

Course of Study

Chemistry

Warren County Career Center

**3525 North State Route 48
Lebanon, Ohio 45036**

Adopted 6-15-06

*This document is for the use of the staff at Warren County Career Center.
Credit is given the designer of the template, Upper Valley JVS, Piqua, Ohio.*

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Chemistry Warren County Career Center

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Statement of Recommendation

The Science Department at Warren County Career Center has reviewed this course of study and recommends it for use as the foundation for instruction in the Chemistry class.

The developers of this course of study have considered local labor market needs and the school's ability to offer specialized programs. The competencies have been reviewed and accepted as being congruent with our school's vision, mission, and strategic goals. When appropriate, additional competencies related to the program area have been incorporated into this course of study.

Achievement of technical competencies, utilizing proper attitudes, and demonstrating appropriate values are critical for successful employment and for furthering educational opportunities within a student's chosen field. We believe that this course of study adequately and correctly focuses upon student development.

This course of study is recommended on: 6-15-06

Warren County Career Center Vision Statement

WCCC is the valued partner of choice within the educational and economic systems of our communities, by providing quality academic and career technical education.

We pave the way for a future of opportunities unique to each of our learners.

Warren County Career Center Mission Statement

To prepare youths and adults to make informed career choices and to successfully enter, compete, and advance in a changing work world.

Warren County Career Values

- Communicating openly and honestly
- Taking ownership of personal actions and being held accountable for results
- Upholding and demonstrating high ethical, educational and fiscal standards
- Exhibiting high levels of professionalism
- Providing high quality instruction and highly qualified staff to ensure success for all learners
- Making quality customer service a high priority
- Promoting partnerships and a team environment
- Celebrating team and individual achievements
- Using data to drive planning, decision making and actions

Course Design

Courses are designed to reflect career-focused education, which combines high-level academics with real-life technical skills. The intent is to maximize a student's present and future academic and career success.

Career-focused education enhances the integration of academic and technical skills, designs programs that prepare students with transferable skills and promotes each student's career opportunities.

Course Philosophy

We believe that the philosophy for our science courses to be:

- Prepare students to use appropriate scientific processes and principles to make personal decisions;
- Enable students to engage in intelligent public discourse about matters of scientific and technological concern;
- Help students develop an understanding of themselves and the world in which they live;
- Foster an understanding of the nature of science, the development of science processes, the principles of science, and the connections between all the sciences;
- Increase their future economic productivity through the use of scientific knowledge, understanding, and skills in their careers.

Course Goals

The course goals for Chemistry are to:

- Set high expectations and provide support for achievement by all students
- Provide balance among conceptual understanding, procedural knowledge and skills, and application and problem-solving
- Provide skills to allow them to be able to apply scientific knowledge and processes to individual and societal issues
- Incorporate the use of technology by all students and the interconnected nature of science and technology
- Understand chemical concepts and how their interactions are involved with technology and career paths

Course Description

This course gives the student a comprehensive study of general chemical concepts and their application in career pathways.

This study of will help students develop the skills necessary for development of critical thinking in the work force and real life situations.

Concepts taught in this course will prepare students for success in college level coursework in the chemical sciences.

Students should have successfully completed Algebra I, and it is highly recommended that the student has successfully completed or concurrently take Algebra II.

Academic and Technical Integration

Expectations of curriculum must be aligned with what is written, taught, assessed, and reported. Student expectations focus on active, project-centered learning—an approach to learning that emphasizes a connection between ideas in a discipline and the outside world. Educational programming and course content will clearly connect career and post-secondary opportunities. At the Warren County Career Center, the main goal is to design courses and projects that use strategies for authentic instruction. These characteristics of instruction focus on deep understanding, established opportunities for concept connections, provide anticipatory and abstract thinking, and emphasize genuine application.

The academic courses at the WCCC follow the state model curricula. They are designed to meet both associate school and state requirements. These standards respond to the need to improve student achievement, quality of curriculum and instruction, and strengthen school and community relationships.

Technology

The Warren County Career Center board and staff believe that technology skills are essential for all students to achieve in the 21st century. It is the goal of this district to infuse technology into all facets of education:

- Instruction
- Assessment
- Administration
- Career planning
- Course design
- Professional development

Strategies to incorporate technology into all facets of education are a priority of the district and there is commitment to a continual process to provide updated hardware, software, and professional development for staff members for the purpose of providing a high quality education, with the integration of technology, for all students.

Students Served

The population served by this program are juniors and seniors at the Warren County Career Center.

Scope and Sequence

Chemistry

Competency 1 The Nature of Chemistry

- 1.1 Explain why a knowledge of chemistry is central to many human endeavors
- 1.2 List and describe the steps of the scientific method
- 1.3 Explain the basic safety rules that must be followed when working in the chemistry laboratory
- 1.4 Identify the metric units of measurement used in chemistry
- 1.5 Explain what causes uncertainty in measurements
- 1.6 Compare accuracy and precision
- 1.7 Explain how to use significant digits and scientific notation
- 1.8 Calculate percent error
- 1.9 Define density and explain how it is calculated
- 1.10 Explain how dimensional analysis and conversion factors are used to solve problems in chemistry

Competency 2 Energy and Matter

- 2.1 Name three basic forms of energy
- 2.2 State the law of conservation of energy
- 2.3 Compare the Fahrenheit, Celsius, and Kelvin temperature scales
- 2.4 Explain what is meant by absolute zero
- 2.5 Name and describe the four states of matter
- 2.6 Compare physical and chemical properties of matter
- 2.7 State the law of conservation of matter
- 2.8 Explain the difference between an element and a compound
- 2.9 Compare heterogeneous and homogenous mixtures
- 2.10 Describe several techniques to separate mixtures

Competency 3 Atomic Structure

- 3.1 Define the term atom
- 3.2 Discuss the historical theories of atomic structure
- 3.3 Name and describe the three subatomic particles in the atom
- 3.4 Determine the number of protons, neutrons and electrons in an atom or ion
- 3.5 Define isotopes and atomic mass
- 3.6 Given the atomic number and mass number, list the number of protons, neutrons, and electrons in an atoms, or given the number of particles, determine the atomic number and mass number
- 3.7 Describe the changes that accompany nuclear reactions
- 3.8 Define radioactivity

Competency 4 Electron Configurations

- 4.1 Explain what is meant by a quantum of energy
- 4.2 Relate the energy of radiation to the frequency
- 4.3 Distinguish between a continuous spectrum and a line spectrum
- 4.4 State the main idea in Bohr's model of the atom
- 4.5 Describe atomic orbitals in terms of their shape, size, and energy

- 4.6 Determine the electron configurations of several elements using the principles of orbital energy, orbital capacity, and electron spin

Competency 5 The Periodic Table

- 5.1 State the periodic law
5.2 Discuss the contributions that Dobereiner, Newlands, Mendeleev and Moseley made to the periodic table
5.3 Explain why elements in a group have similar properties
5.4 Identify the four blocks of the periodic table
5.5 Define the term periodic trend
5.6 Identify four important periodic trends and explain how each reflects the electron configurations of the elements

Competency 6 Groups of Elements

- 6.1 Describe some important alkali metals and alkaline earth metals
6.2 Compare group 1A and Group 2A metals
6.3 Give several examples of the uses of transition metals
6.4 Describe the characteristics of the lanthanides and the actinides
6.5 Describe the trends in the behavior of the elements as you proceed from Group 3A to Group 8A in the periodic table
6.6 Explain the roles played by oxygen, carbon, and nitrogen in your world
6.7 Describe some of the properties of hydrogen

Competency 7 Chemical Formulas and Bonding

- 7.1 Differentiate between chemical symbols and chemical formulas
7.2 Define a compound and its relationship to a formula
7.3 Differentiate between subscripts and coefficients
7.4 Given a formula, state the number of atoms of each element present
7.5 Define ion, polyatomic ion, and oxidation number
7.6 Differentiate between molecular and empirical formulas
7.7 Describe the characteristics of an ionic bond
7.8 State the octet rule
7.9 Describe the characteristics of a covalent bond
7.10 Describe the difference between polar and nonpolar covalent bonds
7.11 Write names for ionic compounds, molecular compounds and acids
7.12 Explain what determines the polarity of a molecule
7.13 Explain why water is a polar molecule
7.14 Identify the common shapes of small molecules

Competency 8 Chemical Reactions and Equations

- 8.1 Define chemical reaction and list the reactants and products in a given reaction
8.2 Describe the characteristics of a chemical reaction
8.3 Classify a given reaction as one of five types: single displacement, double displacement, decomposition, synthesis, or combustion
8.4 Predict the products and balance the equation when given the reactants for one of these five types of reactions
8.5 Define stoichiometry and describe its importance
8.6 Relate stoichiometry to balanced chemical equations
8.7 Identify and solve different types of stoichiometry problems
8.8 Determine the limiting reactant of a chemical reactions

- 8.9 Calculate the amount of product formed in a chemical reaction when reactants are present in a nonstoichiometric proportions

Competency 9 Heat in Chemical Reactions

- 9.1 Differentiate the characteristics of exothermic and endothermic reactions
9.2 Explain what is meant by enthalpy and enthalpy change
9.3 Describe how a calorimeter determines heats of reactions
9.4 Compare heat and temperature
9.5 Compare heat and temperature
9.6 Define activation energy and describe an activated complex
9.7 Define the rate of a chemical reactions
9.8 Identify the intermediate products of a reaction mechanisms
9.9 Describe a rate law for a chemical reactions
9.10 Understand chemical reactions terms of collision theory
9.11 Write balanced chemical equations
9.12 Classify chemical reactions

Competency 10 The Mole

- 10.1 Define a mole and describe its importance
10.2 Identify and use Avagadro's number
10.3 Define molar mass and explain how it relates the mass of a substance to the number of particles I that substance
10.4 Convert amount the number of particles, moles, and mass of a substance
10.5 Describe molar volume and use it to solve problems
10.6 Find the percentage composition of a given formula
10.7 Use percentage composition to determine the formula of a unknown sample
10.8 Find empirical and molecular formulas

Competency 11 States of Matter

- 11.1 Describe the kinetic molecular theory and explain how it accounts for observed gas behavior
11.2 Explain what gas pressure means and describe how it is measures
11.3 Discuss the significant of the ideal gas equation
11.4 Compare ideal and real gases
11.5 Relate gas density to temperature and molar mass
11.6 List standard temperature and pressure and recognize the symbol STP
11.7 State Boyle's Law and use it to solve problems of pressure-volume variation
11.8 State Dalton's Law of partial pressures, and use it to find the dry volume of a gas collected over water
11.9 State Charles's Law, and use it to solve volume-temperature variation problems
11.10 Explain how the kinetic molecular theory accounts for the physical properties of liquids and solids
11.11 Describe the different types of intermolecular forces
11.12 Define viscosity and surface tension, and explain their relationship to intermolecular forces
11.13 Compare crystalline and amorphous substances
11.14 Relate the structure and bonding in the four categories of solids to the properties they exhibit
11.15 Describe vaporization, condensation, and boiling
11.16 Describe freezing and melting
11.17 Identify the features of a phase diagram

Competency 12 Solutions

- 12.1 Describe the properties of solutions
- 12.2 Identify the different types of solutions
- 12.3 Measure the concentration of solution in terms of molarity, molality, and mole fraction
- 12.4 Differentiate among saturates, unsaturated, and supersaturated solutions
- 12.5 Explain how solutions form
- 12.6 Define solubility and describe the factors that affect solubility
- 12.7 Describe the factors that affect the rate at which a solute dissolved in a solvent
- 12.8 Define a colligative property of a solution
- 12.9 Describe four colligative properties of solutions
- 12.10 Compare dissolution and precipitation
- 12.11 Predict whether or not a precipitate will form using the solubility product
- 12.12 Describe a precipitation reaction and relate it to solubility
- 12.13 Describe a common ion and explain how the common ion effect shifts solubility equilibria

Competency 13 Chemical Equilibrium

- 13.1 Describe a reversible reaction
- 13.2 Define chemical equilibrium and explain how it is achieved
- 13.3 Determine the equilibrium constant for a given reaction
- 13.4 Analyze the extent of a reaction from the equilibrium constant
- 13.5 Use the reaction quotient of a reaction to determine if the reaction is at equilibrium
- 13.6 Explain LeChatelier's principle
- 13.7 Describe how changes in concentration, pressure, and temperature affect a reaction at equilibrium
- 13.8 Relate the Haber process to LeChatelier's principle

Competency 14 Acids and Bases

- 14.1 State the Bronsted-Lowery definition of acids and bases
- 14.2 Identify the common physical and chemical properties of acids and bases
- 14.3 Explain what dissociation constants indicate about an acid or base
- 14.4 Use experimental data to calculate a dissociation constant
- 14.5 Explain what most acidic hydrogen atoms have in common
- 14.6 Explain what most bases have in common
- 14.7 Describe how acids are named
- 14.8 Identify the ion concentrations in pure water
- 14.9 Describe the pH scale
- 14.10 Identify a buffer
- 14.11 Explain how buffers work
- 14.12 Describe an acid base titration
- 14.13 Explain how indicators are used in titrations and how they are chosen

Competency 15 Oxidation and Reduction

- 15.1 Define oxidation and reduction
- 15.2 Explain what oxidation numbers are and how they are assigned
- 15.3 Explain what is meant by the activity series of metals
- 15.4 Describe some applications of redox reactions
- 15.5 List the steps in balancing a redox equation

Competency 16 Nuclear Chemistry

- 16.1 Explain what is meant by the half-life of a radioactive element
- 16.2 Describe what happens in a nuclear bombardment reactions

- 16.3 Describe how radiation affects living things
- 16.4 Discuss several beneficial application of radioisotopes
- 16.5 Compare nuclear fission and nuclear fusion
- 16.6 Explain how nuclear reactors are use to produce energy

Source Documents for Scope and Sequence

- * National Science Education Standards
- * Ohio Draft Science Content Standards

TECHNOLOGY STANDARDS

Standard 1: Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts* and relationships between technologies and other fields.

Benchmark A: Synthesize information, evaluate and make decisions about technologies.

Benchmark B: Apply technological knowledge in decision-making.

Benchmark C: Examine the synergy between and among technologies and other fields of study when solving technological problems.

Standard 2: Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

Benchmark A: Interpret and practice responsible citizenship relative to technology.

Benchmark B: Demonstrate the relationship among people, technology and the environment.

Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

Benchmark E: Forecast the impact of technological products and systems.

Standard 3: Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

Benchmark A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

Benchmark B: Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

Standard 4: Technology and Communication Applications

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

Benchmark A: Apply appropriate communication design principles in published and presented projects.

Benchmark B: Create, publish and present information, utilizing formats appropriate to the content and audience.

Benchmark C: Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.

Standard 5: Technology and Information Literacy

Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge.

Benchmark A: Determine and apply an evaluative process to all information sources chosen for a project.

Benchmark B: Apply a research process model to conduct research and meet information needs.

Benchmark C: Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources.

Benchmark D: Evaluate choices of electronic resources and determine their strengths and limitations.

Standard 6: Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

Benchmark A: Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

Benchmark B: Recognize the role of teamwork in engineering design and of prototyping in the design process.

Benchmark C: Understand and apply research, development and experimentation to problem-solving.

Standard 7: Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, issues and career connections.

Benchmark A: Classify, demonstrate, examine, and appraise energy and power technologies.

Benchmark B: Classify, demonstrate, examine and appraise transportation technologies.

Benchmark C: Classify, demonstrate, examine and appraise manufacturing technologies.

Benchmark D: Classify, demonstrate, examine and appraise construction technologies.

Benchmark E: Classify, demonstrate, examine and appraise information and communication technologies

Benchmark F: Classify, demonstrate, examine and appraise medical technologies.

Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.

Performance Measures/Student Assessment/Instructional Strategies

Assessments/Evaluations

- Observations
- Demonstrations
- Portfolios
- Standardized Tests
- Class Assignment
- Quizzes/Tests/Exams

Instructional Strategies

- Teacher-Directed & Student-Centered Activities
- Case Study Problem Solving
- Cooperative Learning
- Project-Based Learning
- Career-Based Learning (Internships/Shadowing/Placement)
- Community-Based Learning (CTSOs and Other)
- Exploratory Learning
- Independent Research
- Team Teaching

Content Specific Strategies