# Chemistry
# Curriculum Framework

Mapping High School Chemistry to:
*Science Cognitive Demands*
*Texas State Standards: Texas Essential Knowledge and Skills, TEKS*
*Underlying Processes in TEKS assessed in*
*Texas Assessment of Knowledge and Skills, TAKS*
*National Science Education Standards*

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# Curriculum Framework for High School Chemistry

A K-16 group of classroom science and biology teachers, faculty, curriculum specialists, and department chairs met over the course of a year and developed a curriculum framework for high school Chemistry, an important step in developing explicit and comprehensive goals for teachers in El Paso area schools. The framework is a product of collective work of K-16 classroom teachers and faculty from K-12 schools, El Paso Community College, and the University of Texas at El Paso. It is meant to assist science teachers in ensuring that current high school courses are aligned with first year college science courses entering college freshmen will take. The group has also developed frameworks for K-8 Science, Biology and Physics. The expectation is that as teachers use the framework to provide challenging courses and curriculum in science, the number of students who successfully enroll in and complete college level science courses will increase. Students will benefit because of the collective effort of K-16 teachers who will embrace the next state in this process: implementation with the goal of providing practical revision. With participation from every high school physics teacher, the framework will become the standard in science coursework for every student in El Paso.

**Background**

In 1998, the El Paso Collaborative Board identified as its top priorities: 1) continuing to focus on mathematics and 2) the alignment of the mathematics curriculum. A review of local data on mathematics achievement showed larger numbers of students enrolled in and completing college preparatory mathematics course in high school. It also revealed a continuous increase in student achievement on TAAS. This high student achievement however, did not reflect student readiness for college mathematics courses. Gaps also existed in high school science preparation for entering college freshmen. Further review of data revealed that large numbers of high school students were placing and enrolling in remedial courses as well as large numbers of students not succeeding in the freshman science courses at El Paso Community College and the University of Texas at El Paso. While many factors contribute to these large numbers, one known factor is that there was little alignment between what high school teachers expect students to know and be able to do, and the expectations of college and university faculty.

To deal with some of these issues, the Mathematics and Science Partnership, MSP, proposed and was funded to continue supporting alignment of mathematics curriculum, assessment, and instruction and to initiate alignment of science K-16. Included in MSP's goals and objectives is to provide students with challenging courses and curriculum in high school mathematics and science courses that prepare them to enroll in and successfully complete college level mathematics and science courses.

**Working Group**

Starting in Fall 2003, MSP convened a working group of classroom teachers to write curriculum frameworks for Chemistry, Physics, Biology and K-8 Science for teachers to use as curriculum guides no matter what instructional materials they were using for the course. The Working Group included: K-12 classroom teachers from both urban and rural independent school districts; mathematics and science staff developers, specialists in science from both rural and urban school districts; science faculty from El Paso Community College; and faculty representing the Colleges of Education and Science from the University of Texas at El Paso. A complete list of the participants in the K-16 Science Working Group is attached.

To prepare for writing curriculum frameworks for K-8 and high school science courses, the Group engaged in dialogue and discussion focused on science teaching and learning. Using whole and small group formatted discussions, the K-16 Science Working Group:

- analyzed and discussed student performance in science using data collected from state mandated assessments and performance in college freshman courses;

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- examined textbooks, course requirements, outline format, state and national placement tools used to assess student readiness for college;
- reviewed the Texas Essential Knowledge and Skills (TEKS), National Science Education Standards, and Atlas of Science Project 2061;
- discussed how concepts were connected and developed in grade levels and how they led to concepts incorporating higher cognitive demands in science;
- identified alternate methods of assessing student learning that provide for standards-based assessment;
- discussed models of teaching science; and
- reviewed and discussed science education literature.

Meeting bimonthly during the 2003 – 2006 academic years and for several days each summer, the Group wrote curriculum frameworks for Chemistry, Physics, K-8 Science, and Biology. Content for the course was placed in text outline form as well as matrix form to map knowledge and skills to cognitive demands as well as to state (TEKS) and national science standards.

**K-16 Leaders Group**

A leaders group of district leaders and central office personnel from both urban and rural independent school districts and the Education Service Center for Region 19, the provost of the University, science and education deans and mathematics and science department chairs from both the Community College and University, and lead principals and teachers from school districts, was also convened. As an advisory group they discussed and engaged in focused dialogue around issues in mathematics and science education and provided guidance and feedback in the development of the K-16 Mathematics and Science frameworks.

**Needs**

What we need now is assistance from high school principals and teachers to review, revise, and make practical use of the framework during the academic year. The chemistry curriculum framework should be reviewed by *every* chemistry teacher, and, if possible, by all high school science teachers to help prioritize aligning K-16 science curriculum, instruction, and assessment. In order to continue this work, we need participation from every science department in every high school in both urban and rural independent school districts and by secondary biology faculty and chairs.

Call 747-5778 for more information on how you can be involved in reviewing and revising these frameworks.

*Lucy Hernandez Michal*
*MSP Director of Mathematics and Science*
*El Paso Collaborative for Academic Excellence*
*lmichal@utep.edu*

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# K-16 SCIENCE ALIGNMENT WORKING GROUP

| | | | |
|---|---|---|---|
| Maria Luisa Arroyo | SISD | El Dorado HS | 2004 – present |
| Socorro Arteaga, Ph. D. | EPCC | Chemistry | 2003 – present |
| Karen Blaine | Region 19 | MSP Staff Dev | 2004 – 2005 |
| Sally Blake, Ph. D. | UTEP | Science Education | 2003 – 2006 |
| Amy Canales | SISD | Science Specialist ES | 2003 – present |
| Evangelina Cantu | SISD | Science Specialist HS | 2004 – present |
| Deborah Caskey | EPCC | Geology | 2004 – present |
| William Cornell, Ph. D. | UTEP | Geology | 2005 – present |
| Karen Davis | Region 19 | MSP Staff Dev | 2003 – 2004 |
| Olga Deslongchamps | YISD | Parkland HS | 2003 – present |
| Sylvia Esparza | SISD | Socorro HS | 2003 – 2005 |
| Maritza Fernandez | YISD | Hacienda Heights ES | 2004 – 2005 |
| Sandy Garza | SISD | Science Specialist ES | 2003 – 2004 |
| Jeannie Geske | EPISD | Bond ES | 2003 – present |
| Kristin Gosselink, Ph. D. | UTEP | Biology | 2005 – present |
| Eric Hagedorn, Ed. D. | UTEP | Physics | 2003 – 2005 |
| Kastro M. Hamed, Ph. D | UTEP | Physics | 2003 – 04, 06 – present |
| Terry Jimarez | UTEP | College of Science | 2003 – 2004 |
| Kathy Kraften | EPISD | MSP Staff Dev | 2003 – present |
| Richard Langford, Ph. D. | UTEP | Geology | 2005 – present |
| Carl Lieb, Ph. D. | UTEP | Biology | 2004 – present |
| Mary Liggett | SISD | Socorro MS | 2003 – 2005 |
| Jorge Lopez, Ph. D. | UTEP | Physics | 2004 |
| Victor Macias | SISD | El Dorado HS | 2003 – Aug. 2004 |
| Jose Maldonado | EPCC | Biology | 2003 – present |
| Michael Martin | SISD | Bill Sybert K-8 | 2006 |
| Nancy Marcus, Ph. D. | UTEP | Mathematics | 2003 |
| Emil Michal | EPCC | Physics | 2003 – present |
| Diana Noriega | YISD | Cadwallader ES | 2003 – present |
| Gloria Ontiveros | YISD | Ranchland Hills MS | 2003 – present |
| Myriam Sanchez | SISD | Sambrano ES | 2003 – 2005 |
| Luis Saez, Ph. D. | UTEP | Physics | 2004 |
| Cynthia Stone | SISD | Science Specialist ES | 2003 – 2004 |
| Virginia Tovar | EPISD | Jefferson HS | 2003 – 2004 |
| Enrique Villalobos | SISD | MSP Staff Dev | 2003 – 2005 |
| Diane Walker | YISD | MSP Staff Dev | 2003 – present |

| | | |
|---|---|---|
| Lucy Hernandez Michal<br>lmichal@utep.edu | K-16 Alignment Director and<br>MSP Director of Mathematics and Science | 2000 - present |

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# CHEMISTRY

## I. COURSE DESCRIPTION

Chemistry is the study of properties of matter and energy and their physical and chemical changes. Students will learn and experience the natural world through an understanding of he periodic table and use of the scientific method to conduct field and laboratory investigations. Along with learning and understanding how chemistry is an integral part of their lives, students will engage in critical thinking to solve problems and make informed decisions about the world around them.

Topics include: characteristics of matter and energy and their transformations during physical and chemical changes, atomic structure, periodic table of elements, behavior of gases, bonding, nuclear fusion and nuclear fission, oxidation-reduction and other chemical reactions, chemical equations, acids and bases, solutes, and properties of solutions. The course will prepare students to enroll and be successful in a college freshman chemistry course.

## II. PREQUISITE KNOWLEDGE

Students entering high school chemistry should know and be able to apply:

A. laboratory techniques and safety
B. four basic operations with real numbers
C. algebra I and concurrent enrollment of second year math course
D. scientific method and scientific process skills, TEKS b1-4
E. reading comprehension at $10^{th}$ grade level
F. writing that clearly expresses thinking
G. understanding of the structures and properties of matter
H. calculator skills
I. metric system
J. conversion factors and scientific notation
K. knowledge of what a system is and how it functions
L. scientific theories and explanations

## III. CONTENT

After taking high school chemistry, students should know, understand, and be able to apply:

A. roles, interactions, characteristics, and transformations of matter and energy in chemical reactions
B. law of conservation
C. atoms and their behavior in bonding and in reactions
D. periodic table of elements
E. behavior of gases
F. chemical formulas and equations
G. chemical reactions-nuclear, oxidation-reduction, and other reactions
H. laboratories and the real world
I. properties and behavior of acids and bases and their ecological interactions
J. solutes and properties of solutions
K. science literacy

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L. connections between chemistry and daily life
M. applications of chemistry to solve problems and make inform decisions, e.g., wise ecological choices in disposing, recycling, conserving matter
N. writing accurate and precise laboratory reports
O. integration of chemistry to other sciences

## V. TIMELINE

A brief overview of everyday applications of chemistry principles may be given during the first week of the semester. It is recommended that the rest of the time be allotted to cover course content and that any further review be embedded in the content units as needed. If a district or school does not have an agreed upon timeline, teachers should convene to agree on a recommended sequence and distribution of time allotted to cover the following units appropriately.

## VI. INFORMATION/RESOURCES REQUIRED FOR STUDENTS

A. Course description
B. Teacher information (conference period, office hours)
C. Work, projects, homework, exams, grading policy for each
D. Rubrics for projects/presentations/portfolios
E. Resources – tutoring, lab, Internet websites specific to the course, computer programs, teacher conference period, other outside support available
F. Weekly calendar
G. Textbook, calculator
H. Lab materials

## VII. MATRIX MAPPING PHYSICS TO COGNITIVE DEMANDS

A. Attached is a matrix that maps knowledge and skills to cognitive demands.
The work on cognitive demands has been guided by work of Andrew Porter, Norman Webb, and John Smithson. The cognitive demands identified by Porter, Webb, and Smithson were used as models and modified by the K-16 Science working group to fit their work in high school science courses. These identify thinking levels that incorporate five (5) levels of cognitive demands. They are listed on the matrix from higher order to lower order as you read from left to right. The matrix also maps content to state standards and, for some courses, frameworks also map textbooks and materials used in major independent school districts. The K-16 Science Working Group produced the matrix to provide guidance for teachers in planning instruction and designing assessment for the course.

B. Cognitive Demands for Science
Cognitive demands assist teachers in distinguishing what students are expected to know and be able to do with science content, and what level of thinking students must be engaged in while learning content. This mapping of topics to cognitive demands describes content knowledge that will not merely be stored, but also understood, represented, organized, connected, and structured in ways that facilitate retrieval and application of knowledge. By mapping knowledge and content to cognitive demands, teachers engage students in using, representing and connecting

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pieces of content knowledge in coherent ways that will determine whether students understand knowledge deeply and can use it to solve new problems. They are:

1. **Analyze Information** – classify and compare data, analyze data, recognize patterns, reason inductively or deductively, draw conclusions, identify faulty arguments or misrepresentations of data, spatial reasoning

2. **Apply Concepts/Make Connections** – apply and adapt science information to real-world situations, apply science ideas outside the context of science, build or revise theory, plan and design experiments, synthesize content and ideas from several sources, use and integrate science concepts

3. **Understand Concepts** – explain concepts, observe and explain teacher/student demonstrations, explain procedures and methods of science inquiry, organize and display data in tables or charts, present science information, construct or use models to represent science ideas

4. **Perform Procedures/Conduct Investigations** – make observations, collect and record data, use appropriate tools make measurements, do computations, organize and display data in tables or charts, execute procedures, generate questions, make predictions, conduct experiments, test effects of different variables, select and use appropriate tools.

5. **Memorize Facts, Definitions, Formulas** – recite basic science facts, recall science terms and definitions, recall scientific formulas

C. Matrix Format and Its Use as A Teaching and Learning Tool
   1. Strands and topics in matrices overlap and may be integrated
   2. Cognitive demands overlap and are neither linear nor sequential.
   3. All TEKS are included
   4. Items in the matrix appearing in regular fonts are actual TEKS and are placed within a suggested cognitive demand.
   5. Italicized items support teaching and learning at a higher level of cognitive demand to reach conceptual understanding of a topic or concept and are meant to support the learning of TEKS with understanding. Paraphrased TEKS are also italicized where they address different cognitive demands or reference TEKS under multiple cognitive demands.

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Chemistry Curriculum Framework Mapping Knowledge and Skills to Cognitive Demands

| | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| **Knowledge and skills** | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| Scientific Processes<br><br>The student:<br>c1 For at least 40% of instructional time, , conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices.<br><br>c2 Uses scientific methods during field and laboratory investigations<br><br>c3 Uses critical thinking and scientific problem solving to make informed decisions | c2D organize, analyze, evaluate, make inferences, and predict trends from data<br><br>c2E communicate valid conclusions<br><br>c3A *Analyze scientific explanations, including hypotheses and theories, add to their strengths and weaknesses using scientific evidence and information* | c2A *Plan investigative procedures*<br><br>c3B Make responsible choices in selecting everyday products and services using scientific information<br><br>c3C Evaluate the impact of research on scientific thought, society, and the environment<br><br>c3D Describe the connection between chemistry and future careers | c1B make wise choices in the use and conservation of resources and the disposal or recycling of materials<br><br>*c2C Manipulate chemical quantities using scientific conventions and mathematical procedures such as dimensional analysis, scientific notation, and significant figures*<br><br>c3A *Review and critique scientific explanations, including hypotheses and theories, add to their strengths and weaknesses using scientific evidence and information* | c1A Demonstrate safe practices during field and laboratory investigations<br><br>c1B Make wise choices in the use and conservation of resources and the disposal or recycling of materials.<br><br>c2A *Implement investigative procedures including asking questions, formulating testable hypothesizes, and selecting equipment and technology*<br><br>c2B Collect data and make measurements with precision<br><br>c2C *Express chemical quantities using scientific conventions and mathematical procedures such as dimensional analysis, scientific notation, and significant figures*<br><br>c3E Research the history of chemistry and contributions of scientists | c3D *List careers in chemistry*<br><br>c3E Describe the history of chemistry and contributions of scientists |
| **Timeline** | **Textbook and Materials** | | | **National Science Standards** | |
| | | | | 9-12 A Science as Inquiry<br>9-12 B Physical Science<br>9-12 F Science n Personal and Social Perspectives<br>9-12 G History and Nature of Science | |

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Chemistry Curriculum Framework Mapping Knowledge and Skills to Cognitive Demands

| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| **Scientific Processes** | c2, c3 | c2, c3 | c1, c2, c3 | c1, c2 | |
| c4 Science Concepts: The student knows the characteristics of matter.<br><br>Interactions of Energy and Matter<br>c5 Science Concepts: The student knows that energy transformations occur during physical or chemical changes in matter. | c4B Analyze examples of solids, liquids & gases to determine their compressibility, structure, motion of particles, shape and volume<br><br>c4D *Make inferences about the physical and chemical characteristics of an element using the periodical table*<br><br>c5A *Determine the nature of the changes in matter* | c4A Differentiate between physical and chemical properties of matter<br><br>c4D *Make inferences about the physical and chemical characteristics of an element using the periodical table*<br><br>c5A *Determine the nature of the changes in matter* | c5 design & present an experiment that shows conceptual understanding of energy transformation | c4C Investigate properties of mixtures and pure substances<br><br>c5A *Observe and examine the forms of energy involved in changes in matter*<br><br>c5B *Measure energy transformation and exchanges involved in chemical reactions*<br><br>c5C Measure the effects of the gain or loss of heat energy on the properties of solids, liquids and gases | c4D *Describe the physical and chemical characteristics of an element using the periodic table*<br><br>c4C *Identify properties of mixtures and pure substances*<br><br>c5A *Identify changes in matter*<br><br>c5B *Identify energy transformation and exchanges involved in chemical reactions* |
| **Timeline** | **Textbook and Materials** | | | **National Science Standards** | |
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| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| | c2, c3 | c2, c3 | c2, c3 | c1, c2 | |
| c6 Science Concepts: The student knows that atomic structure is determined by nuclear composition, allowable electron cloud, and subatomic particles. | c6B Analyze stable and unstable isotopes | c6A *Describe the existence of subatomic particles*<br><br>c6B Determine the relationship between the isotopes stability and its application<br><br>c6C Summarize the historical development of the periodic table | c6B Determine the relationship between the isotopes stability and its application<br><br>c6C Summarize the historical development of the periodic table to understand the concept of periodicity | c6B Determine the relationship between the isotopes stability and its application<br><br>*Design atomic models* | c6A Describe the properties of subatomic particles<br><br>*Vocabulary:*<br>*isotopes*<br>*electron*<br>*cloud*<br><br>**Glossary for teacher understanding:*<br>*Investigate*<br>*Identify*<br>*Evaluate*<br>*Describe*<br>*Determine the Relationship* |

| **Timeline** | **Textbook and Materials** | **National Science Standards** |
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| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| **Scientific Processes** | c1 | c2 ,c3 | c1 | c1, c2 | |
| c7 Science Concepts: The student knows the variables that influence the behavior of gases.<br><br>c8 Science Concepts: The student knows how atoms form bonds to acquire a stable arrangement of electrons. | c7B *Determine if data obtained from investigations with gases within a closed system are consistent with Universal Gas Law*<br><br>c8B Compare the physical and chemical properties of ionic and covalent compounds | c7A Describe interrelationships among temperature, particle number, pressure, and volume of gases contained within a closed system<br><br>c8C Compare the arrangement of atoms in molecules, ionic crystals, polymers, and compounds<br><br>c8D Describe the influence of intermolecular forces on the physical and chemical properties of covalent compounds | *Make a model of a closed system*<br><br>*Make conjectures about closed system*<br><br>c8D Explain how intermolecular forces influence the physical and chemical properties of covalent compounds | c7B *Illustrate the data obtained from conducting investigations with gases in a closed system*<br><br>*Conduct investigation in a closed system*<br><br>c8B *Investigate the physical and chemical properties of ionic covalent compounds* | Vocabulary<br>Particle number<br>Pressure<br>Gas<br>Universal Gas Law<br>Atom<br>Covalent compound<br>Ionic compound<br>Bonding<br><br>c8A Identify characteristics of atoms involved in chemical bonding |
| **Timeline** | **Textbook and Materials** | | | **National Science Standards** | |
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| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| | | c2, c3 | | c1, c2 | |
| c9 Science Concepts: The student knows the processes, effects, and significance of nuclear fission and nuclear fusion.<br><br>c10 Science Concepts: The student knows common oxidation-reactions. | c9A 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<br><br>c10B *Document the effects of a corrosion process* | c9D Evaluate environmental issues associated with the storage, containment, and disposal of nuclear wastes<br><br>c10B *Discuss the importance of electroplating metals* | c9C Evaluate the commercial use of nuclear energy and medical uses of radioisotopes<br><br>Discuss the commercial use of nuclear energy and medical uses of radioisotopes<br><br>c10A Evaluate oxidation-reduction processes<br><br>c10B *Evaluate the importance of electroplating metals* | c9A *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 (computer simulations)*<br><br>C9A *Balance /complete nuclear reaction equation*<br><br>C9B Investigate radioactive elements to determine half-life<br><br>c10B *Demonstrate the effects of a corrosion process* | Fission<br>Fusion<br>Nuclear particles<br>Nuclear forces<br>Electrostatic forces<br><br>Isotopes<br><br>Types of radiation<br><br>Recognize formulae *e.g.* $N_n^Z$<br><br>c10A Identify oxidation-reduction processes |
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| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| | c2, c3 | c2, c3 | c2, c3 | c1, c2 | |
| c11<br>Science Concepts:<br>The student knows that balanced chemical equations are used to interpret and describe the interactions of matter. | c11B *Analyze how to balance chemical reactions by changing coefficients* | *c11B Describe interactions of matter such as chemical and nuclear reactions using symbols, formulas, and equations* | c11C *Explain balanced chemical and nuclear equations using number of atoms, masses and charge*<br><br>c11 *Demonstrate how chemical equations explain chemical reactions* | c11B Demonstrate the use of symbols, formulas, and equations in describing interactions of matter such as chemical and nuclear reactions<br><br>c11C *Balance chemical and nuclear equations using number of atoms, masses and charge* | c11A Identify common elements and compounds using scientific nomenclature |
| **Timeline** | **Textbook and Materials** | | | **National Science Standards** | |
| Five 90-minute classes | | | | 9-12 A Science as Inquiry<br>9-12 B Physical Science<br>9-12 F Science n Personal and Social Perspectives<br>9-12 G History and Nature of Science | |

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|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| | c2, c3 | c2, c3 | c2, c3 | c1, c2 | |
| c12 Science Concepts:<br>The student knows the factors that influence the solubility of solutes in a solvent.<br><br>c13 The student knows relationships among the concentration, electrical conductivity, and colligative properties of a solution. | c12C Analyze the significance of water as a solvent in living organisms and in the environment<br><br>c13A Compare unsaturated, saturated and supersaturated solutions<br><br>c13C Compare the rates of reaction of a solid reactant in solutions of varying concentration | c12B Apply general rules for solubility through investigations with aqueous solutions<br><br>c13B Interpret relationships among ionic and covalent compounds, electrical conductivity, and colligative properties of water | c12A Explain effects of temperature and the nature of solid solutes on the solubility of solids<br><br>c12B Develop general rules for solubility through investigations with aqueous solutions<br><br>c12C Evaluate the significance of water as a solvent in living organisms and in the environment<br>c13B Detect and explain relationships among ionic and covalent compounds, electrical conductivity, and colligative properties of water | c12A Demonstrate effects of temperature and the nature of solid solutes on the solubility of solids<br><br>c13C Measure rates of reaction of a solid reactant in solutions of varying concentration | Solid<br>Solute<br>Solution<br>Aqueous solution<br>Solvent<br>Ionic compounds<br>Covalent compounds<br>Solution<br>Concentration<br>Electrical conductivity<br>Colligative properties<br><br>c13c Identify unsaturated saturated and supersaturated solutions |
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| Knowledge and Skills | Cognitive Demands | | | | |
|---|---|---|---|---|---|
| | **Analyze Information** | **Apply Concepts/ Make Connections** | **Understand Concepts** | **Perform Procedures/ Conduct Investigations** | **Memorize** |
| | c2, c3 | c2, c3 | c2, c3 | c1, c2 | |
| c14 The student knows the properties and behavior of acids and bases.<br><br>c15 Science Concepts: The student knows factors involved in chemical reactions. | c14D Analyze effects of acids and bases on an ecological system<br><br>c15A *Analyze the energy exchange that occurs as a consequence a chemical reactions*<br><br>*Make a conjecture about the energy exchange that occurs as a consequence of chemical reactions* | c14D Describe effects of acids and bases on an ecological system<br><br>c14A *Classify products as acids or bases of common household products using a variety of indicators*<br><br>c15B Relate the rate of a chemical reaction to temperature, concentration, surface area and presence of a catalyst | *Explain relationship between electrons, conduction of electricity, and ionization*<br><br>*c14A Explain ionization and its application to pH*<br><br>c15A *Evaluate the energy exchange that occurs as a consequence of a chemical reaction* | *c14A Measure pH of products using a variety of indicators*<br><br>c14B Demonstrate the electrical conductivity of acids and bases<br><br>c15A *Verify the law of conservation of energy* | Acid<br>Base<br>pH scale<br>Electron<br>Conduction<br>Ionization<br><br>c14C Identify the characteristics of a neutralization reaction<br><br>c15A *State the law of conservation of energy* |
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