



## Chemistry – Part 1

Michigan State Science Content Expectations

### Course Description

Chemistry Part 1 will explore many aspects of chemistry. The learner will begin by investigating matter, atomic structure, and the periodic table. The learner will then explore the role of electrons with respect to ionic, metallic, and covalent bonding. The learner will also demonstrate naming and writing formulas for ionic compounds, molecular compounds, acids and bases. Finally the learner will analyze mole-mass relationships and mole-volume relationships.

### Text Book

Wilbraham, Antony C., Dennis D. Staley, Michael S. Matta, Edward L. Waterman. *Prentice Hall Chemistry*, Upper Saddle River: Prentice Hall, 2005

---

### Unit 1 Description

This unit will introduce the learner to chemistry. The learner will distinguish between the properties of matters, mixtures, elements and compounds. The learner will also convert measurements to scientific notation and distinguish among accuracy, precision, and error of a measurement. In addition the learner will develop skills in constructing conversion factors from equivalent measurements and apply the techniques of dimensional analysis to a variety of conversion problems.

### Essential Content and Skills

The learner will:

- Identify five traditional areas of study in chemistry.
- Identify three steps in the scientific method.
- Define physical property and list several common physical properties of substances.
- Categorize a sample of matter as a substance or a mixture.
- Distinguish between homogeneous and heterogeneous samples of matter.
- Explain the difference between an element and a compound.
- Distinguish between a substance and a mixture.
- Describe what happens during a chemical change and identify four possible clues that a chemical change has taken place.
- Convert measurements to scientific notation.
- Distinguish among accuracy, precision, and error of a measurement.
- Identify the number of significant figures in a measurement and in the result of a calculation.
- Convert between the Celsius and Kelvin temperature scales.

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

- Construct conversion factors from equivalent measurements.
  - Apply the techniques of dimensional analysis to a variety of conversion problems.
  - Calculate the density of a material from experimental data
  - Describe how density varies with temperature.
- 

### Unit 1 Michigan State Content Expectations

[Click here to view the Michigan DOE Curriculum Content Standards.](#)

#### Unit 1 Lesson 1: Chemistry Far and Wide

| State Standard | Description  |
|----------------|--|
| C1.1B          | Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.<br>Evaluate the future career and occupational prospects of science fields. |
| C1.2E          |  |

#### Unit 1 Lesson 2: Thinking like a Scientist

| State Standard | Description  |
|----------------|--|
| C1.1A<br>C1.1C | Generate new questions that can be investigated in the laboratory or field.<br>Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision). |
| C1.1D          |  |

#### Unit 1 Lesson 3: Properties of Matter and Mixtures

| State Standard | Description   |
|----------------|---|
| C2.2B          | Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.<br>Distinguish between chemical and physical changes in terms of the properties of the reactants and products. |
| C5.2B          |   |

#### Unit 1 Lesson 4: Elements and Compounds

| State Standard | Description   |
|----------------|---|
| C2.2B          | Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.<br>Distinguish between chemical and physical changes in terms of the properties of the reactants and products. |
| C5.2B          |   |

#### Unit 1 Lesson 5: Chemical Reactions

| State Standard | Description   |
|----------------|---|
| C3.4A          | Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory.<br>Explain why chemical reactions will either release or absorb energy.<br>Distinguish between chemical and physical changes in terms of the properties of the reactants and products. |
| C3.4B          |   |
| C5.2B          |   |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 1 Lesson 6: Measurement and Uncertainty

| State Standard | Description  |
|----------------|--|
| C1.1B          | Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions. |

### Unit 1 Lesson 7: International System of Units (SI)

| State Standard | Description   |
|----------------|---|
| C1.1C          | Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision). |

### Unit 1 Lesson 8: Conversion Problems

| State Standard | Description  |
|----------------|--|
| C1.1D          | Identify patterns in data and relate them to theoretical models. |

### Unit 1 Lesson 9: Density

| State Standard | Description   |
|----------------|---|
| C4.6a          | Calculate the number of moles of any compound or element given the mass of the substance.     |
| C4.6b          | Calculate the number of particles of any compound or element given the mass of the substance. |

### Unit 1 Lesson 10: Density Lab

| State Standard | Description   |
|----------------|---|
| C1.1C          | Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision). |
| C4.6a          | Calculate the number of moles of any compound or element given the mass of the substance.   |
| C4.6b          | Calculate the number of particles of any compound or element given the mass of the substance.   |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 2 Description

- This unit will introduce the learner to the structure of the atom. The learner will describe the subatomic particles and distinguish between atoms of different elements. The learner will also explore the models of the atom and predict the electron arrangement in various atoms. Finally the learner will describe the classification of the elements according to the periodic table and compare trends among the elements for atomic size, ionization energy, ionic size, and electronegativity.

### Essential Content and Skills

The learner will:

- Define the atom, describe the structure of the atom, and distinguish between atoms of different elements.
- Describe the quantum mechanical model, diagram electron arrangement in atoms, and describe the relationship between the wavelength and frequency of light.
- Explain how elements are organized in a periodic table.
- Classify elements based on electron configuration.
- Describe trends among the elements for atomic size, ionization energy, ionic size, and electronegativity.

---

### Unit 2 Michigan State Content Expectations

#### Unit 2 Lesson 1: Defining the Atom

| State Standard | Description  |
|----------------|--|
| C4.8B          | Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus. |

#### Unit 2 Lesson 2: Structure of the Nuclear Atom

| State Standard | Description  |
|----------------|--|
| C1.2i          | Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.                 |
| C4.8A          | Apply science principles or scientific data to anticipate Identify the location, relative mass, and charge for electrons, protons, and neutrons.                     |
| C4.8B          | Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus. |
| C4.8C          | Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.  |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 2 Lesson 3: Distinguishing between Atoms

| State Standard | Description  |
|----------------|--|
| C4.8A          | Apply science principles or scientific data to anticipate Identify the location, relative mass, and charge for electrons, protons, and neutrons.                     |
| C4.8B          | Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus. |
| C4.9A          | Identify elements with similar chemical and physical properties using the periodic table.  |
| C4.10c         | Calculate the average atomic mass of an element given the percent abundance and mass of the individual isotopes.   |

### Unit 2 Lesson 4: Models of the Atom

| State Standard | Description   |
|----------------|---|
| C4.8e          | Write the complete electron configuration of elements in the first four rows of the periodic table. |
| C4.8h          | Describe the shape and orientation of <i>s</i> and <i>p</i> orbitals.                               |
| C4.8i          | Describe the fact that the electron location cannot be exactly determined at any given time.        |

### Unit 2 Lesson 5: Electron Arrangement in Atoms

| State Standard | Description   |
|----------------|---|
| C4.8e          | Write the complete electron configuration of elements in the first four rows of the periodic table. |
| C4.8h          | Describe the shape and orientation of <i>s</i> and <i>p</i> orbitals.                               |
| C4.8i          | Describe the fact that the electron location cannot be exactly determined at any given time.        |

### Unit 2 Lesson 6: Physics and Quantum Mechanical Model

| State Standard | Description  |
|----------------|--|
| C2.4b          | Contrast the mechanism of energy changes and the appearance of absorption and emission spectra.          |
| C2.4c          | Explain why an atom can absorb only certain wavelengths of light.  |
| C2.4d          | Compare various wavelengths of light (visible and nonvisible) in terms of frequency and relative energy. |

### Unit 2 Lesson 7: Organizing the Elements

| State Standard | Description   |
|----------------|---|
| C4.9A          | Identify elements with similar chemical and physical properties using the periodic table. |
| C4.9b          | Identify metals, non-metals, and metalloids using the periodic table.                     |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 2 Lesson 8: Classifying the Elements

| State Standard | Description   |
|----------------|---|
| C4.9A          | Identify elements with similar chemical and physical properties using the periodic table. |
| C4.9b          | Identify metals, non-metals, and metalloids using the periodic table.                     |

### Unit 2 Lesson 9: Periodic Trends

| State Standard | Description  |
|----------------|--|
| C4.9c          | Predict general trends in atomic radius, first ionization energy, and electronegativity of the elements using the periodic table |

### Unit 2 Lesson 10: Lab

| State Standard | Description   |
|----------------|---|
| C1.1C          | Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision). |
| C 1.1D         | Identify patterns in data and relate them to theoretical models.  |
| C1.1E          | Describe a reason for a given conclusion using evidence from an investigation.  |
| C2.4a          | Describe energy changes in flame tests of common elements in terms of the (characteristic) electron transitions.  |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 3 Description

This unit will explore ions, ionic bonds, and ionic compounds. This unit will also describe molecular compounds, covalent bonds, and polar bonds. The learner will be able to predict the shapes of molecules using VSEPR theory.

### Essential Content and Skills

The learner will:

- Determine the number of valence electrons in an atom of a representative element.
- Classify the elements whose atoms tend to gain electrons and those that tend to lose electrons.
- Describe how cations and anions form.
- Explain the electrical charge of an ionic compound.
- Describe three properties of ionic compounds.
- Model the valence electrons of metal atoms.
- Describe the arrangement of atoms in a metal and explain the importance of alloys.
- Distinguish between molecular compounds and ionic compounds.
- Demonstrate how electron dot diagrams are used
- Apply a rule to determine when two atoms are likely to be joined by a double or triple bond.
- Distinguish between a covalent bond and a coordinate covalent bond and describe how the strength of a covalent bond is related to its bond dissociation energy
- Describe the relationship between atomic and molecular orbitals and how VSPER theory helps predict the shapes of molecules.
- Describe how electronegativity values determine the distribution of charge in a polar molecule.
- Evaluate the strength of intermolecular attractions compared with the strength of ionic and covalent bonds.
- Identify the reason why network solids have high melting points or decompose before melting.

---

### Unit 3 Michigan State Content Expectations

#### Unit 3 Lesson 1: Ions

| State Standard | Description   |
|----------------|---|
| C4.10A         | List the number of protons, neutrons, and electrons for any given ion or isotope. |

#### Unit 3 Lesson 2: Ionic Bonds and Ionic Compounds

| State Standard | Description   |
|----------------|---|
| C5.5A          | Predict if the bonding between two atoms of different elements will be primarily ionic or covalent. |

#### Unit 3 Lesson 3: Bonding in Metals

| State Standard | Description   |
|----------------|---|
| C5.5A          | Predict if the bonding between two atoms of different elements will be primarily ionic or covalent. |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 3 Lesson 4: Molecular Compounds

| State Standard | Description   |
|----------------|---|
| C5.5A          | Predict if the bonding between two atoms of different elements will be primarily ionic or covalent. |

### Unit 3 Lesson 5: Nature of Covalent Bonding

| State Standard | Description   |
|----------------|---|
| C2.1b          | Describe energy changes associated with chemical reactions in terms of bonds broken and formed (including intermolecular forces).<br>Explain how the rate of a given chemical reaction is dependent on the temperature and the activation energy.<br>Describe the energy changes in photosynthesis and in the combustion of sugar in terms of bond breaking and bond making.<br>Describe the relative strength of single, double, and triple covalent bonds between nitrogen atoms.<br>Explain why it is necessary for a molecule to absorb energy in order to break a chemical bond.<br>Explain why chemical reactions will either release or absorb energy. |
| C2.3a          |   |
| C3.2a          |   |
| C3.2b          |   |
| C3.3c          |   |
| C3.4B          |   |

### Unit 3 Lesson 6: Bonding Theories

| State Standard | Description   |
|----------------|---|
| C2.1b          | Describe energy changes associated with chemical reactions in terms of bonds broken and formed (including intermolecular forces).<br>Describe the shape and orientation of <i>s</i> and <i>p</i> orbitals.<br>Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.<br>Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure. |
| C4.8h          |   |
| C5.5A          |   |
| C5.5c          |   |

### Unit 3 Lesson 7: Polar Bonds and Molecules

| State Standard | Description  |
|----------------|--|
| C2.1b          | Describe energy changes associated with chemical reactions in terms of bonds broken and formed (including intermolecular forces).<br>Given the structural formula of a compound, indicate all the intermolecular forces present (dispersion, dipolar, hydrogen bonding).<br>Identify if a molecule is polar or nonpolar given a structural formula for the compound.<br>Compare the melting point of covalent compounds based on the strength of IMFs (intermolecular forces). |
| C4.3g          |  |
| C4.4b          |  |
| C5.4e          |  |

### Unit 3 Lesson 8: Interpreting Graphics

| State Standard | Description   |
|----------------|---|
| C4.4a          | Explain why at room temperature different compounds can exist in different phases.<br>Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.<br>Predict the formula for binary compounds of main group elements. |
| C5.4A          |   |
| C5.4B          |   |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 3 Lesson 9: Paper Chromatography

| State Standard | Description   |
|----------------|---|
| C4.4B          | Identify if a molecule is polar or nonpolar given a structural formula for the compound |

### Unit 3 Lesson 10: Rutherford Gold Foil Experiment

| State Standard | Description   |
|----------------|---|
| C1.1C          | Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>Identify patterns in data and relate them to theoretical models.<br>Describe a reason for a given conclusion using evidence from an investigation. |
| C1.1D          |   |
| C1.1E          |   |

### Unit 4 Description

This unit will allow the learner to demonstrate naming and writing formulas for ionic compounds, molecular compounds, acids, and bases. The learner will also analyze mole-mass relationships and mole-volume relationships.

### Essential Content and Skills

The learner will:

- Determine the charges on monatomic ions by using the periodic table, and write the names of the ions.
  - Define a polyatomic ion and write the names and formulas of the most common polyatomic ions and identify the two common endings for the names of most polyatomic ions.
  - Apply the rules for naming and writing formulas for binary ionic compounds and compounds with polyatomic ions.
  - Interpret the prefixes in the names of molecular compounds in terms of their chemical formulas.
  - Apply the rules for naming and writing formulas for binary molecular compounds
  - Apply three rules for naming acids and writing formulas of acids.
  - Apply the rules for naming bases.
  - Define the laws of definite proportions and multiple proportions.
  - Apply the rules for writing chemical formulas by using a flow chart.
  - Apply the rules for naming chemical compounds by using a flowchart.
  - Define Avogadro's number as it relates to a mole of a substance.
  - Distinguish between the atomic mass of an element and its molar mass.
  - Describe how the mass of a mole of a compound is calculated.
  - Describe how to convert the mass of a substance to the number of moles of a substance, and moles to mass.
  - Describe how to calculate the percent by mass of an element in a compound.
  - Interpret an empirical formula and distinguish between empirical and molecular formulas.
-

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 4 Michigan State Content Expectations

#### Unit 4 Lesson 1: Naming Ions

| State Standard | Description  |
|----------------|--|
| C4.2A          | Name simple binary compounds using their formulae. |

#### Unit 4 Lesson 2: Naming and Writing Formulas for Ionic compounds

| State Standard | Description   |
|----------------|---|
| C4.2c          | Given a formula, name the compound.                                 |
| C4.2d          | Given the name, write the formula of ionic and molecular compounds. |

#### Unit 4 Lesson 3: Naming and Writing Formulas for Molecular Compounds

| State Standard | Description   |
|----------------|---|
| C4.2A          | Name simple binary compounds using their formulae.                  |
| C4.2B          | Given the name, write the formula of simple binary compounds.       |
| C4.2c          | Given a formula, name the compound.                                 |
| C4.2d          | Given the name, write the formula of ionic and molecular compounds. |

#### Unit 4 Lesson 4: Naming and Writing Formulas for Acids and Bases

| State Standard | Description   |
|----------------|---|
| C5.7A          | Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II. |

#### Unit 4 Lesson 5: The Laws Governing Formulas and Names

| State Standard | Description   |
|----------------|---|
| C4.2B          | Given the name, write the formula of simple binary compounds.       |
| C4.2d          | Given the name, write the formula of ionic and molecular compounds. |

#### Unit 4 Lesson 6: Lab 2: Names and Formulas of Ionic Compounds

| State Standard | Description   |
|----------------|---|
| C4.2A          | Name simple binary compounds using their formulae.                  |
| C4.2B          | Given the name, write the formula of simple binary compounds.       |
| C4.2c          | Given a formula, name the compound.                                 |
| C4.2d          | Given the name, write the formula of ionic and molecular compounds. |

#### Unit 4 Lesson 7: The Mole: A Measurement of Matter

| State Standard | Description   |
|----------------|---|
| C4.6a          | Calculate the number of moles of any compound or element given the mass of the substance.     |
| C4.6b          | Calculate the number of particles of any compound or element given the mass of the substance. |

## Course Name - Part

Michigan State Curriculum Content Standards (continued)

---

### Unit 4 Lesson 8: Mole-Mass and Mole-Volume Relationships

| State Standard | Description  |
|----------------|--|
| C4.6a          | Calculate the number of moles of any compound or element given the mass of the substance.<br>Calculate the number of particles of any compound or element given the mass of the substance. |
| C4.6b          |  |

### Unit 4 Lesson 9: Percent Composition and Chemical Formulas

| State Standard | Description   |
|----------------|---|
| C4.1a          | Calculate the percent by weight of each element in a compound based on the compound formula.<br>Calculate the empirical formula of a compound based on the percent by weight of each element in the compound.<br>Use the empirical formula and molecular weight of a compound to determine the molecular formula.<br>Calculate the average atomic mass of an element given the percent abundance and mass of the individual isotopes.<br>Predict which isotope will have the greatest abundance given the possible isotopes for an element and the average atomic mass in the periodic table. |
| C4.1b          |   |
| C4.1c          |   |
| C4.10c         |   |
| C4.10d         |   |

### Unit 4 Lesson 10: Interpreting Graphics

| State Standard | Description  |
|----------------|--|
| C1.1C          | Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.<br>Identify patterns in data and relate them to theoretical models.<br>Calculate the percent by weight of each element in a compound based on the compound formula.<br>Use the empirical formula and molecular weight of a compound to determine the molecular formula.<br>Give the number of electrons and protons present if the fluoride ion has a -1 charge.<br>Predict oxidation states and bonding capacity for main group elements using their electron structure. |
| C1.1D          |  |
| C4.1a          |  |
| C4.1c          |  |
| C4.8D          |  |
| C4.8g          |  |