

Texas University Interscholastic League

Contest Event: Science (Chemistry)

The contest challenges students to read widely in chemistry, to understand the significance of experiments rather than to recall obscure details, and to be alert to new discoveries and information in the areas of science. It is designed to help students gain an understanding of the basic principles as well as knowledge of the history and philosophy of science, and to foster a sense of enthusiasm about science and how it affects our daily lives.

The referenced Texas Essential Knowledge and Skills (TEKS) are from TEA §112.45. Chemistry and TEA §112.42. Integrated Physics and Chemistry.

The Contest Knowledge and Skills are necessarily broad in order to accommodate a wide variety of questions from contest writers. Objectives are provided as a guide, but do not comprise an all-inclusive list of terms and concepts related to the contest topic.

The following are course area abbreviations used for the TEKS in Chemistry:

Chemistry = Chem
Integrated Physics and Chemistry = IPC

Each TEKS begins with the outline number for the appropriate course area.

Texas Essential Knowledge and Skills	Contest Knowledge and Skills
<p><u>Scientific Process Skills:</u></p> <p>1A. Demonstrate safe practices during field and laboratory investigations. (Chem/IPC) 2A. Plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology. (Chem/IPC) 2B. Collect data and make measurements with precision. (Chem/IPC) 2C. Express and manipulate chemical quantities using scientific conventions and mathematical procedures such as dimensional analysis, scientific notation, and significant figures (Chem) 2D. Organize, analyze, evaluate, make inferences, and predict trends from data. (Chem and IPC 2C) 2E. Communicate valid conclusions. (Chem and IPC 2D) 3A. Analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information. (Chem/IPC)</p>	<p><u>Scientific Process Skills:</u></p> <ul style="list-style-type: none"> -Use critical thinking and the scientific method to evaluate scientific investigations. -Identify variables, constants, and controls. -Apply scientific measurement to problem solving and recognize appropriate instrumentation to solve a problem. -Perform data analysis and interpretation using experimental results. -Make predictions based on results.
<p><u>Chemical Research and Current Topics:</u></p> <p>1B. Make wise choices in the use and conservation of resources and the disposal or recycling of materials. (Chem/IPC) 3B. Make responsible choices in selecting everyday products and services using scientific information. (Chem) 3B. Draw inferences based on data related to promotional materials for products and services. (IPC)</p>	<p><u>Chemical Research and Current Topics:</u></p> <ul style="list-style-type: none"> -Identify major discoveries that have contributed to the understanding of matter. -Recognize how chemistry impacts everyday life. -Demonstrate an awareness of current research findings and issues related to chemistry. -Recommended periodical reading list:

<p>3C. Evaluate the impact of research on scientific thought, society, and the environment. (Chem/IPC)</p> <p>3D. Describe the connection between chemistry and future careers. (Chem/IPC)</p> <p>3E. Research and describe the history of chemistry and contributions of scientists. (Chem/IPC)</p> <p>9D. Evaluate environmental issues associated with the storage, containment, and disposal of nuclear wastes. (Chem)</p> <p>14D. Describe effects of acids and bases on an ecological system. (Chem)</p> <p>8E. Research and describe the environmental and economic impact of the end-products of chemical reactions. (IPC)</p> <p>9C. Simulate the effects of acid rain on soil, buildings, statues, or microorganisms. (IPC)</p>	<p><i>Scientific American</i> <i>Discover</i> <i>Science News</i></p>
<p><u>Characteristics of Matter:</u></p> <p>4A. Differentiate between physical and chemical properties of matter. (Chem)</p> <p>4C. Investigate and identify properties of mixtures and pure substances. (Chem)</p> <p>11A. Identify common elements and compounds using scientific nomenclature. (Chem)</p> <p>7E. Classify samples of matter from everyday life as being elements, compounds, or mixtures. (IPC)</p> <p>8A. Distinguish between physical and chemical changes in matter such as oxidation, digestion, change in state, and stages in the rock cycle. (IPC)</p>	<p><u>Characteristics of Matter:</u></p> <p>-Classify matter using chemical and physical properties.</p> <p>-Identify changes of matter.</p> <p>-Use current nomenclature of elements and compounds.</p>
<p><u>Thermodynamics:</u></p> <p>5A. Identify changes in matter, determine the nature of the change, and examine the forms of energy involved. (Chem)</p> <p>5B. Identify and measure energy transformations and exchanges involved in chemical reactions. (Chem)</p> <p>5C. Measure the effects of the gain or loss of heat energy on the properties of solids, liquids, and gases. (Chem)</p> <p>15A. Verify the law of conservation of energy by evaluating the energy exchange that occurs as a consequence of a chemical reaction. (Chem)</p> <p>6A. Describe the law of conservation of energy. (IPC)</p> <p>8B. Analyze energy changes that accompany chemical reactions such as those occurring in heat packs, cold packs, and glow sticks to classify them as endergonic or exergonic reactions. (IPC)</p>	<p><u>Thermodynamics:</u></p> <p>-Analyze energy changes that occur during physical and chemical changes.</p> <p>-Solve calorimetry problems.</p> <p>-Use heat of vaporization and heat of fusion in solving problems involving phase changes.</p> <p>-Determine changes in enthalpy, entropy and free energy for chemical reactions.</p>

<p><u>Structure of Matter:</u></p> <p>6A. Describe the existence and properties of subatomic particles. (Chem) 7B. Research and describe the historical development of the atomic theory. (IPC) 7C. Identify the constituents of various materials or objects such as metal salts, light sources, fireworks displays, and stars using spectral-analysis techniques. (IPC)</p>	<p><u>Structure of Matter:</u></p> <p>-Describe the structure of matter using current atomic theory.</p> <p>-Relate early atomic theories and technology to the current model of the atom.</p>
<p><u>Periodicity:</u></p> <p>4D. Describe the physical and chemical characteristics of an element using the periodic table and make inferences about its chemical behavior. (Chem) 6C. Summarize the historical development of the periodic table to understand the concept of periodicity. (Chem)</p>	<p><u>Periodicity:</u></p> <p>-Use the periodic table to identify relationships between elements and predict properties of elements.</p> <p>-Identify the characteristics of common chemical families.</p>
<p><u>States of Matter:</u></p> <p>4B. Analyze examples of solids, liquids, and gases to determine their compressibility, structure, motion of particles, shape, and volume. (Chem) 5C. Measure the effects of the gain or loss of heat energy on the properties of solids, liquids, and gases. (Chem) 7A. Describe interrelationships among temperature, particle number, pressure, and volume of gases contained within a closed system. (Chem) 7B. Illustrate the data obtained from investigations with gases in a closed system and determine if the data are consistent with the Universal Gas Law. (Chem) 7A. Investigate and identify properties of fluids including density, viscosity, and buoyancy. (IPC)</p>	<p><u>States of Matter:</u></p> <p>-Identify properties of the phases of matter.</p> <p>-Use gas laws to describe and calculate changes in gas phase matter.</p> <p>-Apply the kinetic molecular theory to explain the behavior of matter.</p> <p>-Relate energy changes to changes in phase.</p>
<p><u>Forces of Attraction:</u></p> <p>8A. Identify characteristics of atoms involved in chemical bonding. (Chem) 8B. Investigate and compare the physical and chemical properties of ionic and covalent compounds. (Chem) 8C. Compare the arrangement of atoms in molecules, ionic crystals, polymers, and metallic substances. (Chem) 8D. Describe the influence of intermolecular forces on the physical and chemical properties of covalent compounds. (Chem) 7D. Relate the chemical behavior of an element</p>	<p><u>Forces of Attraction:</u></p> <p>-Relate the type of bonding found in a substance to the properties of that substance.</p> <p>-Describe the characteristics of metallic, ionic, and covalent bonds.</p> <p>-Use molecular models to predict molecular geometry and polarity.</p> <p>-Recognize the intermolecular forces found in the liquid and solid phases of matter.</p>

including bonding, to its placement on the periodic table. (IPC)	
<p><u>Nuclear Chemistry:</u></p> <p>6B. Analyze stable and unstable isotopes of an element to determine the relationship between the isotope's stability and its application. (Chem)</p> <p>9A. Compare fission and fusion reactions in terms of the masses of the reactants and products and the amount of energy released in the nuclear reactions. (Chem)</p> <p>9B. Investigate radioactive elements to determine half-life. (Chem)</p> <p>9C. Evaluate the commercial use of nuclear energy and medical uses of radioisotopes. (Chem)</p> <p>11B. Demonstrate the use of symbols, formulas, and equations in describing interactions of matter such as chemical and nuclear reactions. (Chem)</p> <p>11C. Explain and balance chemical and nuclear equations using number of atoms, masses, and charge. (Chem)</p> <p>8D. Describe types of nuclear reactions such as fission and fusion and their roles in applications such as medicine and energy production. (IPC)</p>	<p><u>Nuclear Chemistry:</u></p> <p>-Demonstrate an understanding of nuclear change and its impact on society and the environment.</p> <p>-Write and balance nuclear equations.</p> <p>-Solve problems involving half life.</p>
<p><u>Reactions:</u></p> <p>10A. Identify oxidation-reduction processes. (Chem)</p> <p>10B. Demonstrate and document the effects of a corrosion process and evaluate the importance of electroplating metals. (Chem)</p> <p>11B. Demonstrate the use of symbols, formulas, and equations in describing interactions of matter such as chemical and nuclear reactions. (Chem)</p> <p>11C. Explain and balance chemical and nuclear equations using number of atoms, masses, and charge. (Chem)</p> <p>8C. Investigate and identify the law of conservation of mass. (IPC)</p>	<p><u>Reactions:</u></p> <p>-Identify characteristics of chemical changes.</p> <p>-Classify types of reactions and predict products of reactions.</p> <p>-Balance equations using the law of conservation of matter.</p> <p>-Use stoichiometry and equilibrium concepts to solve chemical problems.</p> <p>-Analyze redox reactions and apply to electrochemical cells.</p>
<p><u>Solution Chemistry:</u></p> <p>12A. Demonstrate and explain effects of temperature and the nature of solid solutes on the solubility of solids. (Chem)</p> <p>12B. Develop general rules for solubility through investigations with aqueous solutions. (Chem)</p> <p>12C. Evaluate the significance of water as a solvent in living organisms and in the environment. (Chem)</p> <p>13A. Compare unsaturated, saturated, and supersaturated solutions. (Chem)</p> <p>13B. Interpret relationships among ionic and</p>	<p><u>Solution Chemistry:</u></p> <p>-Identify the properties of solutions.</p> <p>-Determine the concentration of solutions.</p> <p>-Solve problems involving colligative properties of solutions.</p> <p>-Calculate the solubility of slightly soluble compounds using solubility equilibrium concepts.</p> <p>-Write net ionic equations using solubility rules.</p>

<p>covalent compounds, electrical conductivity, and colligative properties of water. (Chem)</p> <p>13C. Measure and compare the rates of reaction of a solid reactant in solutions of varying concentration. (Chem)</p> <p>9A. Relate the structure of water to its function as the universal solvent. (IPC)</p> <p>9D. Demonstrate how various factors influence solubility including temperature, pressure, and nature of the solute and solvent. (IPC)</p> <p>9E. Demonstrate how factors such as particle size, influence the rate of dissolving. (IPC)</p>	
<p><u>Acids and Bases:</u></p> <p>14A. Analyze and measure common household products using a variety of indicators to classify the products as acids or bases. (Chem)</p> <p>14B. Demonstrate the electrical conductivity of acids and bases. (Chem)</p> <p>14C. Identify the characteristics of a neutralization reaction. (Chem)</p> <p>9B. Relate the concentration of ions in a solution to physical and chemical properties such as pH, electrolytic behavior, and reactivity. (IPC)</p>	<p><u>Acids and Bases:</u></p> <p>-Use acid-base models to classify and predict the behavior of acids and bases.</p> <p>-Write neutralization reactions and solve titration problems.</p> <p>-Solve problems involving pH and pOH including those involving weak acids and bases.</p> <p>-Describe the properties and composition of buffer solutions.</p>
<p><u>Chemical Kinetics:</u></p> <p>15B. Relate the rate of a chemical reaction to temperature, concentration, surface area, and presence of a catalyst. (Chem)</p>	<p><u>Chemical Kinetics:</u></p> <p>-Analyze factors affecting reaction rate using collision theory.</p> <p>-Solve problems involving rate laws and rate constants.</p> <p>-Describe reaction mechanisms.</p>