solution</b> <i>Learner will calculate concentrations for solutions in terms of molarity.</i>	Lesson
2 days: 10–11	<b>Dilution and Stoichiometry Calculations</b> <i>Learner will use concentrations to perform dilutions and solution stoichiometry.</i>	Lesson
2 days: 12–13	<b>Colligative Properties of a Solution</b> <i>Learner will identify and describe colligative properties of solutions.</i>	Lesson
2 days: 14–15	<b>Unit Activity and Discussion—Unit 1</b>	Unit Activity Discussion
1 day:	<b>Posttest—Unit 1</b>	Assessment

## Unit 2: Reaction Rates

### Summary

In this unit, you will be able to describe the variables that affect reaction rates and apply your understanding quantitatively for reactions in one direction as well as reversible reactions and systems in chemical equilibrium.

Day	Activity/Objective	Type
2 days: 17–18	<b>Reaction Rates</b> <i>Learner will describe reaction rates and identify factors that affect them.</i>	Lesson
2 days: 19–20	<b>Activation Energy</b> <i>Learner will understand activation energy and describe how catalysts affect it.</i>	Lesson
2 days: 21–22	<b>Chemical Equilibrium</b> <i>Learner will describe chemical equilibrium.</i>	Lesson
2 days: 23–24	<b>Equilibrium Constants</b> <i>Learner will write and evaluate equilibrium constant expressions.</i>	Lesson
2 days: 25–26	<b>Le Chatelier's Principle</b> <i>Learner will identify Le Chatelier's principle and explain how stressors affect chemical equilibrium.</i>	Lesson
2 days: 27–28	<b>Rate Law for a Reaction</b> <i>Learner will write a rate law for a reaction based on experimental data.</i>	Lesson
2 days: 29–30	<b>Unit Activity and Discussion—Unit 2</b>	Unit Activity Discussion
1 day: 31	<b>Posttest—Unit 2</b>	Assessment

## Unit 3: Acids and Bases

### Summary

In this unit, you will be able to describe acids and bases by their properties and from a theoretical perspective. You will also be able to make quantitative calculations and predictions about acids, bases, and reactions between them.

Day	Activity/Objective	Type
2 days: 32–33	<b>Properties of Acids and Bases</b> <i>Learner will identify properties of acids and bases.</i>	Lesson
2 days: 34–35	<b>Types of Acids and Bases</b> <i>Learner will differentiate among the three types of acids and bases.</i>	Lesson
2 days: 36–37	<b>The pH Scale</b> <i>Learner will describe the auto ionization of water and calculate <math>pH</math>.</i>	Lesson
2 days: 38–39	<b>Strong and Weak Acids and Bases</b> <i>Learner will identify strong and weak acids and bases.</i>	Lesson
2 days: 40–41	<b>Neutralization Reactions</b> <i>Learner will identify and describe neutralization reactions.</i>	Lesson
2 days: 42–43	<b>Titration Calculations</b> <i>Learner will use titrations to calculate concentrations.</i>	
2 days: 44–45	<b>Unit Activity and Discussion—Unit 3</b>	Unit Activity Discussion
1 day: 46	<b>Posttest—Unit 3</b>	Assessment

## Unit 4: Energy

### Summary

In this unit, you will learn about key thermochemical values (heat, entropy, enthalpy, and free energy) and use these values to make predictions about chemical interactions.

Day	Activity/Objective	Type
2 days: 47–48	<b>Entropy</b> <i>Learner will describe the concept of entropy.</i>	Lesson

2 days: 49–50	<b>Thermochemical Calculations</b> <i>Learner will use calorimetry and thermochemical equations to solve problems involving heat.</i>	Lesson
2 days: 51–52	<b>Energy Diagrams for Reactions</b> <i>Learner will draw an energy profile for a reaction.</i>	Lesson
2 days: 53–54	<b>Hess's Law</b> <i>Learner will calculate enthalpy changes using Hess's law.</i>	Lesson
2 days: 55–56	<b>The Gibbs Free Energy Equation</b> <i>Learner will describe the Gibbs free energy equation.</i>	Lesson
2 days: 57–58	<b>Unit Activity and Discussion—Unit 4</b>	Unit Activity Discussion
1 day: 59	<b>Posttest—Unit 4</b>	Assessment

## Unit 5: Reduction Reactions Oxidation-

### Summary

In this unit, you will use your knowledge of oxidation and reduction to analyze and make predictions about potential chemical interactions.

Day	Activity/Objective	Type
2 days: 60–61	<b>Oxidation and Reduction</b> <i>Learner will describe the process of oxidation and reduction.</i>	Lesson
2 days: 62–63	<b>Redox Reactions</b> <i>Learner will identify and describe oxidation-reduction reactions.</i>	Lesson
2 days: 64–65	<b>Standard Reduction Potentials</b> <i>Learner will describe and calculate standard reduction potentials.</i>	Lesson
2 days: 66–67	<b>Voltaic and Electrochemical Cells</b> <i>Learner will describe voltaic and electrochemical cells.</i>	Lesson
2 days: 68–69	<b>Standard Cell Potentials</b> <i>Learner will relate standard cell potentials to Gibbs free energy and equilibrium constants</i>	Lesson
3 days: 70–72	<b>Unit Activity and Discussion—Unit 5</b>	Unit Activity Discussion

1 day: 73	<b>Posttest—Unit 5</b>	Assessment
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## Unit 6: Nuclear Chemistry and Biochemistry

### Summary

In this unit, you will apply your knowledge of nuclear reactions and nuclear forces to solve real-world problems. You will also learn to recognize, name, and understand the properties of basic organic and biochemical structures and molecules.

Day	Activity/Objective	Type
2 days: 74–75	<b>Nuclear Forces</b> <i>Learner will describe nuclear forces.</i>	Lesson
2 days: 76–77	<b>Radioactive Decay</b> <i>Learner will identify naturally occurring radioactive isotopes and the ways that they decay.</i>	Lesson
2 days: 78–79	<b>Nuclear Fission and Fusion</b> <i>Learner will describe nuclear fission and fusion.</i>	Lesson
2 days: 80–81	<b>Hydrocarbons</b> <i>Learner will use proper nomenclature to name basic hydrocarbons and organic molecules.</i>	Lesson
2 days: 82–83	<b>Organic Functional Groups</b> <i>Learner will identify organic functional groups.</i>	Lesson
2 days: 84–85	<b>Biochemical Molecules</b> <i>Learner will describe and identify basic organic molecules important to life.</i>	Lesson
3 days: 86–88	<b>Unit Activity and Discussion—Unit 6</b>	Unit Activity Discussion
1 day: 89	<b>Posttest—Unit 6</b>	Assessment
1 day: 90	<b>End of Semester Test</b>	Assessment



# Test and Study References

**Periodic Table of the Elements**  
**TESTING AND ASSESSMENT Reference**

1 <b>H</b> 1.008																	2 <b>He</b> 4.00										
3 <b>Li</b> 6.941	4 <b>Be</b> 9.01															9 <b>F</b> 18.998	10 <b>Ne</b> 20.18										
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.30															17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95										
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.956	22 <b>Ti</b> 47.867	23 <b>V</b> 50.942	24 <b>Cr</b> 51.996	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.64	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.8										
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> 98	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.6	53 <b>I</b> 126.91	54 <b>Xe</b> 131.293										
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	71 <b>Lu</b> 174.97	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.94	74 <b>W</b> 183.84	75 <b>Re</b> 186.207	76 <b>Os</b> 190.23	77 <b>Ir</b> 192.217	78 <b>Pt</b> 195.078	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.38	82 <b>Pb</b> 207.2	83 <b>Bi</b> 208.98	84 <b>Po</b> 209	85 <b>At</b> 210	86 <b>Rn</b> 222										
87 <b>Fr</b> 223	88 <b>Ra</b> 226	103 <b>Lr</b> 262	104 <b>Rf</b> 261	105 <b>Db</b> 262	106 <b>Sg</b> 266	107 <b>Bh</b> 264	108 <b>Hs</b> 277	109 <b>Mt</b> 268	110 <b>Ds</b> 271	111 <b>Rg</b> 272																	
											65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.5	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04											
											96 <b>Cm</b> 247	97 <b>Bk</b> 247	98 <b>Cf</b> 251	99 <b>Es</b> 252	100 <b>Fm</b> 257	101 <b>Md</b> 258	102 <b>No</b> 259										
											57 <b>La</b> 138.91	58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> 145	62 <b>Sm</b> 150.36	63 <b>Eu</b> 151.964	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.5	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04			
											89 <b>Ac</b> 227.03	90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> 237	94 <b>Pu</b> 244	95 <b>Am</b> 243	96 <b>Cm</b> 247	97 <b>Bk</b> 247	98 <b>Cf</b> 251	99 <b>Es</b> 252	100 <b>Fm</b> 257	101 <b>Md</b> 258	102 <b>No</b> 259			

# Periodic Table of the Elements

## Student Study Reference

1A																		2A																		3A																		4A																		5A																		6A																		7A																		8A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452	1453	1454	1455	1456	1457	1458	1459	1460	1461	1462	1463	1464	1465	1466	1467	1468	1469	1470	1471	1472	1473