

**CHEMISTRY | Curriculum Map and Pacing Guide**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>COURSE DESCRIPTION:</b><br/>                 This course is organized around a central theme: Properties of matter are a consequence of its structure. A working chemistry vocabulary is developed early through quantitative lab work. Students evaluate the function of chemistry in society and in their lives. They learn basic measurement principles and mathematical techniques used in problem solving and lab work. Study of structure includes the atom and subatomic particles. The periodic system of classification is explored. Students learn about chemical bonds and resulting molecular geometries and study the states of matter, reaction rates, equilibrium, acid/base chemistry, nuclear chemistry, and organic chemistry.</p> | <p><b>Course SCI340</b><br/> <b>1 year, 1 credit</b><br/> <b>Grades 10-12</b><br/> <b>Prerequisite:</b> Physical Science and Geometry, Honors Biology or comparable course; teacher recommendation</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| QUARTER 1                                                                                                               |                                                                                                                       |                                                       |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Topic:</b> Introduction to Chemistry and Matter                                                                      |                                                                                                                       |                                                       |
| <b>Key Terms:</b> fact, law, theory, precision, accuracy, element, compound, mixture, matter, energy, conservation laws |                                                                                                                       |                                                       |
| <b>Measurable Skills:</b> Calculate: Percent error, K to C temperatures, C to K temperatures, density                   |                                                                                                                       |                                                       |
| Ohio Science Standards (2018)                                                                                           | Student Learning Targets                                                                                              | Learning Activities/Investigations                    |
| C.PM.1: Atomic structure                                                                                                | Explain why mass is used as a quantity of matter and differentiate between mass and weight.                           | Eureka Video<br>Weight vs. Mass Activity              |
|                                                                                                                         | Explain density qualitatively and solve density problems by applying an understanding of the concept of density.      | Density Sheet<br>Density of Al lab                    |
|                                                                                                                         | Calculate percent error and analyze experimental errors that affect percent error.                                    | Lab Calculations<br>Error Sheet                       |
|                                                                                                                         | Explain the basis and importance of the absolute temperature scale and convert between the Kelvin and Celsius scales. | Temperature Conversion Sheet<br>Measurement Challenge |
|                                                                                                                         | Compare the characteristics of elements, compounds, and mixtures.                                                     | Vocabulary Journals<br>CO2 Extinguisher Demo          |
|                                                                                                                         | Compare the definition of matter and energy and the laws of conservation of matter and energy.                        | Vocabulary Journals<br>Change in Mass Lab             |
|                                                                                                                         | Describe how matter is classified by state of matter and by composition.                                              | Lecture<br>Fire Writing Demo                          |

## BEXLEY CITY SCHOOLS

### QUARTER 1

**Topic:** Introduction to Chemistry and Matter

**Key Terms:** fact, law, theory, precision, accuracy, element, compound, mixture, matter, energy, conservation laws

**Measurable Skills:** Calculate: Percent error, K to C temperatures, C to K temperatures, density

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                                                             | Learning Activities/Investigations                                                    |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                               | Explain the difference between chemical and physical changes and demonstrate how these changes can be used to separate mixtures and compounds into their components. | Lecture<br>Chemical and Physical Properties Demo                                      |
|                               | Define chemical and physical properties and compare them by providing examples.                                                                                      | Chem. vs. Phys. Prop. Activity                                                        |
|                               | Describe differences between solids, liquids, and gases at the atomic and molecular levels.                                                                          | Video<br>State of Matter Activity                                                     |
|                               | Describe and perform common separation techniques (e.g., filtration, distillation, and chromatography).                                                              | Quantitative Separation Lab<br>Qualitative Separation Lab<br>Paper Chromatography Lab |

### QUARTER 1

**Topic:** Structure of the Atom

**Key Terms:** Wave, Wavelength, Frequency, Wave energy, Wave speed, Orbitals

**Measurable Skills:** Use Periodic table, Calculate Avg. Atomic Mass, Determine Elemental Electron Configurations

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                                                 | Learning Activities/Investigations                                      |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| C.PM.1: Atomic structure      | Compare characteristics of isotopes of the same element.                                                                                                 | Isotopes Sheet<br>Isotopes and Ropes Demo<br>Bermanium Lab              |
|                               | Describe the importance of models for the study of atomic structure.                                                                                     | World of Chemistry Model Video Sheet                                    |
|                               | Describe the crucial contributions of scientists and the critical experiments that led to the development of the modern atomic model.                    | Timeline Activity<br>Cathode Ray Tube demo<br>Rutherford Scattering Lab |
|                               | Use the periodic table to determine the atomic number; atomic mass; mass number; and number of protons, electrons, and neutrons in isotopes of elements. | Isotopes Sheet                                                          |

## BEXLEY CITY SCHOOLS

### QUARTER 1

**Topic:** Structure of the Atom

**Key Terms:** Wave, Wavelength, Frequency, Wave energy, Wave speed, Orbitals

**Measurable Skills:** Use Periodic table, Calculate Avg. Atomic Mass, Determine Elemental Electron Configurations

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                     | Learning Activities/Investigations                                         |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
|                               | Calculate the weighted average atomic mass of an element from isotopic abundance, given the atomic mass of each contributor. | Avg. Atomic Mass Sheet                                                     |
|                               | Describe characteristics of a wave, such as wavelength, frequency, energy, and speed.                                        | Vocabulary Journals<br>Flame Test Demo<br>Gas Tubes and Spectroscopes demo |
|                               | Describe the role of probability in orbital theory.                                                                          | Lecture<br>Quantum Mechanical Lab                                          |
|                               | Describe atomic orbitals (s, p, d, f) and their basic shapes.                                                                | Vocabulary Journals                                                        |
|                               | Apply Hund's rule and the Aufbau process to specify the electron configurations of the elements.                             | Electron Configuration Sheets<br>Paramagnetism Demo                        |

### QUARTER 1

**Topic:** Periodic Table and Ionic Bonding

**Key Terms:** period, group, family, series, ionic compound, ionic bond

**Measurable Skills:** Draw Ionic Lewis Structures, Convert Ionic Compound Names to formulas and vice versa

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                                                                                                                                                                 | Learning Activities/Investigations                 |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| C.PM.2: Periodic Table        | Describe the historical development of the modern periodic table, including work by Mendeleev and then Moseley.                                                                                                                                                          | Video/Lecture                                      |
|                               | Describe and explain the organization of elements into periods and groups in the periodic table.                                                                                                                                                                         | P.T. Trend Activity                                |
|                               | Identify regions (e.g., groups, families, and series) of the periodic table and describe the chemical characteristics of each.                                                                                                                                           | P.T. Trend Activity<br>Reactivity of Metals Demo   |
|                               | Compare the periodic properties of the elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity and electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table. | P.T. Trend Activity<br>Reactivity of Halogens Demo |

## BEXLEY CITY SCHOOLS

### QUARTER 1

| <b>Topic:</b> Periodic Table and Ionic Bonding                                                                 |                                                                                                                                                                                                       |                                                 |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>Key Terms:</b> period, group, family, series, ionic compound, ionic bond                                    |                                                                                                                                                                                                       |                                                 |
| <b>Measurable Skills:</b> Draw Ionic Lewis Structures, Convert Ionic Compound Names to formulas and vice versa |                                                                                                                                                                                                       |                                                 |
| Ohio Science Standards (2018)                                                                                  | Student Learning Targets                                                                                                                                                                              | Learning Activities/Investigations              |
|                                                                                                                | Use the periodic table to predict and explain the valence electron configurations of the elements, to identify members of configuration families, and to predict the common valences of the elements. | P.T. Trend Activity                             |
| C.PM.4: Representing compounds                                                                                 | Use the names, formulas, and charges of commonly referenced polyatomic ions AND common acids.                                                                                                         | Ion/Acid Quizzes<br>Cation Test Lab             |
|                                                                                                                | Provide the interconversion of ionic formulas, and names, translation: write names for formulas and formulas from names).                                                                             | Naming Compounds Sheet                          |
|                                                                                                                | Use Lewis dot diagrams to represent bonding in ionic compounds.                                                                                                                                       | Ionic Lewis structures and Elec. Configs. Sheet |
| C.PM.3: Chemical bonding                                                                                       | Describe the characteristics of ionic bonding.                                                                                                                                                        | Lecture                                         |
|                                                                                                                | Explain ionic stability, recognize typical ionic configurations, and predict ionic configurations for elements (e.g., electron configurations, Lewis dot models).                                     | Ionic Lewis structures and Elec. Configs. Sheet |
|                                                                                                                | Describe the nature of the chemical bond with respect to valence electrons in ionic bonding atoms.                                                                                                    | Lecture<br>Chemical Change Lab                  |

### QUARTER 1

| <b>Topic:</b> Covalent Bonding and Intermolecular Forces                                                                                                                  |                                                                                                                                                     |                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>Key Terms:</b> Covalent compound, Covalent bond, dipole moment, polarity, hydrogen bonding                                                                             |                                                                                                                                                     |                                    |
| <b>Measurable Skills:</b> Draw covalent Lewis Structures, Convert covalent Compound Names to formulas and vice versa, identify molecular geometries from Lewis structures |                                                                                                                                                     |                                    |
| Ohio Science Standards (2018)                                                                                                                                             | Student Learning Targets                                                                                                                            | Learning Activities/Investigations |
| C.PM.3 Chemical Bonding<br>C.PM.6 Intermolecular Forces                                                                                                                   | Provide the interconversion of molecular formulas, structural formulas, and names, (translation: write names for formulas and formulas from names). | Naming Compounds Sheet             |

**QUARTER 1**

**Topic:** Covalent Bonding and Intermolecular Forces

**Key Terms:** Covalent compound, Covalent bond, dipole moment, polarity, hydrogen bonding

**Measurable Skills:** Draw covalent Lewis Structures, Convert covalent Compound Names to formulas and vice versa, identify molecular geometries from Lewis structures

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                            | Learning Activities/Investigations                                                                    |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|                               | Describe the characteristics of covalent bonding.                                                                                   | Vocabulary Journal                                                                                    |
|                               | Describe the nature of the chemical bond with respect to valence electrons in covalent bonding atoms.                               | Lecture                                                                                               |
|                               | Explain how ionic and covalent compounds differ.                                                                                    | World of Chemistry Bonds Video Sheet                                                                  |
|                               | Explain and provide examples for dipole moments, bond polarity, and hydrogen bonding.                                               | Video/Lecture<br>Viscosity of Liquids Demo<br>Evaporation Lab                                         |
|                               | Use Lewis dot diagrams to represent bonding in covalent compounds.                                                                  | Covalent Lewis structures Sheet                                                                       |
|                               | Draw Lewis structures for molecules and polyatomic ions, including those that must be represented by a set of resonance structures. | Covalent Lewis structures Sheet                                                                       |
|                               | Use VSEPR theory to explain geometries of molecules and polyatomic ions.                                                            | Molecular Geometry activity<br>Bubble Molecule Demo                                                   |
|                               | Describe how orbital hybridization models relate to molecular geometry.                                                             | Lecture                                                                                               |
|                               | Describe the molecular orbital models for double bonds, triple bonds, and delocalized pi electrons                                  | Lecture                                                                                               |
|                               | Describe the relationship between molecular polarity and bond polarity.                                                             | Vocabulary Journal<br>Polar vs. Nonpolar Liquids Demo<br>Graphite Dots Demo<br>Water on a String Demo |

**QUARTER 2**

**Topic:** Chemical Reactions

**Key Terms:** solution, solute, solvent

**Measurable Skills:** Write and balance equations, classify chemical reactions, predict products of reactions

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                                                         | Learning Activities/Investigations                                    |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| C.IM.1                        | Explain how conservation laws form the basis for balancing chemical reactions and know what quantities are conserved in physical, chemical, and nuclear changes. | Lecture                                                               |
|                               | Write and balance chemical equations, given the names of reactants and products.                                                                                 | Balancing Sheet                                                       |
|                               | Describe what is represented, on a molecular and molar level, by chemical equations.                                                                             | Lecture<br>Balloon to make H <sub>2</sub> O                           |
|                               | Use the appropriate symbols for state (i.e., solid, liquid, gaseous, aqueous) and reaction direction when writing chemical equations.                            | Balancing Sheet                                                       |
|                               | Classify chemical reactions as being synthesis, decomposition, single replacement, or double replacement reactions.                                              | Balancing Sheet<br>Elephant Toothpaste demo<br>Types of Reactions Lab |
|                               | Predict the products of synthesis, combustion, and decomposition reactions and write balanced equations for these reactions.                                     | Predict Product Sheet<br>Steel Balls SR Demo                          |
|                               | Predict products of single replacement reactions, using the activity series, and write balanced equations for these reactions.                                   | Predict Product Sheet<br>Carbon Soufflé Demo                          |
|                               | Predict the products of double replacement reactions, using solubility charts to identify precipitates, and write balanced equations for these reactions.        | Predict Product Sheet                                                 |
|                               | Write ionic equations, identifying spectator ions and the net ionic equation.                                                                                    | Ionic equation Sheet                                                  |
|                               | Define solution, solute, and solvent.                                                                                                                            | Vocabulary Journals                                                   |

QUARTER 2

**Topic:** Mole and Stoichiometry

**Key Terms:** chemical symbols, empirical formulas, molecular formulas, structural formulas, mole, Avogadro's number, formula mass, empirical mass, molecular mass, gram molecular mass, and gram formula mass

**Measurable Skills:** calculate the percent composition, conversions from mass, moles, to particles, do stoichiometry, finding limiting reagents, and do percent yield

| Ohio Science Standards (2018)                      | Student Learning Targets                                                                                                       | Learning Activities/Investigations                                  |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| C.IM.3: Stoichiometry<br>C.PM.5 Quantifying Matter | Distinguish between chemical symbols, empirical formulas, molecular formulas, and structural formulas.                         | Vocabulary Journal                                                  |
|                                                    | Interpret the information conveyed by chemical formulas for numbers of atoms of each element represented.                      | Counting atoms and Molar mass worksheet                             |
|                                                    | Calculate the percent composition of a substance, given its formula or masses of each component element in a sample.           | Percent composition worksheet<br>Hydrate Lab                        |
|                                                    | Determine the empirical formulas and molecular formulas of compounds, given percent composition data or mass composition data. | Empirical Formula Worksheet<br>MgO Lab<br>Baking Soda Lab           |
|                                                    | Explain the meaning of mole and Avogadro's number.                                                                             | Vocabulary Journal                                                  |
|                                                    | Interconvert between mass, moles, and number of particles.                                                                     | Conversion Worksheet                                                |
|                                                    | Distinguish between formula mass, empirical mass, molecular mass, gram molecular mass, and gram formula mass.                  | Vocabulary Journal                                                  |
|                                                    | Use chemical equations to perform basic mole-mole, mass-mass, and mass-mole computations for chemical reactions.               | Stoichiometry Worksheet                                             |
|                                                    | Identify limiting reagents and use this information when solving reaction stoichiometry problems.                              | Limiting Reagent worksheet<br>S'mores Activity                      |
|                                                    | Compute theoretical yield, actual (experimental) yield, and percent yield.                                                     | Percent Yield worksheet<br>Nail Lab<br>Al and CuCl <sub>2</sub> Lab |

QUARTER 2

**Topic:** States of Matter

**Key Terms:** gas pressure, torr, kilopascals, mm Hg, atmospheres, van der Waals, dispersion, ionic, molecular, metallic, and network

**Measurable Skills:** Classify solids as ionic, molecular, metallic or network

| Ohio Science Standards (2018)                              | Student Learning Targets                                                                                                                                    | Learning Activities/Investigations                                  |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| C.PM.6: Intermolecular Forces                              | Describe the phase and energy changes associated with boiling/condensing, melting/freezing, sublimation, and crystallization (deposition).                  | Video<br>Black blocks melting Demo                                  |
|                                                            | Define gas pressure and the various pressure units (e.g., torr, kilopascals, mm Hg, and atmospheres).                                                       | Vocabulary Journal<br>Pressure mat Demo                             |
|                                                            | Describe the use and operation of mercury barometers and manometers to find atmospheric pressure or relative gas pressures.                                 | Vocabulary Journal<br>Candle under glass demo<br>Jelly Jars demo    |
|                                                            | Explain the basis for gaseous diffusion and effusion.                                                                                                       | Effusion/Diffusion Demo                                             |
|                                                            | Use the kinetic molecular theory to explain the states and properties (i.e., microscopic and macroscopic) of matter and phase changes.                      | World of Chemistry Matter of State video<br>Super-heated steam demo |
|                                                            | Use the kinetic-molecular theory as a basis for explaining gas pressure, Avogadro's hypothesis, and Boyle's/Charles's laws.                                 | Reading with Questions                                              |
|                                                            | Compare the different types of intermolecular forces (e.g., van der Waals, dispersion).                                                                     | Vocabulary Journal<br>Pop Can skating rink demo                     |
|                                                            | Describe the unique physical and chemical properties of water resulting from hydrogen bonding.                                                              | World of chemistry video Water<br>How ice skates work demo          |
|                                                            | Explain the relationship between evaporation, vapor pressure, molecular kinetic energy, and boiling point for a single pure substance.                      | Reading with questions                                              |
|                                                            | Explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in the properties of pure substances. | Worksheet                                                           |
| Classify solids as ionic, molecular, metallic, or network. | Worksheet                                                                                                                                                   |                                                                     |



## BEXLEY CITY SCHOOLS

### QUARTER 3

| <b>Topic:</b> Gases                                                                                                                            |                                                                                                                                                         |                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| <b>Key Terms:</b> Avogadro's hypothesis, ideal gas, real gas, Boyle's law, Charles' law, Gay-Lussac's law, and Dalton's law                    |                                                                                                                                                         |                                                        |
| <b>Measurable Skills:</b> Solve problems using gas stoichiometry, ideal gas law, Boyle's law, Charles' law, Gay-Lussac's law, and Dalton's law |                                                                                                                                                         |                                                        |
| Ohio Science Standards (2018)                                                                                                                  | Student Learning Targets                                                                                                                                | Learning Activities/Investigations                     |
| C.IM.2: Gas Laws                                                                                                                               | Predict boiling point changes based on changes in atmospheric pressure.                                                                                 | Syringe Demo                                           |
|                                                                                                                                                | Describe Avogadro's hypothesis and use it to solve stoichiometric problems.                                                                             | Worksheet                                              |
|                                                                                                                                                | Explain the difference between an ideal and real gas, the assumptions made about an ideal gas, and what conditions favor ideal behavior for a real gas. | Notes<br>Cartesian Diver Demo                          |
|                                                                                                                                                | Apply the mathematical relationships that exist among the volume, temperature, pressure, and number of particles in an ideal gas.                       | Worksheet<br>Calculating R with Water Displacement Lab |
|                                                                                                                                                | Compute gas density when given molar mass, temperature, and pressure.                                                                                   | Worksheet<br>Can Crush Demo                            |
|                                                                                                                                                | Apply the ideal gas law to determine the molar mass of a volatile compound.                                                                             | Worksheet<br>Molar Mass of Air Lab                     |
|                                                                                                                                                | Solve gas stoichiometry problems at standard and nonstandard conditions.                                                                                | Worksheet<br>CO2 Cannon Demo                           |
|                                                                                                                                                | Define the gas laws given by Boyle, Charles, Gay-Lussac, and Dalton and solve problems based on these laws.                                             | Vocabulary Journal<br>Gas Laws Lab                     |

### QUARTER 3

| <b>Topic:</b> Solutions                                                                                                                            |                                                                                                                 |                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| <b>Key Terms:</b> saturated, unsaturated, supersaturated, dilute, concentrated, molality, mole fraction, suspensions, colloids, and true solutions |                                                                                                                 |                                             |
| <b>Measurable Skills:</b> Calculate changes in the boiling point and freezing point                                                                |                                                                                                                 |                                             |
| Ohio Science Standards (2018)                                                                                                                      | Student Learning Targets                                                                                        | Learning Activities/Investigations          |
| C.IM.3: Stoichiometry                                                                                                                              | Define the terms saturated, unsaturated, supersaturated, dilute, and concentrated as they pertain to solutions. | Vocabulary Activity<br>Super Saturated Demo |
|                                                                                                                                                    | Define and calculate the molarity of a solution.                                                                | Worksheet<br>Composition of Acetic Acid Lab |

## BEXLEY CITY SCHOOLS

### QUARTER 3

**Topic:** Solutions

**Key Terms:** saturated, unsaturated, supersaturated, dilute, concentrated, molality, mole fraction, suspensions, colloids, and true solutions

**Measurable Skills:** Calculate changes in the boiling point and freezing point

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                  | Learning Activities/Investigations        |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
|                               | Define and calculate the percent composition of a solution.                                                               | Worksheet                                 |
|                               | Describe the preparation and properties of solutions.                                                                     | Book questions<br>Acid Base Titration Lab |
|                               | Describe the relationship between temperature or pressure and the solubility of gases in liquids.                         | Notes<br>Hand Boiler                      |
|                               | Describe the relationship between solvent character and solute character and explain miscibility.                         | Notes<br>Bubble Speed Demo                |
|                               | Apply the general rules of solubility to aqueous salt solutions.                                                          | Lab activity                              |
|                               | Describe the factors affecting the solubility of a solute in a given solvent and its rate of solution.                    | Notes                                     |
|                               | Describe qualitatively the effect of adding solute on freezing point, boiling point, and vapor pressure of a solvent.     | Notes                                     |
|                               | Define molality and mole fraction.                                                                                        | Vocabulary Activity                       |
|                               | Compare properties of suspensions, colloids, and true solutions.                                                          | Vocabulary Activity                       |
|                               | Calculate changes in the boiling point and freezing point when nonvolatile, nonelectrolyte solutes are added to solvents. | Worksheet Problems                        |

### QUARTER 3

**Topic:** Thermal Energy and Heat

**Key Terms:** law of conservation of energy, heat, heat energy, temperature, enthalpy, endothermic, exothermic, entropy, chemical changes, and physical changes

**Measurable Skills:** Calculate heat capacity, heat of fusion, heat of vaporization, heat of reaction, Hess' Law, and heat of reaction forward and reverse

| Ohio Science Standards (2018) | Student Learning Targets                                         | Learning Activities/Investigations |
|-------------------------------|------------------------------------------------------------------|------------------------------------|
| C.IM.1: Chemical reactions    | Explain the law of conservation of energy in chemical reactions. | Notes<br>Boiling water in cup Demo |

**QUARTER 3**

**Topic:** Thermal Energy and Heat

**Key Terms:** law of conservation of energy, heat, heat energy, temperature, enthalpy, endothermic, exothermic, entropy, chemical changes, and physical changes

**Measurable Skills:** Calculate heat capacity, heat of fusion, heat of vaporization, heat of reaction, Hess' Law, and heat of reaction forward and reverse

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                                  | Learning Activities/Investigations                                         |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
|                               | Describe the concept of heat, and explain the difference between heat energy and temperature.                                             | Vocabulary Activity                                                        |
|                               | Explain physical and chemical changes as endothermic or exothermic energy changes.                                                        | Notes/Book problems<br>Cold Pack Demo<br>Hot Pack demo                     |
|                               | Solve heat capacity and heat transfer problems involving specific heat, heat of fusion, and heat of vaporization.                         | Worksheet<br>Specific heat of unknown solid<br>Enthalpy of fusion of water |
|                               | Calculate the heat of reaction for a given chemical reaction when given calorimetric data.                                                | Worksheet<br>Cheeto Calorimetry                                            |
|                               | Define enthalpy and explain how changes in enthalpy determine whether a reaction is endothermic or exothermic.                            | Vocabulary Activity<br>Fire Syringe demo<br>Drinky Bird demo               |
|                               | Compute $\Delta H_{rxn}$ from $\Delta H_f^\circ$ values and explain why the $\Delta H_f^\circ$ values for elements are zero.              | Worksheet                                                                  |
|                               | Explain and apply, mathematically, the relationship between $\Delta H_{rxn}^\circ$ (forward) and $\Delta H_{rxn}^\circ$ .                 | Worksheet                                                                  |
|                               | Define entropy and explain the role of entropy in chemical and physical changes, and explain the changes that favor increases in entropy. | Vocabulary Activity                                                        |

QUARTER 4

**Topic:** Reaction Rates

**Key Terms:** collision theory, reaction rates, kinetic theory, reaction mechanism, rate-determining step, activated complex, heat of reaction, activation energy, reaction kinetics, catalysts, and potential energy diagrams

**Measurable Skills:** Interpret and label a plot of energy versus reaction coordinate

| Ohio Science Standards (2018) | Student Learning Targets                                                                                                          | Learning Activities/Investigations                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| C.IM.1: Chemical reactions    | Explain the collision theory of reactions                                                                                         | Vocabulary Activity                                                                                |
|                               | Analyze factors (e.g., temperature, nature of reactants) affecting reaction rates in relation to the kinetic theory               | Notes<br>Alka Seltzer Lab                                                                          |
|                               | Relate reaction mechanism, rate-determining step, activated complex, heat of reaction, and activation energy to reaction kinetics | Vocabulary Activity                                                                                |
|                               | Interpret potential energy diagrams for chemical reactions                                                                        | Notes                                                                                              |
|                               | Relate the rate of a chemical reaction to the appearance of products and the disappearance of reactants                           | Book Problems                                                                                      |
|                               | Describe the meaning of reaction mechanism and rate-determining step                                                              | Vocabulary Activity                                                                                |
|                               | Relate collision theory to the factors that affect the rate of reaction.                                                          | Vocabulary Activity<br>Reaction Rates Book lab<br>Inhibition of H <sub>2</sub> O <sub>2</sub> Demo |
|                               | Describe the meaning of activation energy and activated complex.                                                                  | Vocabulary Activity                                                                                |
|                               | Interpret and label a plot of energy versus reaction coordinate.                                                                  | Worksheet                                                                                          |
|                               | Explain the effects of catalysts on reaction rates (e.g., mechanism, activation energy/activated complex).                        | Notes<br>Catalytic Oxidation of acetone demo                                                       |
| C.IM.1: Chemical reactions    | Describe the unique features of bonding in carbon compounds.                                                                      | Notes                                                                                              |
|                               | Describe the conditions that define equilibrium systems on a dynamic molecular level and on a static macroscopic scale.           | Characteristics of Equilibrium Lab<br>N <sub>2</sub> gas oscillator Demo                           |
|                               | Apply Le Châtelier's principle to explain a variety of changes in physical and chemical equilibria.                               | Worksheet<br>Cobalt Chloride Demo<br>Copper Chloride Demo                                          |

**BEXLEY CITY SCHOOLS**

**QUARTER 4**

**Topic:** Reaction Rates

**Key Terms:** collision theory, reaction rates, kinetic theory, reaction mechanism, rate-determining step, activated complex, heat of reaction, activation energy, reaction kinetics, catalysts, and potential energy diagrams

**Measurable Skills:** Interpret and label a plot of energy versus reaction coordinate

| Ohio Science Standards (2018) | Student Learning Targets                                                                                             | Learning Activities/Investigations |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------------------|
|                               | Define $K_{sp}$ and manipulate $K_{sp}$ to predict solubility.                                                       | Worksheet                          |
|                               | Explain the law of concentration (mass) action and write equilibrium law expressions for chemical equilibria.        | Worksheet                          |
|                               | Determine solubility product constants from solubilities (and vice versa) for a given solubility equilibrium system. | Notes and Problems                 |

**QUARTER 4**

**Topic:** Acids and Bases

**Key Terms:** acid, base, hydronium ion, amphoterism, Arrhenius and Brønsted-Lowry acids and bases, conjugate acids and bases,  $K_w$ , pH scale, percent ionization,  $K_a$ ,  $K_b$ , buffer

**Measurable Skills:** Solve stoichiometry calculations based on reactions involving aqueous solutions, identify conjugate acids and bases in reactions, Write and balance a simple equation for a neutralization reaction, calculate hydrogen ion concentration, hydroxide ion concentration, pH, and pOH

| Ohio Science Standards (2018) | Student Learning Targets                                                                                      | Learning Activities/Investigations                      |
|-------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| C.IM.1: Chemical reactions    | Solve stoichiometry calculations based on reactions involving aqueous solutions.                              | Notes and Problems<br>How to blow out a light bulb demo |
|                               | Describe the nature and interactions of acids and bases.                                                      | Notes                                                   |
|                               | Describe the hydronium ion and the concept of amphoterism.                                                    | Vocabulary activity                                     |
|                               | Describe Arrhenius and Brønsted-Lowry acids and bases; identify conjugate acids and bases in reactions.       | Notes and worksheet                                     |
|                               | Define the water constant, $K_w$ , and the pH scale.                                                          | Vocabulary activity                                     |
|                               | Describe characteristics of strong and weak acids and bases, and identify common examples of both.            | Vocabulary Activity<br>Acid Strength demo               |
|                               | Write and balance a simple equation for a neutralization reaction.                                            | Notes and problems                                      |
|                               | Calculate hydrogen ion concentration, hydroxide ion concentration, pH, and pOH for acidic or basic solutions. | Notes and problems<br>Std. of NaOH lab                  |

**QUARTER 4**

**Topic:** Acids and Bases

**Key Terms:** acid, base, hydronium ion, amphoterism, Arrhenius and Brønsted-Lowry acids and bases, conjugate acids and bases, Kw, pH scale, percent ionization, Ka, Kb, buffer

**Measurable Skills:** Solve stoichiometry calculations based on reactions involving aqueous solutions, identify conjugate acids and bases in reactions, Write and balance a simple equation for a neutralization reaction, calculate hydrogen ion concentration, hydroxide ion concentration, pH, and pOH

| Ohio Science Standards (2018) | Student Learning Targets                                                                                      | Learning Activities/Investigations |
|-------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------------|
|                               | Explain how the acid-base indicators work.                                                                    | Notes<br>Rainbow reaction demo     |
|                               | Define percent ionization, Ka, and Kb and explain how they relate to acid/base strength.                      | Vocabulary Activity                |
|                               | Qualitatively understand the behavior of a buffer and explain why buffer solutions maintain pH upon dilution. | Vocabulary Activity<br>Buffer Lab  |

**District Instructional Resource:**

*World of Chemistry* (2013) / Cengage (6-year online subscription: 2019-2020 to 2024-2025)

**Standards Alignment:**

Ohio Learning Standards (2018) – retrieved Jan. 2, 2019

<http://education.ohio.gov/getattachment/Topics/Learning-in-Ohio/Science/Ohios-Learning-Standards-and-MC/SciFinalStandards121018.pdf.aspx?lang=en-US>