High School Instructional Guide For Chemistry

Instructional Support Services Division
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Los Angeles Unified School District
High School Instructional Guide for Chemistry
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Foreword:

In 1996, the Los Angeles Unified School District adopted student-learning standards in Science, History/Social Studies, Mathematics and Language Arts. By adopting standards, the District joined with nationwide reform efforts. These efforts were given impetus by the passage of three legislative acts which emphasize the need for school districts to establish standards for what students should know and be able to do upon high school graduation. Goals 2000 (PL 103-227), Improving America's Schools Act (PL 103-382), and the School-to-Work Opportunity Act (PL 103-239). The Individuals with Disabilities Act Amendments of 1997 also calls for districts to maintain high academic standards and clear performance goals for students with disabilities, consistent with the standards and expectations for all students.

All elements of the District's educational program – the curricula, daily learning activities, materials, textbooks, and assessments – should be aligned to support student progress toward achievement of the science standards. In accordance with their Individualized Education Programs (IEPs), students with disabilities may require accommodations, modifications, and/or supplemental aids and services in order to access the curriculum and work toward achievement of the standards. It is strongly recommended that schools explore all options to ensure equal access to, and evidence of, learning in the core curriculum for all learners – i.e., Special Education, English Language Learners (ELs), Standard English Language Learners (SELs), Gifted and Talented Learners (GATE), etc. The goal of enabling all students to achieve a common set of standards requires equitable treatment and multiple and varied opportunities to learn.

To this end, we present the Science Instructional Guide for High Schools, Biology, Chemistry, Physics and Earth Science Version 2.0 which is meant to guide teachers to meet State and District expectations and requirements as well as provide guidance to meet the District commitment to provide every student with the knowledge and skills necessary to excel as citizens in the evolving global community of the twenty first century. The revisions in this publication reflect an alignment with the latest State Textbook adoption and updating of relevant information that will help strengthen the High School science program for all students.

David L. Brewer III
Superintendent of Schools

Todd Ullah
Director Secondary Science

Every LAUSD student will receive a state-of-the-art education in a safe, caring environment, and every graduate will be college-prepared and career-ready

Science Instructional Guide Overview

The *Science Instructional Guides* for Integrated/Coordinated Science I, Biology, Chemistry, Physics, and Earth Science provide a contextual map for teaching the California Science Standards. The *Guides* provide the foundation for building a classroom curriculum and instructional program that engages *all* students in rigorous and dynamic learning. Aligned to the California Science Standards and the *Science Framework for California Public Schools*, the instructional resources in this Guide support District initiatives to close the achievement gap and raise all students to "proficient" performance in science. The *Science Instructional Guide* is one part of a "systemic" approach to the teaching of science that aligns curriculum, instruction, assessment, and professional development which is made systemically coherent through local district professional development.

Background

The State of California established the Standardized Testing and Reporting (STAR) Program to evaluate programs and determine student proficiency on the content standards for Language Arts, Mathematics, Science, and Social Studies. The STAR Program tests 5th Grade students with a California Standards Test (CST) in science that is aligned to the grades 4 and 5 California standards. Specific California Standards Tests are also given at grade 8 and at the high school level for grades 9 - 11.

The STAR Program is also used by California to meet some of the requirements of the *No Child Left Behind* (NCLB) Act (PL 107-110), signed into law in January 2002. The Federal NCLB Legislation specifies a timeline that requires states to adopt grade-level content standards, aligned to benchmarked standards, in English, mathematics and science. Once these content standards are adopted, states must phase in assessments aligned to their adopted content standards. The NCLB science requirement specifies that, by the 2007-08 school year, states should give standards-aligned assessments in science at least once in the grade spans 3-5, 6-9, and 10-12. In 2007, the test in Grade 8 focused on the Grade 8 content standards and a test at Grade 10 focused on the Grade 6-8 Life Science and high school Biology standards. The 5th Grade CST is used for both the STAR Program and the NCLB requirement. The results of these assessments, as well as those in English and mathematics, are used in the states' accountability programs as one of several indicators for schools', districts', and states' Adequate Yearly Progress (AYP). Schools, districts, and states that do not meet their AYP targets may face Federal sanctions under NCLB.

The purposes of this *Instructional Guide* and the accompanying periodic assessments are to: 1) provide teachers with the support needed to ensure that students have received the science content specified by the *Science Content Standards for California Public Schools*, and 2) to provide direction for instruction or additional resources that students may require in order to become proficient in the science course being studied. This *Guide* is intended to be the foundation of a standards-based instructional program in science which the local districts, schools and classroom teachers will enrich and expand based on local expertise and available resources.

The Role of the *Instructional Guide* is to Support Instruction

The *Instructional Guides* are a foundation for the teaching of science in Integrated/Coordinated Science I, Biology, Chemistry, Physics and Earth Science. The *Guide* is designed to provide support for teachers with instructional resources to assist them in their implementation of a standards-based program. The *Guides* are designed as a resource to support the implementation of a balanced instructional program that employs myriad learning activities to produce the conceptual understanding of scientific phenomena.

This *Guide* should be used at the local district level as a foundation for the development of an instructional program that best utilizes the expertise and resources within that local district. In implementing this *Guide*, it is suggested that teachers work together to select the best combination of resources to meet the instructional goals and specific learning needs of their students. Therefore, this *Guide* focuses on the efficient use of all instructional resources found in LAUSD schools.

Another role of this *Guide* is to support the use of periodic diagnostic assessments to ensure that students have access to the *Science Content Standards for California Public Schools*. Proficiency of the K - 12 science standards will provide a strong foundation by which students may go on to become "scientifically literate" citizens of the 21st century.

Organization of the Science Instructional Guide

The Science Instructional Guides are organized into three "Instructional Components" that map out the academic year. Included in each instructional component for Integrated/Coordinated Science I, Biology, Chemistry, Physics and Earth Science are the following:

- **Standards for the Instructional Component**
- **Standard Groups**
- **Key Concepts**
- **Analyzed Standards**
- **Instructional Activities and Resources**
- **Immersion Units (extended science investigations)**

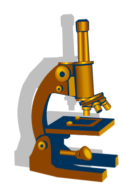
Immersion units are extended science investigations (four weeks or more). The use of an immersion unit is an instructional task that combines and applies concepts to ensure that all students engage in an extended scientific investigation at least once per year. The immersion projects will provide all students with the opportunity to:

- **Investigate a scientific topic in-depth over an extended period of time.**
- **Gather data that tests a hypothesis.**
- **Confront conflicting evidence and analyze.**
- **Draw conclusions and reflect on those conclusions.**

These immersion units are an ideal way of deepening inquiry in science by supporting personalized learning and can be used in Small Learning Community settings. These extended investigations also support culturally responsive pedagogy; all students use both deductive and inductive reasoning to built concepts and make connections to prior experiences.

• Appendix

An Appendix with District contacts and other useful information is included at the end of this *Instructional Guide*.



Science Instructional Guides* Graphic Organizer
+Overview For Integrated/Coordinated Science, Biology and Chemistry

Science Instructional Guide Overview

I. Major District Initiatives
- Secondary Literacy Plan
- IFL Nine Principles of Learning
- Culturally Relevant Teaching Methods to Close the Achievement Gap
- Small Learning Communities
- LAUSP
- MSP-SCALE

II. State of California Document
- *The California Content Standards*
- *Science Framework for California Public Schools*
- *California Standards for the Teaching Profession*

III. Science Pedagogy

IV. Assessment
- Periodic Assessment
- Scoring of Periodic Assessments
- Unit Reflection and Intervention

Appendix
- District Contacts and other useful information

→

Instructional Component 1

- Standard sets
- Content Standard Group
- Analyzed Standards
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible Standards Aligned Resources

↕ Science** Periodic Assessment

→

Instructional Component 2

- Standard sets
- Content Standard Group
- Analyzed Standards
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible Standards Aligned Resources

↕ Science Periodic Assessment 2

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Instructional Component 3

- Standard sets
- Content Standard Group
- Analyzed Standards
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible Standards Aligned Resources

↕ Science Periodic Assessment 3

↔

Overarching Instructional Components

- Review and Re-teach
- Review results of Periodic Assessments
- Extended Learning Interventions
- Student/teacher reflection on student work
- End of unit assessments
- Use of data

California NCLB Standards Test (Grade 10)

*This Instructional Guide is designed for students in the core areas of Integrated Science I, Biology, and Chemistry

**There will be 4 Periodic assessments for Integrated/Coordinated Science I

+Professional development will be designed to accompany the Instructional Guide and Assessments

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I. Major District Initiatives

The Science Instructional Guides and Periodic Assessments are part of the larger District Periodic Assessment System that support the following Los Angeles Unified School District Initiatives:

- Secondary Literacy Plan,
- Closing the Achievement Gap: Improving Educational Outcomes for Under-Achieving Students Initiative,
- Small Learning Communities, and
- The Mathematics Science Program for System-Wide Change for All Learners and Educators (S.C.A.L.E.).

A. Excerpts from the Secondary Literacy Plan

The goal of the Los Angeles Unified School District's *Secondary Literacy Plan* is to enhance the District's efforts to provide learning opportunities and instruction to enable all middle and high school students to perform rigorous work and to meet or exceed proficiency in each content area. The plan is designed to address student and teacher needs and overcome challenges commonly faced in middle and high school today. The purposes of the plan include the following:

- To address literacy in all content areas.
- To help secondary teachers define their role in teaching reading and writing in their content areas.
- To help struggling students with basic reading and writing skills and to provide differentiated support.
- To train secondary content area teachers to provide additional, differentiated support for students who lack basic reading and writing skills.
- To change the institutional culture and school structures of traditional middle and high schools that often isolate teachers and students and act as barriers to learning and change.

To meet the challenges of the *Secondary Literacy Plan* some actions are to:

- Develop instructional guides to support standards-based instruction for specific content areas.
- Communicate that content literacy addresses the development of literacy and content knowledge simultaneously.
- Organize instruction at the secondary level to create and support learning conditions that will help all students succeed.
- Implement a coherent ongoing professional development plan that will provide content area teachers with content-specific knowledge and expertise to meet the varied learning and literacy needs of all students.
- Structure an organizational design (literacy cadres and coaches) that will enhance each schools capacity to address the teaching of students with diverse learning needs.
- Create an infrastructure that will include instructional models to support the expert teaching of content aligned to the standards.
- Differentiate instructional programs to meet the varied needs of all students, particularly those who need extensive accelerated instruction in decoding, encoding, and reading fluency

The Division of Instructional Support Services is presently engaged in a comprehensive review of all intervention strategies and programs. This office will bring forward recommendations that will better define our intervention programs and ensure that all interventions are research-based, effective, and correlated to classroom instruction. The office will identify specific interventions and recommendations for grades K through 12 including a comprehensive review of the present summer school, intercession, and other interventions programs. It is critical that as we implement standards-based instruction, that we have the capacity to diagnose student weaknesses and prescribe specific interventions that will help correct those weaknesses. In accomplishing this goal, we will need to: identify in-class strategies, extended day strategies, and strategies that can be implemented in summer school and intersession programs. Professional development must be provided so that all teachers are taught instructional approaches that support success for all students.

Figure 1 illustrates an overview of the Secondary Literacy Plan Components and shows the "content connections" among the disciplines of Science, English Language Arts, Mathematics, and Social Studies. The interaction of the standards, professional development, assessment and evaluation combine to form an interactive system that promotes content literacy.

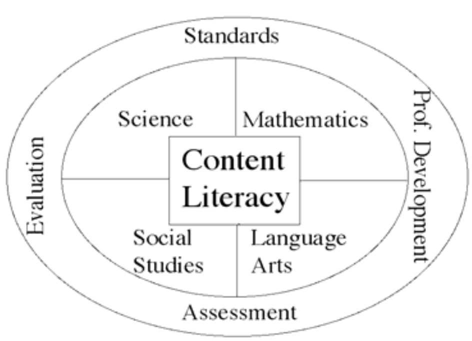

Figure 1- Secondary Literacy Chart

B. Culturally Relevant Teaching Methods to Close the Achievement Gap

In June of 2000, the LAUSD Board of Education approved a resolution that called for an Action Plan to eliminate the disparities in educational outcomes for African American as well as other student groups. Five major tenets, along with their recommendations, performance goals, and evaluations are to be embedded into all District instructional programs. The Science Instructional Guide for Middle School Grades 6-8 supports these tenets that are:

• Tenet 1 – Students Opportunity to Learn (Student-Focused):

Comprehensive professional development for administrators, teachers, counselors, and coaches on Culturally Responsive and Culturally Contextualized Teaching will ensure that instruction for African American students is relevant and responsive to their learning needs.

• Tenet 2 - Students' Opportunity to Learn (Adult-Focused):

The District will provide professional development in the Academic English Mastery Program (AEMP) to promote language acquisition and improve student achievement.

• Tenet 3 – Professional Development for Teachers and Staff Responsible for the Education of African American Students.

The District will make every effort to ensure that all staff (Central, Local District, and School Site) and all external support providers are adequately trained and have the pedagogical knowledge and skill to effectively enhance the academic achievement of African American students.

• Tenet 4 - Engage African American parents and community in education of African American students.

Parents should be given the opportunity and the tools to be effective educational advocates for their children. The District will continue to support the efforts of its schools to engage parents in the education of their children through improved communication among schools, teachers, and parents.

•Tenet 5 - Ongoing planning, systematic monitoring, and reporting

The disparities in educational outcomes for African American as well as other students will be systemically monitored and ongoing reflection and planning will occur at all levels in the District.

Culturally Relevant and Responsive Methods for increasing achievement outcomes for African American and other underachieving students of Color.

The following are basic assumptions upon which culturally relevant and responsive instruction and learning is built.

Basic Assumptions

- **Comprehensible:** Culturally Responsive Teaching teaches the whole child. Culturally Responsive teachers develop intellectual, social emotional, and political learnings by using cultural references to impart knowledge, skills, and attitudes.

- **Multidimensional:** Culturally Responsive Teaching encompasses content, learning context, classroom climate, student-teacher relationships, instructional techniques, and performance assessments.

- **Empowering:** Culturally Responsive Teaching enables students to be better human beings and more successful learners. Empowering translates into academic competence, personal confidence, courage, and the will to act.

- **Transformative:** Culturally Responsive Teaching defies conventions of traditional educational practices with respect to ethnic students of color. It uses the cultures and experience of students of color as worthwhile resources for teaching and learning, recognizes the strengths of these students and enhances them further in the instructional process. Culturally Responsive Teaching transforms teachers and students. It is in the interactions with individual educators that students are either empowered or alternately, disabled - personally and academically.

- **Emancipatory:** Culturally Responsive Teaching is liberating. It makes authentic knowledge about different ethnic groups accessible to students and the validation, information, and pride it generates are both psychologically and intellectually liberating.

C. Small Learning Communities

The Los Angeles Unified School District is committed to the learning of every child. That commitment demands that every child has access to rich educational opportunities and supportive, personalized learning environments. That commitment demands that schools deliver a rich and rigorous academic curriculum and that students meet rigorous academic standards. Correspondingly, the large, industrial model schools typical of urban areas will be reconfigured and new schools will be built and/or organized to accommodate Small Learning Communities. These communities will be characterized by:

- Personalized instruction
- Respectful and supportive learning environments
- Focused curriculum
- Rigorous academic performance standards
- Continuity of instruction
- Continuity of student-teacher relationships
- Community-based partnerships
- Joint use of facilities
- Accountability for students, parents, and teachers
  - Providing differentiated professional development in content and pedagogy in standards- based curriculum.
  - Encouraging enrollment in advanced mathematics and science courses.
- Increased communication and collaboration
- Flexibility and innovation for students, parents, and teachers

The LAUSD is committed to the redesign of its schools. That commitment includes the willingness to treat students as individuals and the willingness to allow each school to fulfill the goals of the Small Learning Community ideals in the uniqueness of its own setting.

D. Mathematics, Science, Partnership Grants - System-wide Change for All Learners and Educators (S.C.A.L.E)

The S.C.A.L.E. partnership is a five year NSF grant program that brings together mathematicians, scientists, social scientists, engineers, technologists, and education practitioners to build a whole new approach to enhancing mathematics and science education. The goal of S.C.A.L.E. is to improve the mathematics and science achievement of all students at all grade levels by engaging them in deep and authentic instructional experiences. One major component of the partnership is to have all students engaged in an extended (e.g., four weeks or more) scientific investigation at least once a school year.

I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding of a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

Sir Isaac Newton (1642-1727) English physicist, mathematician.

II. State of California Documents

The High School Instructional Guide for Chemistry is built upon the framework provided by the *Science Content Standards for California Public Schools© 2000*, the *California Standards for the Teaching Profession*, and the *Science Framework for California Public Schools©2003*. Each of these California documents has overarching implications for every grade level from Pre-K to 12.

The *Science Content Standards for California Public Schools, Kindergarten through Grade 12* represents the content of science education and includes essential skills and knowledge students will need to be scientifically literate citizens in the twenty-first century. The *Science Framework for California Public Schools* is a blueprint for reform of the science curriculum, instruction, professional preparation and development, and instructional materials in California. The science standards contain precise descriptions of what to teach at specific grade levels; the framework extends those guidelines by providing the scientific background and the classroom context for teachers to use as a guide. The framework is intended to (1) organize the body of knowledge that student need to learn during their elementary and secondary school years; and (2) illuminate skills that will be used to extend that knowledge during the students' lifetimes. These documents drive science instruction in California.

A. The California Content Standards

The California content standards are organized in each assessment period for instructional purposes and continuity of scientific concepts. They provide the foundational content that each student should achieve. Simply dividing the standards by the number of instructional days and teaching each standard discretely is neither efficient nor effective. The *Framework* states, "effective science programs reflect a balanced, comprehensive approach that includes the teaching of investigation and experimentation skills along with direct instruction and reading (p.11)." Teaching them in the same sequence as written also contradicts the *Framework* which states that "Investigation and experimentation cuts across all content areas…(p.11)"

The standards for, Biology, Chemistry, Physics, and Earth Science are mapped into 3 assessment and instructional components. The standards for Integrated/Coordinated Science I are mapped into 4 assessment and instructional components. The teacher, student, administrator and public must understand that the standards reflect "the desired content of science curriculum…" and they "should be taught so that students have the opportunity to build connections that link science to technology and societal impacts (*Science Content Standards*, p. ix)." Thus, the standards are the foundation for understanding societal issues such as the environment, community health , natural resources , population, and technology.

B. Science Framework for California Public Schools

The *Science Framework for California Public Schools* supports the California Science Content Standards. The *Framework* "establishes guiding principles that define attributes of a quality science curriculum at all grade levels...(pp v -vi) "

These principles of an effective science education program address the complexity of the science content and the methods by which science content is effectively taught. The guiding principles are discussed in this Instructional Guide in the section entitled: "The Role of the *Instructional Guide* as a Resource to Support Instruction." These principles state that effective science programs:

- Are based on standards and use standards-based instructional materials.
- Develop students' command of the academic language of science used in the content standards.
- Reflect a balanced, comprehensive approach that includes the teaching of investigation and experimentation skills along with direct instruction and reading.
- Use multiple instructional strategies and provide students with multiple opportunities to master content standards.
- Include continual assessment of students' knowledge and understanding with appropriate adjustments being made during the academic year.

C. California Standards for the Teaching Profession

The *California Standards for the Teaching Profession* provide the foundation for the teaching profession. These standards offer a common language and create a vision that enables all teachers to define and develop effective teaching practices. Reflected in these standards is a critical need for all teachers to be responsive to the diverse cultural, linguistic, and socioeconomic backgrounds of their students. These standards, which take a holistic view of teaching that recognizes its complexity, are based upon expert advice and current research on the best teaching practices. *The California Standards for the Teaching Profession* provides a framework of six standards with thirty-two key elements that represent a developmental, holistic view of teaching, and are intended to meet the needs of diverse teachers and students. These standards are designed to help educators do the following:

- Reflect about student learning and practice;
- Formulate professional goals to improve their teaching practice; and
- Guide, monitor and assess the progress of a teacher's practice toward professional goals and professionally accepted benchmarks.

The teaching standards are summarized below. Further expansion and explanation of the key elements are presented in the complete text, *California Standards for the Teaching Profession*, which can be obtained from the California Commission on Teacher Credentialing at: http://www.ctc.ca.gov/reports/cstpreport.pdf

1. Standard for Engaging and Supporting All Students in Learning

Teachers build on students' prior knowledge, life experience, and interests to achieve learning goals for all students. Teachers use a variety of instructional strategies and resources that respond to students' diverse needs. Teachers facilitate challenging learning experiences for all students in environments that promote autonomy, interaction and choice.

Teachers actively engage all students in problem solving and critical thinking within and across subject matter areas. Concepts and skills are taught in ways that encourage students to apply them in real-life contexts that make subject matter meaningful. Teachers assist all students to become self-directed learners who are able to demonstrate, articulate, and evaluate what they learn.

2. Standard for Creating and Maintaining Effective Environments for Student Learning

Teachers create physical environments that engage all students in purposeful learning activities and encourage constructive interactions among students. Teachers maintain safe learning environments in which all students are treated fairly and respectfully as they assume responsibility for themselves and one another. Teachers encourage all students to participate in making decisions and in working independently and collaboratively. Expectation for student behavior are established early, clearly understood, and consistently maintained. Teachers make effective use of instructional time as they implement class procedures and routines.

3. Standard for Understanding and Organizing Subject Matter for Student Understanding

Teachers exhibit strong working knowledge of subject matter and student development. Teachers organize curriculum to facilitate students' understanding of the central themes, concepts, and skills in the subject area. Teachers interrelate ideas and information within and across curricular areas to extend students' understanding. Teachers use their knowledge of student development, subject matter, instructional resources and teaching strategies to make subject matter accessible to all students.

4. Standard for Planning Instruction and Designing Learning Experiences for All Students

Teachers plan instruction that draws on and values students' backgrounds, prior knowledge, and interests. Teachers establish challenging learning goals for all students based on student experience, language, development, and home and school expectations, and include a repertoire of instructional strategies. Teachers use instructional activities that promote learning goals and connect with student experiences and interests. Teachers modify and adjust instructional plans according to student engagement and achievement.

5. Standard for Assessing Student Learning

Teachers establish and clearly communicate learning goals for all students. Teachers collect information about student performance from a variety of sources. Teachers involve students in assessing their own learning. Teachers use information from a variety of on-going assessments to plan and adjust learning opportunities that promote academic achievement and personal growth for all students. Teachers exchange information about student learning with students, families, and support personnel in ways that improve understanding and encourage further academic progress.

6. Standard for Developing as a Professional Educator

Teachers reflect on their teaching practice and actively engage in planning their professional development. Teachers establish professional learning goals, pursue opportunities to develop professional knowledge and skill, and participate in the extended professional community. Teachers learn about and work with local communities to improve their professional practice. Teachers communicate effectively with families and involve them in student learning and the school community. Teachers contribute to school activities, promote school goals and improve professional practice by working collegially with all school staff. Teachers balance professional responsibilities and maintain motivation and commitment to all students.

These Standards for the Teaching Profession along with the Content Standards and the Science Framework provide guidance for our District to achieve the objective that all students achieve a "high degree of scientific literacy."

III. Pedagogy for Science

Webster's defines pedagogy as: "1. the function or work of the teacher; teaching, 2. the art or science of teaching; education: instructional methods."

A. Instruction, Learning Transfer, Inquiry

By the time students enter high school, they are required to shift from a middle school science focus on experiential based thinking to more abstract hypothetical thinking required by the High School Content standards and the Investigation and Experimentation (I&E) Standards described in the Science Framework for California Public Schools. For instance, in grade six the I&E Standards call for students to "develop a hypothesis" and "construct appropriate graphs from data and develop qualitative statements about the relationships between variables." This emphasis is consistent with the increased cognitive demand in middle school mathematics: "By the end of grade seven, students are adept at manipulating numbers and equations and understand the general principles at work…They graph linear functions and understand the idea of slope and its relationship to ratio." (Mathematics Framework for California Public Schools). By providing multiple opportunities for students to learn the science content by designing experiments, generating hypotheses, collecting and organizing data, representing data in tables and graphs, analyzing the results and communicating the findings, students are developing and applying mathematical concepts in multiple contexts. This process facilitates the development of students' hypothetical thinking operations and provides the foundation for transfer of learning not only between mathematics and science but also to other disciplines and creates the need to use these mathematical and scientific tools in the students' everyday lives.

In learning the science content standards in grade eight, as well as in grades six and seven, students will need multiple opportunities to "plan and conduct a scientific investigation to test a hypothesis… construct appropriate graphs from data and develop quantitative statements about the relationships between variables,…apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms…Distinguish between linear and nonlinear relationships on a graph of data" as described in the Standards. Focusing instruction on the acquisition of these mathematical and scientific tools will ensure that "Students…are prepared to undertake the study of algebra… in grade eight… and will be on the pathway for success in high school science." (Science Framework for California Public Schools)

To ensure that students are prepared for the quantitative and abstract nature of high school science, there should be a continued emphasis on the inquiry-based instructional model. This model includes many common elements or phases described in the research literature on how students best learn science concepts. The research clearly points out that inquiry involves asking a question, making observations related to that question, planning an investigation, collecting relevant data, reflecting on the need to collect additional data, analyzing the data to construct plausible explanations, and then communicating findings to others.

Such a process is at the heart of the immersion units (extended inquiry) described in both the elementary and secondary instructional guides. To help science teachers plan and organize their immersion and other inquiry-based units the following process can serve as a guide:

- Phase 1. Students are engaged by a scientific question, event, or phenomenon. A connection is made to what they already know. Questions are posed in ways that motivate students to learn more.
- Phase 2. Students explore ideas through direct, hands-on investigations that emphasize observation, solve problems, formulate and test explanations, and create and discuss explanations for what they have observed.
- Phase 3. Students analyze and interpret data they have collected, synthesize their ideas, and build concepts and new models with the support of their teacher. The

interaction between teachers and students and the use of other sources of scientific knowledge allows learners to clarify concepts and explain that have been developed.

- Phase 4. Students apply their new understanding to new settings including real life situations to elaborate on their new knowledge.
- Phase 5. Students, with their teachers, review and assess what they have learned, and evaluate their understanding.

There are many factors that should be included in such instructional models to ensure the transfer of learning to new settings[1]. One such factor that affects transfer of learning is the degree of mastery of initial learning. Initial learning is influenced by the degree to which students learn with understanding rather than memorizing a set of facts or procedures. Students must be provided with enough time for them to process information. Attempts to cover too many topics too quickly may inhibit later transfer because students only remember isolated facts or are introduced to organizing concepts they cannot grasp because they do not have enough specific information related to what they are learning.

Motivation is a factor that affects the amount of time students are willing to spend on science learning. Students who have "choice and voice" in investigations they are conducting, who engage in novel experiences, and who encounter unexpected outcomes usually develop the intrinsic motivation associated with long-term, sustainable intellectual growth that characterizes effective learning transfer. Knowing that one is contributing something meaningful to others (in cooperative groups) is particularly motivating. Learners are also motivated when they are able to see the usefulness of learning and when they can use what they have learned to do something that has an impact on others. Examples include tutoring or helping younger students learn science or participatory science nights for parents, community members and other students. Seeing real life application of what students have learned creates the so-called "Aha" response when they fit concepts learned to actual situations. Such transfer can be very motivating to students[1].

A crucial element of learning transfer is related to the context of learning. Knowledge or concepts that are taught in a single context are less likely to support transfer than is knowledge that is taught and experienced in multiple contexts. Students exposed to several contexts are more likely to abstract and intuit common features of experience and by so doing develop a more flexible representation of knowledge. To accomplish all of this, teachers of science:[2]

- Plan an inquiry-based science program for their students
- Guide and facilitate learning
- Use standards aligned texts and supplemental materials
- Engage in ongoing assessment of both their teaching and student learning
- Design and manage learning environments that provide students with the time, space, and resources needed for learning science
- Develop communities of science learners that reflect the intellectual rigor of science inquiry and the attitudes and social values conducive to science learning
- Actively participate in the ongoing planning and development of the school science program

The following chart provides a way to gauge instructional transfer by monitoring student behavior or by using possible teacher strategies. The chart is adapted with permission from BSCS (Biological Science Curriculum Study) and is intended to be used to assess units of study rather than individual lessons:

[1] How People Learn, Expanded Edition; Bransford, John D; Chapter 3, Learning and Transfer; National Academy Press; Washington D.C.; 2000

[2] National Science Education Standards; Chapter 3, Science Teaching Standards; National Academy Press, Washington D.C.; 1996

The Learning Cycle

Stage of Inquiry in an Inquiry-Based Science Program	Possible Student Behavior	Possible Teacher Strategy
Engage	Asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? How can I solve this problem? Shows interest in the topic.	Creates interest. Generates curiosity. Raises questions and problems. Elicits responses that uncover student knowledge about the concept/topic.
Explore	Thinks creatively within the limits of the activity. Tests predictions and hypotheses. Forms new predictions and hypotheses. Tries alternatives to solve a problem and discusses them with others. Records observations and ideas. Suspends judgment. Tests idea	Encourages students to work together without direct instruction from the teacher. Observes and listens to students as they interact. Asks probing questions to redirect students' investigations when necessary. Provides time for students to puzzle through problems. Acts as a consultant for students.
Explain	Explains their thinking, ideas and possible solutions or answers to other students. Listens critically to other students' explanations. Questions other students' explanations. Listens to and tries to comprehend explanations offered by the teacher. Refers to previous activities. Uses recorded data in explanations.	Encourages students to explain concepts and definitions in their own words. Asks for justification (evidence) and clarification from students. Formally provides definitions, explanations, and new vocabulary. Uses students' previous experiences as the basis for explaining concepts.
Elaborate	Applies scientific concepts, labels, definitions, explanations, and skills in new, but similar situations. Uses previous information to ask questions, propose solutions, make decisions, design experiments. Draws reasonable conclusions from evidence. Records observations and explanations	Expects students to use vocabulary, definitions, and explanations provided previously in new context. Encourages students to apply the concepts and skills in new situations. Reminds students of alternative explanations. Refers students to alternative explanations.
Evaluate	Checks for understanding among peers. Answers open-ended questions by using observations, evidence, and previously accepted explanations. Demonstrates an understanding or knowledge of the concept or skill. Evaluates his or her own progress and knowledge. Asks related questions that would encourage future investigations.	Refers students to existing data and evidence and asks, What do you know? Why do you think...? Observes students as they apply new concepts and skills. Assesses students' knowledge and/or skills. Looks for evidence that students have changed their thinking. Allows students to assess their learning and group process skills. Asks open-ended questions such as, Why do you think...? What evidence do you have? What do you know about the problem? How would you answer the question?

Chart 1 - The 5 E Model (R. Bybee)

B. Principles and Domains of Culturally Relevant and Responsive Pedagogy

1. Knowledge and Experience
   a. Teachers must build their personal knowledge of cultures represented in the classroom.
   b. Teachers must identify cultural practices aligned with specific learning tasks
   c. Teachers must engage students in instructional conversations that draw on their language competencies outside the school to serve as learning norms of reasoning within the academic subject matter.

2. Social and Emotional Elements
   a. Teachers must begin the process of becoming more caring and culturally competent by acquiring a knowledge base about ethnic and cultural diversity in education.
   b. Teachers must conduct a careful self-analysis of what they believe about the relationship among culture, ethnicity, and intellectual ability.
   c. Teachers must identify and understand attitudes and behaviors that can obstruct student achievement.
   d.
3. Equity and Equality
   a. Teachers must vary the format of instruction by incorporating multi-modality teaching that allows students to demonstrate competence in different ways.
   b. Teachers must acknowledge and accept that students can demonstrate knowledge in non-traditional ways.
   c. Teachers must build knowledge and understanding about cultural orientations related to preferred cognitive, interactive, and learning styles.
4. Quality and Rigorous Instruction
   a. Teachers must emphasize academic rigor at all times
   b. Teachers must provide clear expectations of student's accomplishments.
   c. Teachers must promote higher order thinking skills
5. Instructional strategies
   a. Teachers must use cooperative learning, apprenticeship, and peer coaching strategies as instructional strategies.
   b. Teachers must provide ample opportunity for each student to read, write, and speak.
   c. Teachers must use constructivist learning approaches.Teachers must teach through active application of facts and skills by working with other students, use of computers, and other multi-media.

   d. Teachers must provide continuous feedback on students work
6. Pedagogical Approaches
   a. Teachers must assist students to use inductive and deductive reasoning to construct meaning.
   b. Teachers must scaffold and relate students' everyday learning to their accumulative previous academic knowledge
   c. Teachers must modify curriculum-learning activities for diverse students.
   d. Teachers must believe that intelligence is an effort-based rather than inherited phenomenon
7. Assessment and Diagnosis
   a. Teachers must use testing measurements for diagnostic purposes.
   b. Teachers must apply periodic assessments to determine students' progress and adjust curriculum
   c. Teachers must seek alternative approaches to fixed time tests to assess students' progress.
   d. Teachers must supplement curriculum with more multi-cultural and rigorous tests.
   e. Teachers must evaluate students of different backgrounds by standards appropriate to them and their education and life experience

> But are we sure of our observational facts? Scientific men are rather fond of saying pontifically that one ought to be quite sure of one's observational facts before embarking on theory. Fortunately those who give this advice do not practice what they preach. Observation and theory get on best when they are mixed together, both helping one another in the pursuit of truth. It is a good rule not to put overmuch confidence in a theory until it has been confirmed by observation. I hope I shall not shock the experimental physicists too much if I add that it is also a good rule not to put overmuch confidence in the observational results that are put forward until they have been confirmed by theory.
>
> Sir Arthur Stanley Eddington (1882-1944) English astronomer and physicist.

IV. Overview of Assessment

A. Concepts for Assessment in Science

Instruction in our district is assessment-driven. The Framework states "that effective science programs include continual assessment of student's knowledge and understanding, with appropriate adjustments being made during the academic year (p.11)."[1] Assessments can be on demand or over a long period of time.

The chart below, adapted from *A Guide for Teaching and Learning*, NRC (2000), gives some examples of on demand and over time assessment.

On Demand → Over Time

answering questions multiple choice true false matching	constructed response essays	investigations immersion projects research reports projects	portfolios journals lab notebooks

Chart 1 - Assessment Examples

Grant Wiggins and Jay McTighe state that, "The continuum of assessment methods includes checks of understanding (such as oral questions, observations, and informal dialogues); traditional quizzes, tests, and open-ended prompts; and performance tasks and projects. They vary in scope (from simple to complex), time frame (from short-term to long-term), setting (from decontextualized to authentic contexts), and structure (from highly structured to unstructured). Because understanding develops as a result of ongoing inquiry and rethinking, the assessment of understanding should be thought of in terms of a collection of evidence over time instead of an event, a single moment in time test at the end of instruction, as so often happens in current practice.[2]

B. LAUSD Periodic Assessments in Science

As an integral element of the Secondary Periodic Assessment Program, Integrated/Coordinated Science, Biology and Chemistry science assessments are designed to measure teaching and learning. The intent of these Periodic Assessments is to provide teachers and the LAUSD with the diagnostic information needed to ensure that students have received instruction in the science content specified by the *California Academic Content Standards*, and to provide direction for instruction or additional resources that students may require in order for students to become proficient in science. They are specifically designed to:

- focus classroom instruction on the California Content Standards;
- ensure that all students are provided access to the content in the Standards;
- provide a coherent system for connecting the assessment of content with district programs and adopted materials;
- be administered to all students on a periodic basis;

- guide instruction by providing frequent feedback that will help teachers target the specific standards-based knowledge and skills that students need to acquire;
- assist teachers in determining appropriate extensions and interventions;
- motivate students to be responsible for their own learning;
- provide useful information to parents regarding student progress toward proficiency of the standards; and
- connect professional development to standards-specific student achievement data.

Results from the Periodic Assessments should be used to specify immediate adjustments and guide modifications in instruction to assist all students in meeting or exceeding the State's science content standards.

Each instructional component provides sample performance tasks that can be used to monitor student progress. These classroom level assessments, along with other teacher designed tests, student evaluations, and student and teacher reflections, can be used to create a complete classroom assessment plan.

Results from classroom assessments and the Periodic Assessments provide administrators, teachers and students with immediate and useful information on progress toward achievement of the standards. With results and reflection, administrators, teachers and students can make informed decisions about instruction.

At the conclusion of each instructional component, students will take a Periodic Assessment that will be scored electronically. These diagnostic assessments are a more formal assessment of the students' accomplishment of the standards within the science discipline but should not be considered the sole method of assessing students' content knowledge. Each assessment is designed to measure a range of skills and knowledge.

Each periodic assessment will consist of multiple-choice questions and one short constructed response question. Each assessment will be scheduled within a testing window at regular intervals during the school year. Science test booklets will be available in both English and Spanish.

C. Scoring of District Periodic Assessments

The multiple-choice sections of each periodic assessment will be scored electronically at the school site by each teacher. The short constructed response section will be scored by the teacher using a four point rubric.

D. Unit Reflection, Intervention, Enhancement

Reflection and intervention is a part of daily classroom instruction and unit planning. Decisions to simply review or to incorporate research-based practices to assist students in achieving the complex tasks identified in the science content standards are made each day as teachers assess student understanding. In addition, following each periodic assessment, time is set aside for reflection, intervention, and lesson planning as students and teachers review assessment scores and strategically establish a course of action before moving on to the next instructional component. To aid in post-assessment discussion, each teacher will receive with each form of the assessment a detailed answer key and answer rationale document that can be used for reflection and discussion of the standards.

Using the answer rationale document with the explanation of the distracters for each standards-aligned test item, teachers can discuss common misconceptions and beliefs related to each item with their students. It must be noted that, at present, 4 days are set aside for formal intervention and/or enhancement of the assessed *Instructional Component.* To enhance post assessment dialogue, a professional development module will be provided for each component.

> The men of experiment are like the ant, they only collect and use; the reasoners resemble spiders, who make cobwebs out of their own substance. But the bee takes the middle course: it gathers its material from the flowers of the garden and field, but transforms and digests it by a power of its own. Not unlike this is the true business of philosophy (science); for it neither relies solely or chiefly on the powers of the mind, nor does it take the matter which it gathers from natural history and mechanical experiments and lay up in the memory whole, as it finds it, but lays it up in the understanding altered and disgested. Therefore, from a closer and purer league between these two faculties, the experimental and the rational (such as has never been made), much may be hoped.
>
> Francis Bacon, *Novum Organum*, Liberal Arts Press, Inc., New York, p 93. (5)

E. Sample California Standards Test Questions

Chemistry Released Test Questions

This is a sample of California Standards Test questions. This is NOT an operational test form. Test scores cannot be projected based on performance on released test questions.
C A L I F O R N I A S T A N D A R D S T E S T

1 Electrical fires cannot be safely put out by dousing them with water. However, fire extinguishers that spray solid carbon dioxide on the fire work very effectively. This method works because carbon dioxide
A displaces the oxygen.
B renders the fire's fuel non-flammable.
C forms water vapor.
D blows the fire out with strong wind currents.

2 In order to advance to the level of a theory, a hypothesis should be
A obviously accepted by most people.
B a fully functional experiment.
C in alignment with past theories.
D repeatedly confirmed by experimentation.

3 When a metal is heated in a flame, the flame has a distinctive color. This information was eventually extended to the study of stars because
A the color spectra of stars indicate which elements are present.
B a red shift in star color indicates stars are moving away.
C star color indicates absolute distance.
D it allows the observer to determine the size of stars.

7 Which of the following atoms has six valence electrons?
A magnesium (Mg)
B silicon (Si)
C sulfur (S)
D argon (Ar)

8 Which statement *best* describes the density of an atom's nucleus?
A The nucleus occupies most of the atom's volume but contains little of its mass.
B The nucleus occupies very little of the atom's volume and contains little of its mass.
C The nucleus occupies most of the atom's volume and contains most of its mass.
D The nucleus occupies very little of the atom's volume but contains most of its mass.

9 A 2-cm-thick piece of cardboard placed over a radiation source would be *most* effective in protecting against which type of radiation?
A alpha
B beta
C gamma
D x-ray

10 The reason salt crystals, such as KCl, hold together so well is because the cations are strongly attracted to
A neighboring cations.
B the protons in the neighboring nucleus.
C free electrons in the crystals.

12 Which substance is made up of many monomers joined together in long chains?
A salt
B protein
C ethanol
D propane

D neighboring anions.

13 Proteins are large macromolecules composed of thousands of subunits. The structure of the protein depends on the sequence of

A lipids.
B monosaccharides.
C amino acids.
D nucleosides.

14 When someone standing at one end of a large room opens a bottle of vinegar, it may take several minutes for a person at the other end to smell it. Gas molecules at room temperature move at very high velocities, so what is responsible for the delay in detection of the vinegar?

A the increase in the airspace occupied by vinegar molecules
B the chemical reaction with nerves, which is slower than other sensory processes
C attractive forces between the air and vinegar molecules
D random collisions between the air and vinegar molecules

17 What is the equivalent of 423 kelvin in degrees Celsius?

A –223 ºC
B –23 ºC
C 150 ºC
D 696 ºC

18 If the attractive forces among solid particles are less than the attractive forces between the solid and a liquid, the solid will

A probably form a new precipitate as its crystal lattice is broken and re-formed.
B be unaffected because attractive forces within the crystal lattice are too strong for the dissolution to occur.
C begin the process of melting to form a liquid.
D dissolve as particles are pulled away from the crystal lattice by the liquid molecules.

19 If the solubility of NaCl at 25 $_{o}$C is 36.2 g/100 g H_2O, what mass of NaCl can be dissolved in 50.0 g of H_2O?

A 18.1 g
B 36.2 g
C 72.4 g
D 86.2 g

20 How many moles of HNO_3 are needed to prepare 5.0 liters of a 2.0 M solution of HNO_3?

A 2.5
B 5
C 10
D 20

21 The random molecular motion of a substance is greatest when the substance is

A condensed.
B a liquid.
C frozen.
D a gas.

22 The boiling point of liquid nitrogen is 77 kelvin. It is observed that ice forms at the opening of a container of liquid nitrogen. The *best* explanation for this observation is

A water at zero degrees Celsius is colder than liquid nitrogen and freezes.
B the nitrogen boils and then cools to form a solid at the opening of the container.
C water trapped in the liquid nitrogen escapes and freezes.

D the water vapor in the air over the opening of the liquid nitrogen freezes out.

23 The specific heat of copper is about 0.4 joules/ gram °C. How much heat is needed to change the temperature of a 30-gram sample of copper from 20.0 °C to 60.0 °C?
A 1000 J
B 720 J
C 480 J
D 240 J

24 Equal volumes of 1 molar hydrochloric acid (HCl) and 1 molar sodium hydroxide base (NaOH) are mixed. After mixing, the solution will be
A strongly acidic.
B weakly acidic.
C nearly neutral.
D weakly basic.

25 A catalyst can speed up the rate of a given chemical reaction by
A increasing the equilibrium constant in favor of products.
B lowering the activation energy required for the reaction to occur.
C raising the temperature at which the reaction occurs.
D increasing the pressure of reactants, thus favoring products

.

26 When a reaction is at equilibrium and more reactant is added, which of the following changes is the immediate result?
A The reverse reaction rate remains the same.
B The forward reaction rate increases.
C The reverse reaction rate decreases.
D The forward reaction rate remains the same.

29 How many moles of carbon-12 are contained in exactly 6 grams of carbon-12?
A 0 5 . mole
B 2 0. moles
C 3 01 10^{23} . × moles
D 6 02 10^{23} . × moles

30 How many moles of CH_4 are contained in 96.0 grams of CH_4?
A 3.00 moles
B 6.00 moles
C 12.0 moles
D 16.0 moles

Question Number	Correct Answer	Standard	Year of Test
1	A	Chemistry I & E 1d	2004
2	D	Chemistry I & E 1f	2004
3	A	Chemistry I & E 1k	2003
7	C	Chemistry 1d	2003
8	D	Chemistry 1e	2004
9	A	Chemistry 11e	2003
10	D	Chemistry 2c	2004
12	B	Chemistry 10a	2003
13	C	Chemistry 10c	2004
14	D	Chemistry 4b	2004
15	C	Chemistry 4c	2003
16	A	Chemistry 4d	2004
17	C	Chemistry 4e	2003
18	D	Chemistry 6b	2004
19	A	Chemistry 6d	2003

20	C	Chemistry 6d	2004
21	D	Chemistry 7a	2003
22	D	Chemistry 7c	2004
23	C	Chemistry 7d	2003
24	C	Chemistry 5a	2003
25	B	Chemistry 8c	2003
26	B	Chemistry 9a	2003
29	A	Chemistry 3b	2004
30	B	Chemistry 3d	2003

V. Introduction to the Chemistry Section

District Course Name: Chemistry AB

Thumbnail Description: Annual Course—Grades 10–12 Prerequisite: Algebra 1AB or equivalent. Geometry 1AB is recommended.

Course Code Number and Abbreviation:

36-14-01 Chem A
36-14-02 Chem B
Brief Course Description*:*
Chemistry is a laboratory-based college-preparatory course. Laboratory experiments provide the empirical basis for understanding and confirming concepts. This course emphasizes discussions, activities, and laboratory exercises which promote the understanding of the behavior of matter at the macroscopic and the molecular-atomic levels. Chemical principles are introduced so that students will be able to explain the composition and chemical behavior of their world. **Chemistry AB meets the Grades 9–12 District physical science requirement. Students must complete one physical and one life science requirement. This course meets one year of the University of California '*d*' entrance requirement for laboratory science.**

Content of this Section:

- Chemistry Periodic Assessments Organizer - A place for you to write down the 5 day window for your assessment.

- Science Instructional Guide Graphic Organizer Overview for Chemistry - Provides the user with the Content Standards for the 3 Periodic Diagnostic Assessments.

- Legend Key for Matrix Chart - Provides a key that explains the Matrix Chart

- LAUSD - Chemistry Matrix Chart - Contains the Content Standards, the standards grouped in Content Standard Groups, the Standards Analyzed, and Instructional Resources with Sample Performance Tasks, Sample Scoring Criteria, Some Suggested Concepts and Skills to Support Student Success on the Sample Performance Task, and Possible Standards Aligned Resources.

- Chemistry

Periodic Assessments Organizer

This page will serve as a reference for you. Please fill in your appropriate track periodic assessment dates. Also fill in the dates for 4 days of reflection, intervention, and enrichment following the first two periodic assessments.

Chemistry Periodic Assessment	Periodic Assessment I	Periodic Assessment II	Periodic Assessment III
Assessment Window Single Track			
Assessment Window Three Tracks			
Assessment Window Four Tracks			

Science Instructional Guide Graphic Organizer Overview For Chemistry

<u>Science Instructional Guide Overview</u>

I. Major District Initiatives
- Secondary Literacy Plan
- IFL Nine Principles of Learning
- Culturally Relevant Teaching Methods to Close the Achievement Gap
- Small Learning Communities
- LAUSP
- MSP-SCALE

II. State of California Document
- *The California Content Standards*
- *Science Framework for California Public Schools*
- *California Standards for the Teaching Profession*

III. Science Pedagogy

IV. Assessment
- Periodic Assessment
- Scoring of Periodic Assessments
- Unit Reflection and Intervention

Appendix
- District Contacts and other useful information

<u>Instructional Component 1</u>

Standard Sets:
(1b, 1f*, 1c), (1h*, 1i*, 1j*, 1e), (1a, 1g*, 1d), (2e, 2a, 1c, 2g*, 2b, 2c, 2d, 2h*, 2f*), (3b, 3c, 3a)
- Content Standard Group
- Analyzed Standard
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible Standards Aligned Resources

Science Periodic Assessment 1

<u>Instructional Component 2</u>

Standard Sets:
(3d, 3e, 3f*, 3g*) (4a, 4b, 4e, 4f, 4g*) (4c, 3d, 4d, 4h*, 4i*) (6a, 6b, 6d, 6e* 6f*), (9a, 9b, 6c, 9c*), (5a, 5b, 5e*), (5d, 5c, 5f*, 5g*)
- Content Standard Group
- Analyzed Standard
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible

Science Periodic Assessment 2

<u>Instructional Component 3</u>

Standard Sets:
(7a, 7c, 7d), (7b, 7e*, 7f*), (8a, 8b, 8d*, 8c), (10b, 10d*, 10e*, 10a, 10c, 10f*), (11a, 11c, 11d, 11e, 11f*), (11b), (11g*)
- Content Standard Group
- Analyzed Standard
- Instructional Resources:
  - Sample Performance Tasks
  - Sample Scoring Criteria
  - Some Suggested Concepts and Skills to Support Student Success on the Sample Performance
  - Possible Standards Aligned

Science Periodic Assessment 3

<u>Overarching Instructional Components</u>
- Review and Re-teach
- Review results of Periodic Assessments
- Extended Learning Interventions
- Student/teacher reflection on student work
- End of unit assessments
- Use of data

California NCLB Standards Test

LAUSD - High School Instructional Guide
Legend for Matrix Chart

Standards for Instructional Component
The Standard Sets lay the foundation for each Instructional Component. The standards to be learned during this Instructional Component are listed numerically and alphabetically for easy reference and do not intend to suggest any order of teaching the standards.
Content Standard Group: The standards within each Standard Set are organized into smaller "Standard Groups" that provide a conceptual approach for teaching the standards within each Instructional Component. Key Concept for the Content Standard Group: **The Key Concept signifies the "big idea" represented by each Standards Group.**

Analyzed Standards The Standards grouped here cover the Key Concept.	**Instructional Resources**	**Connections and Notes**
Analyzed Standards are a translation of the State's content standards (that begin with students know) into statements of student performance that describes both the activity and the "cognitive" demand placed on the students. The detailed description of the content standards in the *Science Framework for California Public Schools: Kindergarten Through Grade Twelve* (2003) was used extensively in the development of the analyzed standards.	**Possible Standards Aligned Resources** **A. Text Activities** Laboratory and other supplemental activities that address the Standards taken from the supplemental materials of the cited textbooks. **B. Supplemental Activities/Resources** Laboratory and other supplemental activities that address the Standards taken from various cited sources **C. Text Book References** Textbook references from LAUSD adopted series that have been correlated with the Content Standard Group. (The standard(s) for each reference are in parenthesis before the page numbers.) The textbooks referenced are: ***Chemistry: Matter and Change*, (Dingrando, et al.), 2007** **Holt *Chemistry, CA Edition*, (Myers, et al.), 2007** ***World of Chemistry*, (Zumdahl, et al), 2007**	Connections to Investigation and Experimentation standards (I&E), English Language Arts Standards (ELA) and Math Standards (Algebra 1 and Geometry) and space for teachers to make their own notes.

Chemistry
Instructional Component 1

Standards for Instructional Component 1

1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:
a. Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.
b. *Students know* how to use the periodic table to identify metals, semimetals, nonmetals, and halogens.
c. *Students know* how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.
d. *Students know* how to use the periodic table to determine the number of electrons available for bonding.
e. *Students know* the nucleus of the atom is much smaller than the atom yet contains most of its mass.
f*. *Students know* how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.
g*. *Students know* how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.
h*. *Students know* the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.
i*. *Students know* the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.
j*. * *Students know* that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$).

2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:
a. *Students know* atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
b. *Students know* chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent.
c. *Students know* salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
d. *Students know* the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

e. *Students know* how to draw Lewis dot structures.
f*. *Students know* how to predict the shape of simple molecules and their polarity from Lewis dot structures.
g*. *Students know* how electronegativity and ionization energy relate to bond formation.
h*. *Students know* how to identify solids and liquids held together by van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/ melting point temperatures.

3. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:
a. *Students know* how to describe chemical reactions by writing balanced equations.
b. *Students know* the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.
c. *Students know* one mole equals 6.02×10^{23} particles (atoms or molecules).

Investigation and Experimentation (I & E) Standards:

I. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms.
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
j. Recognize the issues of statistical variability and the need for controlled tests.
k. Recognize the cumulative nature of scientific evidence.
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

Standard Group 1 – The Periodic Table
1b. *Students know* how to use the periodic table to identify metals, semimetals, nonmetals, and halogens.
1f*. *Students know* how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.
1c. *Students know* how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.

Standard Group 1 Key Concept – The Periodic Table

Analyzed Standards 1b, 1f*, 1c	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
1b • Classify elements as metals, semimetals, nonmetal, and halogens based on their location on the periodic table.	Glencoe: p. 154 – 158, p. 160, p. 194 – 195 ChemLab: Descriptive chemistry of the elements; or, Lab Manual, p52 – 56, The Periodic Puzzle; Holt: Ch. 4–Sec. 2, p. 124-131 Introductory Activity: Supermarket Activity (ICS-pg. 358-359) Culminating Activity: p. 778; Mendeleev Lab of 1869 Microscale Lab: Reactivity of Halides (CRF) McDougal Littell: Ch 3.4 – A, B, pp. 68-75 GP pp. 75. Ch 3 Sec 3.4 Review Questions IP: pp. 88-89. HW: 32, 34,36, 37, 39, 40, 41, 43 M: pp. 75: Hands-on Minilab	Integrate I & E standards 1d, 1g, and 1l. Activity/Labs: Chemistry: Matter & Change, p 170 – 172, or, Flinn - ChemTopic Labs 4 – The Periodic Table: It's in the Cards
1f* • Classify elements as lanthanide, actinide, and transactinide based on their location on the periodic table. • Understand that the transuranium elements are manmade.	Glencoe: p. 815 - 816 Holt: Ch.4–Sec. 2, p. 130-148 McDougal Littell: 3.4 – A, B; pp. 68-75, 19.1 – B; pp. 674 GP: pp. 75. Section 3.4 Review Questions IP: pp. 88-89. HW: 32, 34,36, 37, 39, 40, 41, 43 M: Lab Manual: Experiment 13: Classifying Elements	Standard 1c has been divided into two parts. Here students will identify chemical groups or families using the periodic table.
1c • Classify elements as alkali	Glencoe: p. 156 – 158, p. 160 – 161, p. 181 – 185	

metals, alkaline earth metals, and transition metals, based on their locations on the periodic table.	(p. 163 – 169)*; p. 197 – 201 Holt: Ch.4–Sec. 3, p. 132-148 Lab 7 : Properties of Some Representative Elements, p. 57 (Introductory Chemistry in the Laboratory by J. Hall, 3rd Ed., p. 57) McDougal Littell: 3.4 – A, B; pp. 68-75, 11.4 – C ; pp. 386- 387 (Metals and Nonmetals) IG: pp. 394: 48-57	

Standard Group 2 – Atomic Structure

1h*. *Students know* the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.
1i*. *Students know* the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.
1j*. *Students know* that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$).
1e. *Students know* the nucleus of the atom is much smaller than the atom yet contains most of its mass.

Standard Group 2 Key Concept – Atomic Structure

Analyzed Standards 1h*, 1i*, 1e, 1a, 1g*, 1d	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
1h* • Analyze the historical development of experimental findings for various subatomic particles as well as the photoelectric effect.	Glencoe: p. 92 – 97, p. 123 – 124 Holt: Ch.3 –Sec. 2, p. 78-79, 81 Ch.3 –Sec. 3, p. 90, 94 Start Activity: Forces of Attraction, p. 73 McDougall Litell: 3.3 – A, B, C, pp. 60-67, 11.1 – A, B, C, 11.2 – A, B, C; pp. 360-370 GP: Section 3.3 (pp. 67), 11.1 (pp. 365), 11.2 (pp. 370) Review Questions IP: pp. 87-88, HW: 17, 20, 21, 24, 25, 28-30.; pp.392, HW: 1-23	Integrate Investigation & Experimentation (I & E) standards 1c, 1d, 1g, and 1k. Integrate I & E standards 1a, 1c, 1d, 1g, 1k.
1i* • Explain the spectral evidence of energy levels in the Bohr model, and the historical importance of the Bohr model as a bridge between classical and modern atomic theory.	Glencoe: p. 127 - 134 Holt" Ch. 3–Sec. 3, p. 91-94 McDougall Litell: See ih* above GP: See ih* above IP: See ih* above M: Lab Manual Exp't 47: Flame Tests	Activity/Lab: Chemisty: Matter & Change, p 124 miniLab Flame Tests or, p 142 ChemLab Line Spectra, or P 953 Try Home Lab #4 Comparing Atomic Sizes
1j*		Integrate I & E standard

• Explain that the spectral pattern in a bright-line spectrum of any element is unique and is produced from the changes in energy levels of electrons according the formula, $E = h\nu$. 1e • Recognize that the volume of the nucleus is much smaller than the volume of the atom, but also makes up most (99.99% or more) of the atom's mass.	Glencoe: p. 122 - 126 Holt: Ch. 3–Sec. 3, p. 92-94 McDougal Littell: See ih* above GP: See ih* above IP: See ih* above Glencoe: p. 94 – 96 Holt: Ch. 3-Sec. 2. p. 82-88 McDougal Littell: See ih* above	1d.

Standard Group 3 – Periodicity and Electron Arrangement
1a. *Students know* how to relate the position of an element in the periodic table to its atomic number and atomic mass
1g*. *Students know* how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.
1d. *Students know* how to use the periodic table to determine the number of electrons available for bonding.

Standard Group 3 Key Concept – Periodicity and Electron Arrangement

Analyzed Standards 1a, 1g*, 1d	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
1a • Understand and recognize that the positions of the elements in the periodic table are determined by their atomic number and, with a few exceptions, by atomic mass.	Glencoe: p. 96 – 104 p. 152 – 154 Holt: Ch. 3-Sec. 2. p. 84-88 Activity: Atoms with more than one Electron (ICS; p.395-402) McDougal Littell: 3.4 A, pp. 68 IP: pp. 88, HW: 39-40	Integrate I & E standards 1a, 1c, 1g. Integrate I & E standards 1c and 1d.
1g* • Identify and group elements based on the element's electron configurations. Students relate the number of valence electrons in an atom of an element to its reactivity and bonding characteristics.	Glencoe: p. 135 – 141; p. 159 – 162 Holt: Ch. 3-Sec. 3. p. 94-97 Group Activity; p. 160 Activity of Structure of Atoms and Ions (hand-out) McDougal Littell: 11.3 – A, B, 11.4 – All, pp. 371-390 GI: Section 11.3 (pp. 376), 11.4 (pp. 390) Review Ques IP: pp. 393-394, HW: 24-57	Chemistry Small Scale Lab Manual, p 13 Lab 4, Periodicity & Properties of Elements, or P 17 Lab 5, Properties of Transition Metals, or Chemistry Matter & Change, p. 164 miniLab Periodicity of Molar Heats
1d • Identify the number of electrons available for bonding according to location on the periodic table.	Glencoe: p. 140, p. 159 – 162, (p. 163 – 169)* Holt: Ch. 4-Sec. 1. p. 116-122, Ch. 4-Sec. 2. p. 124-130 Ch. 5-Sec. 1. p. 158-165 McDougal Littell: 3.5 – A, B, pp. 76-83, See 1 g*	*Note: it is our opinion that the second part of 1c dealing with the trends of ionization energy,

	GI: Section 3.5 Review Questions IP: See 1g*	electronegativity and relative size of elements and ions, should be located in Standard Group 3 Periodicity and Electron Arrangement.of Fusion & Vaporization

Standard Group 4 – Chemical Bonding
2e. *Students know* how to draw Lewis dot structure.
2a. *Students know* atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
1c. *Students know* how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.
2b. *Students know* chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent.
2c. *Students know* salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
2d. *Students know* the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
2h*. *Students know* how to identify solids and liquids held together by van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/ melting point temperatures.
2f*. *Students know* how to predict the shape of simple molecules and their polarity from Lewis dot structures.

Standard Group 4 Key Concept – Chemical Bonding

Analyzed Standards **2e, 2a, 1c, 2g*, 2b, 2c, 2d, 2h*, 2f***	**Instructional Activities, Resources, and Performance Tasks**	**Connections and Notes**
2e • Draw Lewis structures.	Glencoe: p. 140 – 141, p. 160, p. 243 – 244, p. 252 - 255 Holt: Ch. 6-Sec 2, p. 199-207 Lab 50: Models of Molecules (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 285) McDougal Littell: 12.3 – A, B, pp. 413-422 GP: Section 12.3 Review Questions, pp. 422 IP: pp. 436, HW: 30-37	
2a • Understands how atoms of molecules are bonded together by sharing electrons; how kernels of	Glencoe: p. 211 – 217, p. 228 – 229, p. 241 – 247 Holt: Ch. 5-Sec 2, p. 166-179; ionic Ch. 6-Sec 1, p. 190-198; covalent	

atoms in metals are bonded together by sharing electrons, and how ionic compounds are held together by the electrostatic attraction of positive and negative ions.	McDougal Littell: 12.1 – A, B, pp. 400-404 GP: Section 12.1 Review Questions1-3 …..IP: pp. 435, HW: 1-12	
1c • Identify the types of bonding (covalent or ionic) based on the location in the periodic table.	Glencoe: p. 166 – 169, p. 263 – 266 Holt: Ch. 4-Sec 3, p. 132-141 Lab: Conductivity as an Indicator of Bond Type (CRF) McDougal Littell: 3.5 –A, pp. 76-78, 11.4 – C , pp. 385-390, 12.1 – A, B, C. pp. 400-406 GP: pp. 406, Section 12.1 Review Questions IP: pp. 435: 1-2, 4-5, 7-8, 11,14, 15, 17, pp. 394: 48-57 M: pp. 435: 1-2, 4-5, 7-8, 11,14, 15, 17, pp. 394: 48-57	
2g* • Predict bonding characteristics (or type of bonding) by comparing differences in electronegativities.	Glencoe: p. 166 – 169, p. 263 – 266* Holt: Ch. 4-Sec 3, p. 133, 137-138 *This text is weak on this topic. Teachers may need to reference other text or website for better coverage of the material. McDougal Littell: See 1c	
2b • Identify molecules as covalent (large biological molecules as well as organic).	Glencoe: p. 243 – 246, p. 698 – 710, p. 776 – 777, p. 781 – 785 Holt: Ch. 6-Sec 1, p.190-198, Ch. 19-Sec. 1, p.680-681 McDougal Littell: See 1c	
2c • Recognize that crystalline	Glencoe: p. 217 - 220	

structures of salts are repeating patterns of positive and negative charges held together by electrostatic attraction.	Holt: Ch. 5-Sec 2, p. 166-179, Ch. 11-Sec 2. p. 391 Designing a Model, p. 174 McDougal Littell: See 2a	
2d • Recognize that intermolecular forces are responsible for the physical state of matter (i.e., solids, liquids, and gases).	Glencoe: p. 393 – 395 Holt: Ch. 11-Sec 1-2, p. 376-392 Start-up Activity: Heating Curve for Water, p.377 McDougal Littell: 14.1 Introduction, A, pp. 488-497 GP: pp. 497, Section 14.1 Review Questions IP: pp. 514-515, HW: 1-23	
2h* • Distinguish between the type of intermolecular forces including hydrogen bonding, dipole-dipole forces, and Van der Waals attractions (London dispersion forces). • Predict volatility and boiling/melting point temperatures using knowledge of intermolecular forces.	Glencoe: p. 393 – 395 Holt: Ch. 11-Sec 1-2, p. 376-392 McDougal Littell: 14.1, 2, pp. 488-502 GP: pp. 503, Section 14.2 Review Questions IP: pp. 515, HW: 24-32	
2f* • Predict shapes and polarity of simple molecules using Lewis structures.	Glencoe: p. 259 – 260, p. 264 – 265 Holt: Ch. 6-Sec 3, p. 208-213 Lab: Model Building (hand-out) McDougal Lityell: 12.4–A, B, C, pp. 423-433, 12.1 – B, C, pp. 402-406 GP: Section 12.1 Review Questions4- IP: pp. 435, HW: 13-17 M: Lab Manual: Experiment 49: Dyes and Dying	

Standard Group 5 – The Mole Concept
3b. *Students know* the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.
3c. *Students know* one mole equals $6.02x10^{23}$ particles (atoms or molecules).
3a. *Students know* how to describe chemical reactions by writing balanced equations.

Standard Group 5 Key Concept – The Mole Concept

Analyzed Standards 3b. 3c, 3a	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
3b • Recognize that the atomic mass unit is based upon 1/12 the mass of one carbon-12 isotope. Students also recognize that the number of atoms in 12 grams of carbon-12 isotope is defined as one mole. • Students identify the molar mass of an element to be numerically equivalent to atomic mass.	Glencoe: p. 100 – 104, p. 309 – 310, p. 313 Holt: Ch. 3-Sec. 4, p. 100-104 Start-up Activity: Counting Large Numbers, p. 223 Lab 13: Counting by Weighing, (Introductory Chemistry in the Laboratory by J. Hall, 3rd Ed, p. 121) Lab 22: The Bean Lab, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 119) McDougal Littell: 6.1 – B, pp. 174-177 GP: Hands-on Minilab, pp. 177; Hands-on Minilab, pp. 191 M: Lab Manual: Experiment 22: The Bean Lab.	Activity/Lab: Chemistry: Matter & Change, p 314 problem-solving Lab: Molar Mass, Avogadro's Number & Atomic Nucleus, or p 410 – 411, ChemLab 13 Comparison Rates of Evaporation, or Lab Manual, p 81 – 83 #11.1, Estimating the size of a Mole
3c • Define one mole as $6.02x10^{23}$ atoms, molecules, ions, formula units, or particles.	Glencoe: p. 311 – 319, p. 325 – 327 Holt: Ch. 3-Sec. 4, p. 100-104 Lab: Chalk It Up (handout) Quick Lab: pg 225 McDougal Littell: 6.1 – C, pp. 178	3c Students probably will enter a chemistry course with vague or incorrect notions of molecules and ions. Whenever the words come up in class discussion or in the text, you may want to begin to clarify the

• Know that the mole is a number, just as a dozen is 12. • Know that the mole is a counting number, just as a dozen is equals to 12.		difference between the meanings of the two words. Molecules are usually associated with a cluster of atoms that are grouped together by covalent bonds. Ions and formula units are associated with ionic substances. Students should learn to distinguish when to use the mole as a counting device similar to the dozen. This will be done when students wish to determine the number of molecules, atoms, ions, particles ore formula units contained in a particular mole amount. Conversely, students will learn to apply formula mass or molecular mass of the elements, ions, molecules or compounds as a composition constituent of a substance.
3a • Take inventory of atoms and adjust coefficients accordingly to a balanced chemical reaction.	Glencoe: p. 62 – 65, p. 277 – 291 Holt: Ch. 8-Sec. 1-4, p. 260-289 Ch. 9-Sec. 1, p. 303-304 Quick Lab: p. 282 McDougal Littell: 7.2, pp. 220-223, 7.3, pp. 223- 232	Integrate I & E standard 1l.

	GP: Section 7.2 (pp. 223), 7.3 (pp. 232) Review Quest IP: pp. 234, HW: 5-36 M: Lab Manual: Experiment 28: Conservation of Mass	

Instructional Component 2

Standards for Instructional Component 2

3. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:
d. *Students know* how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.
e. *Students know* how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.
f*. *know* how to calculate percent yield in a chemical reaction.
g*. *Students know* how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.

4. The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:
a. *Students know* the random motion of molecules and their collisions with a surface create the observable pressure on that surface.
b. *Students know* the random motion of molecules explains the diffusion of gases.
c. *Students know* how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.
d. *Students know* the values and meanings of standard temperature and pressure (STP).
e. *Students know* how to convert between the Celsius and Kelvin temperature scales.
f. *Students know* there is no temperature lower than 0 Kelvin.
g*. *Students know* the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.
h*. * *Students know* how to solve problems by using the ideal gas law in the form $PV = nRT$.
i*. *Students know* how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.

5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:
a. *Students know* the observable properties of acids, bases, and salt solutions.
b. *Students know* acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
c. *Students know* strong acids and bases fully dissociate and weak acids and bases partially dissociate.
d. *Students know* how to use the pH scale to characterize acid and base solutions.
e*. *Students know* the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.
f*. *Students know* how to calculate pH from the hydrogen-ion concentration.
g*. *Students know* buffers stabilize pH in acid-base reactions.

6. Solutions are homogeneous mixtures of two or more substances. As a basis for understanding this concept:
a. *Students know* the definitions of solute and solvent.
b. *Students know* how to describe the dissolving process at the molecular level by using the concept of random molecular motion.
c. *Students know* temperature, pressure, and surface area affect the dissolving process.
d. *Students know* how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.
e*.* *Students know* the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.
f*. *Students know* how molecules in a solution are separated or purified by the methods of chromatography and distillation.

9. Chemical equilibrium is a dynamic process at the molecular level. As a basis for understanding this concept:
a. *Students know* how to use Le Chatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
b. *Students know* equilibrium is established when forward and reverse reaction rates are equal.
c*. *Students know* how to write and calculate an equilibrium constant expression for a reaction.

Investigation and Experimentation (I & E) Standards:

I. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms.
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
j. Recognize the issues of statistical variability and the need for controlled tests.
k. Recognize the cumulative nature of scientific evidence.
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

Standard Group 1 – Stoichiometry
3d. *Students know* how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.
3e. *Students know* how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.
3f*. *Students know* how to calculate percent yield in a chemical reaction.
3g*. *Students know* how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.

Standard Group 1 Key Concept – Stoichiometry

Analyzed Standards 3d, 3e, 3f*, 3g*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
3d • Calculate the molar mass of a molecule given the chemical formula and the periodic table as a reference. • Convert the mass of a substance to moles of a substance and vice versa. • Convert number of particles to mass using mole conversions.	Glencoe: p. 319 – 327, p. 430 – 431 Holt: Ch. 3-Sec. 4, p. 101; molar mass Ch. 7-Sec. 1, p. 224-233; molar conversions Ch. 9-Sec. 1, p. 308-311; molar volume McDougal Littell: 6.1, 2, 3,pp. 184-208 GP: Section 1, 2, 3 Review, pp. 184, 195, 208	Integrate I & E standards 1l. Integrate I & E standards 1l. Integrate I & E standards 1l. Refer to the gas laws for finding the volume of gas given the number of moles of the gas.
3e • Recognize that the coefficients in a balanced equation can represent the number of moles, number of molecules or number of ions involved in a reaction. • Relate number of moles of	Glencoe: p. 353 – 363 Holt: Ch. 7-Sec. 2, p. 234-240; stoichiometry Ch. 9-Sec. 1, p. 301-311; mass stoichiometry Lab: Stoichiometry and Gravitmetric Analysis, p. 786 Lab 37: Stoichiometry (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 207)	Activity/Lab: Chemistry: Matter & Change, p 957 Try At Home Lab # 12, Baking

reactant to number of moles of product. • Set up mole ratios using coefficients from a balanced equation. • Calculate mass of product or reactant using mole rations. 3f* • Calculate theoretical yield, determine actual yield, and solve for percent yield. 3g* • Identify oxidation and reduction reactions. Students balance simple redox reactions.	Lab 29: Reactions in Solution I: Precipitation, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 155) McDougal Littell: 9.1, 2, pp. 280-305 GP: Section 1, 2 Review, pp. 287, 295 Glencoe: p. 364 – 373 Holt: Ch. 9-Sec. 2, p. 316-318; percent yield McDougal Littell: 9.3, pp. 305-308 GP: Section 3 Review, pp. 287, 295 Glencoe: p. 222, p. 634 – 653, p. 758 – 759, p. Holt: Ch. 17-Sec. 1, p. 604-631; redox, balancing, reactions Lab: Redox-Titrations, p. 818 Lab 12: Oxidation-Reductions, (Introductory Chemistry in the Laboratory by J. Hall, 3rd Ed, p. 113.) McDougal Littell: 8.3, pp 263-269 ; 8.3, pp 263-269; 18.1; pp 636-641; 18.2, pp 642-651;18.3, pp 652-660 GP: Section 3 Review, pp. 269; Section 3 Review pp. 269; Section 1 Review, pp. 641; Section 2 Review, pp. 651; Section 3 Review pp. 660	Soda Stoichiometry, or ChemLab12 p 374 – 375, A Mole Ratio Integrate I & E standards 1l. Integrate I & E standards 1l. Activity/Lab: Chemistry: Matter & Change, p 961 Try at Home Labs #20 Kitchen Oxidation Integrate I & E standards 1l.

Standard Group 2 – Kinetic Motion of Gases

4a. *Students know* the random motion of molecules and their collisions with a surface create the observable pressure on that surface.

4b. *Students know* the random motion of molecules explains the diffusion of gases.

4e. *Students know* how to convert between the Celsius and Kelvin temperature scales.

4f. *Students know* there is no temperature lower than 0 Kelvin.

4g*. *Students know* the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.

Standard Group 2 Key Concept – Kinetic Motion of Gases

Analyzed Standards 4a, 4b, 4e, 4f, 4g*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
4a • Understand that pressure is caused by gas particles bumping into the walls of a container. • Understand that the greater the number of particles the greater the pressure.	Glencoe: p. 385 – 389 Holt: Ch. 12-Sec. 1, p. 416-422; random motion of gases, creating pressure, KMT http://mc2.cchem.berkely.edu/java/molecules Start-up Activity: Pressure Relief, p. 415 Lab 51: Gas Laws and Drinking Straws,(World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 291) Lab 54: Molar Volume and Universal Gas Constant (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 307) McDougal Littell: 13.1, pp 442-457; 14.2, pp 498-503 GP: Sec 1 Review pp 457; Sec 2 Review pp 503	You may want to summarize Standards 4a, 4b, and 4g, by discussion the tenets of the KMT. More to come next session Integrate I & E standards 1a, 1c, and 1l.
4b • Understand that gas particles move in random motion until they are evenly distributed	Glencoe: p. 386 – 388 Holt: Ch. 12-Sec. 3, p. 436-438; diffusion McDougal Littell: 13.3 pp 474-478; 14.2 pp 498-503 GP: Sec 3 Review pp 478; Sec 3 Review pp 478	Make sure the students understand the relationship between temperature and

throughout the container. 4e • Calculate the temperature in Kelvin from degrees Celsius by adding 273.15. 4f • Understand the concept that there is no temperature lower than 0 Kelvin. 4g* • Understand that the greater the Kelvin temperature the faster the molecules are moving.	Glencoe: p. 30 Holt: Ch. 2-Sec. 1, p. 43; temperature conversion McDougal Littell: 13.1 pp 442-457; 14.2 pp 458-473 GP: Sec 1 Review pp 457; Sec 2 Review pp 473 Glencoe: p. 423 Holt: Ch. 2-Sec. 1, p. 43; absolute zero, kelvin McDougal Littell: 5.3 pp 149-156; 13.1, pp 450-457 GP: Sec 1 Review pp 457 Glencoe: p. 385 – 386, p. 419 – 420 Holt: Ch. 12-Sec. 1, p. 422; absolute vs. kinetic energy McDougal Littell: 14.1 pp 492-497 GP: Sec 1 Review pp 497	kinetic energy of particles. This concept is a recurring theme in chemistry, for example in a microscopic understanding of gas pressure and the dissolving process.

Standard Group 3 – The Gas Laws

4c. *Students know* how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.

3d. *Students know* how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.

4d. *Students know* the values and meanings of standard temperature and pressure (STP).

4h*. *Students know* how to solve problems by using the ideal gas law in the form PV = nRT.

4i*. *Students know* how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.

Standard Group 3 Key Concept – The Gas Laws

Analyzed Standards 4c, 3d, 4d, 4h*, 4i*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
4c • Understand that T stands for temperature, measured in K, that P stands for pressure, measured in atmospheres or mm Hg, and that V stands for volume, measured in mL or L. • Use the gas laws ($P_1V_1 = P_2V_2$, $P_1/T_1 = P_2/T_2$, $V_1/T_1 = V_2/T_2$, $P_1V_1/T_1 = P_2V_2/T_2$) to solve for an unknown value. • Understand inverse relationships in the gas laws, e.g., as volume	Glencoe: p. 421 – 433 Holt: Ch. 12-Sec. 2, p. 423-432; Boyle's, Charles, Gay-Lussacs', Avogadro Laws Ch. 12-Sec. 3, p. 433-436; Ideal Gas Laws Lab: Molar Volume of a Gas, Chem File Laboratory Experiments, Holt 2004, p. 61 McDougall Litell: 13.1 pp 442-457; 13.2 pp 458 – 473 GP: Sec Review pp 457; Sec Review pp 473	Integrate I & E standards 1g and 1l. Students should be reminded that the mole is a useful device for counting ions, particles, formula units, and molecules. Integrate I & E standards 1g and 1l.

increases, pressure decreases. • Understand direct relationships in the gas laws, e.g., as temperature increases volume increases. 3d • Recognize the molar volume of a gas at standard temperature and pressure is 22.4 L. 4d • Understand that standard temperature and pressure are agreed upon measures to be used in many problems. • Understand that standard pressure is 1 atmosphere or 760 mm Hg and standard temperature is 273 K or 0˚C. • Recognize a value of R as 0.0821 L·atm/mol·K. 4h* • Memorize the equation PV = nRT and understand what each letter represents. • Calculate the value of an unknown quantity using PV = nRT. 4i* • Understand that the pressure of a	Glencoe: p. 431 Holt: Ch. 3-Sec. 1, p. 308-309; molar volume Ch. 12 Sec. 2 pg 432 McDougall Litell: Ch 13.2 C pp 470-472 Definition: pp 470 GP/IP: 4c Glencoe: p. 388 – 390, p. 431, p. 434 – 438 Holt: Ch. 12-Sec. 2, p. 420; STP McDougall Litell: See 3d GP/IP: See 4c Glencoe: p. 434 – 435 Holt: Ch. 12-Sec. 3, p. 434; PV=nRT McDougal Littell: Ch 13.2 A pp 458-464 GP/IP: Ch 13 Sec 4c Glencoe: p. 387, p. 391 – 392	For any ideal gas, measuring the volume of the gas (given known temperature and pressure) is another way of counting particles. Activity/Lab: Glencoe Small-Scale Lab Manual: p37 Lab 10 Relating Gas Pressure & Gas Volume Mc Dougall Litell: For the whole Standard Group 3: Lab Manual Experiment 54: Molar Volume and the Universal Gas Constant

mixture of gases is the sum of the pressure of each of the gases present. • Understand that diffusion of a gas is caused by random motion. • Understand that effusion is the process by which particles move through a minute opening into a vacuum. • Calculate the relative sped of molecules using Graham's Law.	Holt: Ch. 12-Sec. 3, p. 437-439; Graham's Law, Dalton's Law Mc Dougal Littell: Ch 13.2 B pp 464 GP: Sec 13 RQ: 5, 6 pp 473 IP: pp 481-482; HW 31-36	Integrate I & E standards 1g and 1l. The particles mentioned here are usually atoms or molecules.

Standard Group 4 – Solutions

6a. *Students know* the definitions of solute and solvent.
6b. *Students know* how to describe the dissolving process at the molecular level by using the concept of random molecular motion.
6d. *Students know* how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.
6e*.* *Students know* the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.
6f*.* *Students know* how molecules in a solution are separated or purified by the methods of chromatography and distillation.

Standard Group 4 Key Concept – Solutions

Analyzed Standards 6a, 6b, 6d, 6e*, 6f*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
6a • Understand that a solution is composed of a solute and solvent. • Explain why certain solids dissolve in water. 6b • Explain the phenomenon of dissolving in terms of the motion of solute particles. • Recognize that the surface area of the solute affects the rate at which the solute dissolves. • Determine that a solution is homogeneous due to uniform distribution of solute particles. • Understand a state of equilibrium results from a uniform	Glencoe: p. 292, p. 453 – 454 Holt: Ch. 13-Sec. 1, p. 455; solute/solvent McDougal Littell: Ch 15.1 A pp 520-524 GP: Ch 15 Sec 1 RQ: 1-4 pp 527 IP: pp 555 HW 1,2,3,4 M: LM Exp't 62: Polar and Non-Polar Solvents Glencoe: p. 455 – 456, p. 458 Holt: Ch. 13-Sec. 3, p. 468-477, 470; dissolving on particle level Quick Lab, p. 453 Lab 61: Solution Properties, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 345) Lab 62: Polar and Non-Polar Solvents, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 351) McDougal Littell: Ch 15.1 A, B, C pp 520-527	The concept of solubility and dissociation should be emphasized during the dissolving process. These concepts will allow students to gain a deeper understanding of the nature of salts, polarity, inter and intramolecular forces and hydrogen bonding.

distribution of bond strength among solute and solvent and between solute and solute. • Understand that ionic salts exist only as positive and negative ions and readily dissociate in solution.	GP: Ch 15 Sec 1 RQ: 5, 6 IP: pp 555; HW: 6, 8, 10, 11 See 6b pp 555-556: 19, 20, 21 a-b, 22 a-b, 24, 26, 27 a-b, 29 a-b M: LM Exp't 62: Solution Property LM Exp't 63: Temperature and Solubility	
6d • Observe that precipitates form when the concentration exceeds the solvent's ability to dissolve them. • Understand that temperature affect the solubility of a solute. • Use molarity to calculate the number of moles of dissolved solute per total volume of solution in liters. • Calculate parts per million (ppm) of solute per total volume of solution. • Calculate percent composition of solute per volume of solution.	Glencoe: p. 462 – 470 Holt: Ch. 13-Sec. 3, p. 460-467; concentration, molarity, molality, PPM McDougal Littell: Ch 15.1 B, C pp 525-527 Ch 15.2 B pp 530-535 GP: See 6b Ch 15.2 RQ 4,5 p 540	"A solution with a concentration of 1 ppm has 1 gram of substance for every million grams of solution. Because the density of water is 1 g per mL and we are adding such a tiny amount of solute, the density of a solution at such a low concentration is approximately 1 g per mL. Therefore, in general, one ppm implies one milligram of solute per liter of solution." MSDS HyperGlossary

6e* • Distinguish between molality and molarity. • Understand that molality is independent of temperature. • Understand that the magnitude of freezing point depression or elevation is dependent on concentration of solute particles.	Glencoe: p. 471 – 475 Holt: Ch. 13-Sec. 4, p. 481; molality, freezing point depression, boiling point elevation McDougal Littell: (molarity not covered in this text).	http://www.ilpi.com/msds/ref/ Integrate I & E standards 1a, 1c, 1g. Integrate I & E standards 1a, 1c, 1g, and 1l.
6f* • Understand the basis of separation by chromatography. • Recognize petroleum to be a mixture of substances that can be separated. • Understand that the basis of distillation is the difference in boiling point of mixtures comprised of several substances.	Glencoe: p. 68 – 69 Chromatography Lab: p. 268 - 269 Holt: Ch. 13-Sec. 1, p. 471-473; chromatography, distillation Quick Lab. p. 458 Lab: Paper Chromatography of Colored Markers,p. 800 McDougal Littell: See 6e; Sec. 2.3 B, pp.40-43 GP: Sec. 2.3 RQ: 7 M: LM Expt 10: Distillation	

Standard Group 5 – Chemical Equilibrium
9a. *Studen know* how to use Le Chatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
9b. *Students know* equilibrium is established when forward and reverse reaction rates are equal.
6c.*Students know* temperature, pressure, and surface area affect the dissolving process.
9c*. *Students know* how to write and calculate an equilibrium constant expression for a reaction.

Standard Group 5 Key Concept – Chemical Equilibrium

Analyzed Standards 9a. 9b. 6c, 9c*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
9a • Recognize a balanced chemical equation. • Consider the energy part of a reaction as either a reactant or product. • Describe a shift in equilibrium if any of the reactants or products is altered. • Realize that because the concentration of a gas depends on pressure, then a change in equilibrium of the reaction will shift in a manner to reduce the effect of the change.	Glencoe: p. 569 – 574, p. 588 Holt: Ch. 14-Sec. 3, p. 512-516; Le Chatelier's Microscale Lab: Equilibrium, CRF Lab 74: Equilibrium Beads (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 427) Lab 75: Equilibrium with Le Chalelier's Principle, (World of Chemistry, Zumdahl, Laboratory Experiments -2007, p. 433) Lab 76: Chemical Equilibrium(World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 439) McDougal Littell: Ch 17.3A pp. 612-620 GP: Sec 17.4 Sample Practice Problem 4, 5, & 6; Sec 17.3 RQ 1-5 pp 625 IP: pp. 629-630, HW: 27-35 M: LM Expt 75: Equilibrium and Le Chaterlier's Principle	Activity/Lab Chemistry: Matter & Change, p 573 miniLab Shifts in Equilibrium, or ChemLab P 586 –587 #18 Comparing two solubility constants, or Glencoe Lab Manual, p 137 #18.1 Reversible Reactions, or Glencoe Small-Scale Lab Manual, p 57 #15, Observing Equilibrium
9b • Recognize when a reaction is at equilibrium. • Explain equilibrium in terms of equal rates of the forward and	Glencoe: p. 559 – 563 Holt: Ch. 4-Sec. 1, p. 497; equilibrium definition McDougal Littell: Ch. 17.1 D, E pp.601-604 M: Hands-on Chem Mini-Lab: Reaching Equilibrium:	Integrate I & E standard 1e.

reverse reactions. 9c* • Write an equilibrium expression for a reaction. • Recognize the units in the equilibrium expression can be expressed as molar concentration of reactants and products. • Understands that the equilibrium constant is dimensionless, i.e., has no units. • Realize that exponents used in an equilibrium expression correspond to reaction coefficients. • Realize that only concentrations of gases and aqueous solutions are found in equilibrium expressions. • Use the equilibrium constant to indicate a positive value as favoring the forward reaction. • Compare the equilibrium constant and solubility product to describe the behavior of slightly soluble salts.	Are we there yet? pp. 604; pp. 628, HW 36-42 Glencoe: p. 563 – 568, p. 577 – 582 Holt: Ch. 14-Sec. 2, p. 502-511 Microscale Lab: Solubility Product Constant, CRF McDougal Littell: Ch. 17.3 B pp.620-625 GP: Sec. 17.3 RQ: 5-7 p. 625 IP: p. 630 HW: 36-42 M: Lab Manual Expt 76: Chemical Equilibrium	Integrate I & E standard 1e. K_{eq} is dimensionless in the context of thermodynamics, but not dimensionless in the context of kinetics. Most instances of K_{eq} at the high school level are in the area of thermodynamics, and therefore K_{eq} is diminsionless. Integrate I & E standard 1e.

Standard Group 6 – Acids and Bases
5a. *Students know* the observable properties of acids, bases, and salt solutions.
5b. *Students know* acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
5e*.* *Students know* the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.

Standard Group 6 Key Concept – Acids and Bases

Analyzed Standards 5a, 5b, 5e*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
5a • Differentiate between acids and bases by using indicators, such as, red or blue litmus or cabbage juice. • Recognize that an acid reacts with some metals to produce bubbles of hydrogen gas.	Glencoe: p. 250, p. 594 – 597 Holt: Ch. 15-Sec. 1, p. 530-534; acids/bases Quick Lab: Acids and Bases in the Home, p. 535 Lab 66: Acids and Bases, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 375) Lab 67: Acid Rain, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p.383) Lab 68: Indicators, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 389) McDougal Littell: Ch. 16.2 B pp. 579-580 GP: Section 16.2 RQ: 6 pp. 581 IP: Hand-on Chem MiniLab: Cabbage Juice Indicator M: Lab Manual Expt 68: Indicators	Integrate I & E standards 1g and 1l. Molar Volume of Gas lab in a previous unit can be used as a reference to acids reacting with metals. Integrate I & E standards 1a, 1c, 1g, 1j, and 1l. Activity/Lab
5b • Demonstrate that when acids and bases are mixed, acids donate hydrogen ions and bases accept hydrogen ions, and that acids and bases neutralize each other as determined by the resultant pH.	Glencoe: p. 597 – 599 Holt: Ch. 15-Sec. 1, p. 535-538; Bronted-Lowry Lab: Drip Drop Acid-Base. P. 804 Lab: Acid Base Titration of an Egg Shell. P 808 McDougal Littell: 16.1 A pp. 562-565 GP: Section 16.1 Review Questions: 1, 5, 6 pp. 572 IP: pp. 589 HW: 1, 2, 3, 5, 6 M: Lab Manual Expt 66: Acids and Bases	Glencoe Lab Manual, p 145 # 19.1 Acids, Bases & Neutralization, or Chemistry: Matter & Change, p 626 – 627 ChemLab # 19 Standardizing a Base Solution by Titration
5e*		

• Understand that one of the definitions of a base is that a base is a substance that provides hydroxide ions to a solution.	Glencoe: p. 597 – 599, p. 602 – 604 Holt: Ch. 15-Sec. 1, p. 532; Arrhenius McDougal Littell: See 5b	

Standard Group 7 – Acid/Base Equilibrium
5b. *Students know* acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
5c. *Students know* strong acids and bases fully dissociate and weak acids and bases partially dissociate.
9a. *Students know* how to use Le Chatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
9b. *Students know* equilibrium is established when forward and reverse reaction rates are equal.
9c*. *Students know* how to write and calculate an equilibrium constant expression for a reaction.
5f*. *Students know* how to calculate pH from the hydrogen-ion concentration.
5g*. *Students know* buffers stabilize pH in acid-base reactions.

Standard Group 7 Key Concept – Acid/Base Equilibrium

Analyzed Standards **5b. 5c, (revisit 9a-c*), 5f*, 5g***	**Instructional Activities, Resources, and Performance Tasks**	**Connections and Notes**
5b • Understand the pH scale and are able to identify the approximate pH of some common solutions. • Demonstrate pH values <7 as acids whereas pH values >7 correspond to bases. • Understand that distilled water is neutral and has a pH value of 7.0.	Glencoe: p. 596 – 601 Holt: Ch. 15-Sec. 1, p. 535-538 McDougal Littell: Ch. 16.2 A, B, pp. 565-581 GP/IP/M: See 5 b in Standard Group 6	Integrate I & E standard 1e. Integrate I & E standards 1g and 1l. Integrate I& E standard 1e.
5c • Differentiate between strong acids and weak acids by the amount of dissociation. • Understand that the dissociation reaction for water $2H_2O(l) \leftrightarrow H_3O^+(aq) + OH^-(aq)$ is the basis for the pH scale.	Glencoe: p. 602 – 609 Holt: Ch. 15-Sec. 1, p. 532-534; strong vs. weak acid-base McDougal Littell: Ch. 16.1 B, C, pp. 565-572	Standards 9a-c* can be re-introduced here. Glencoe Small-Scale lab Manual, p 65 # 17 Comparing the Strengths of Acids, or

• Write dissociation reaction equations for weak acids, such as, acetic acid. 5f* • Perform logarithmic calculations involving pH and concentration. • Demonstrate that one pH unit corresponds to a factor of 10 in terms of molar concentration of hydrogen ions. 5g* • Identify the chemical composition of a buffer. • Recognize a buffer as a solution that resists large changes in pH upon addition of an acid or base.	Glencoe: p. 612 – 616 Holt: Ch. 15-Sec. 2, p. 542-545; pH, pH calculations McDougal Littell: Ch. 16.2 A, C GP: Section 16.2 Review Questions:1, 2, 3, 4, 5, 7, pp. 581 IP: pp. 590, HW: 26-42 M: Lab Manual Expt 66: Acid Rain Glencoe: p. 610 – 611, p. 622 – 675 Holt: Ch. 15-Sec. 4, p. 561-563; buffers Lab: Buffer Capacity in Commercial Beverage, CRF	P 69 # 18 Testing the Acidity of Aspirin Integrate I & E standards 1e, 1g, and 1l. Integrate I & E standard 1e. Integrate I & E standards 1e, 1g, and 1l.

Instructional Component 3

Standards for Instructional Component 3

7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept.
a. *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
b. *Students know* chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.
c. *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
d. *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.
e*. *Students know* how to apply Hess's law to calculate enthalpy change in a reaction.
f*. *Students know* how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.

8. Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. As a basis for understanding this concept.
a. *Students know* the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.
b. *Students know* how reaction rates depend on such factors as concentration, temperature, and pressure.
c. *Students know* the role a catalyst plays in increasing the reaction rate.
d*. *Students know* the definition and role of activation energy in a chemical reaction.

10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:
a. *Students know* large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
b. *Students know* the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
c. *Students know* amino acids are the building blocks of proteins.
d*. *Students know* the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.

e*.* *Students know* how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.
f*. *Students know* the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:
a. *Students know* protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.
b. *Students know* the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E = mc2) is small but significant in nuclear reactions.
c. *Students know* some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.
d. *Students know* the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.
e. *Students know* alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.
f*. *Students know* how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.
g*. *Students know* protons and neutrons have substructures and consist of particles called quarks.

Investigation and Experimentation (I & E) Standards:

I. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms.
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.

i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
j. Recognize the issues of statistical variability and the need for controlled tests.
k. Recognize the cumulative nature of scientific evidence.
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

Standard Group 1 – Chemical Thermodynamics

7a. *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
7c. *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
7d. *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.
7b. *Students know* chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.
7e*. *Students know* how to apply Hess's law to calculate enthalpy change in a reaction.
7f*. *Students know* how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.
8a. *Students know* the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.
8b. *Students know* how reaction rates depend on such factors as concentration, temperature, and pressure.
8d*. *Students know* the definition and role of activation energy in a chemical reaction.
8c. *Students know* the role a catalyst plays in increasing the reaction rate.

Standard Group 1 Key Concept – Chemical Thermodynamics

Analyzed Standards 7a, 7c, 7d, 7b, 7e*, 7f*, 8a, 8b, 8d*, 8c	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
7a • Differentiate between heat and temperature based on an understanding of relative kinetic energies, molecular motion, and direction of heat flow. 7c	Glencoe: p. 386, p. 404 – 409 Holt: Ch 10-Sec 1, p. 338-341; heat flow Lab: Calorimetry and Hess's Law, p. 792 Lab 43: Stoichometry and Calorimetry, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 245) Lab 45: Heats of Reaction and Hess's Law, (World of Chemistry, Zumdahl, Laboratory Experiments-2007, p. 257) McDougal Littell: Ch. 10.1 B, pp. 323-324 GP: Section 10.1 Review Questions: 5, pp. 325 IP: pp. 353,HW: 6-10 M: pp. 353, HW: 6-10	Integrate I & E standard 1d. The Celsius and Kelvin temperature scales can be reviewed here. Integrate I & E standard 1d.

• Explain the relationship between phase change and energy flow, and relate energy required for phase changes to intermolecular forces.	Glencoe: 404 – 409, p. 502 – 503 Holt: Ch. 11-Sec. 1, p. 381-384; release of absorption energy during freezing, melting, evaporating McDougal Littell: Ch. 14.1 B, C, pp. 492-497 GP: Section 14.1 Review Questions: 4, 5, 6, 7, pp. 325 IP: pp. 514, HW: 10-23 M: Lab Manual Expt 58: Heat of Fusion of Ice	Integrate I & E standard 1l. Glencoe Lab Manual, p121 #16.1 Heats of Solution & Reaction, or Glencoe Small-Scale Lab Manual, p 45 #12 Specific Heat of Metals, or
7d • Solve numeric problems (e.g. Q = m·ΔT·°C and Q = m·ΔH) involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	Glencoe: p. 492 – 505 Holt: Ch. 2-Sec. 3, p. 60-61; heat flow, specific heat calculation. Ch. 11-Sec. 1, p. 341-342 McDougal Littell: Ch. 10.2 B, pp. 327-333 GP: Section 10.2 RQ: 2-6, pp. 333 IP: pp. 353, HW: 22-28 M: Lab Manual Expt 40: Energy Value of Nuts	Chemistry: Matter & Change p 505 miniLab Enthalpy of Fusion for Ice, or Chemistry: Matter & Change, p 521 ChemLab 16 Calorimetry Integrate I & E standard 1d.
7b • Relate the energy change (endothermic/exothermic) that occurs during a chemical reaction to form or break chemical bonds.	Glencoe: p. 219 – 220, p. 499 – 500 Holt: Ch. 2-Sec. 1, p. 40; definitions of exothermic and endothermic Ch. 10 sec. 3, pg.347-349; 351-352 McDougal Littell: Ch. 10.1 C, pp. 324-325 GP: Section 10.3 Review Questions: 3, 4, 5, pp. 338 IP: pp. 354, HW: 32-35 M: Lab Manual Experiment 44: Heat of Reaction	Integrate I & E standard 1l. Activity/Lab: Chemistry: Matter & Change, p 550 – 551 ChemLab 17 Concentration & Reaction,
7e* • Calculate enthalpy change in a chemical reaction using Hess' Law.	Glencoe: p. 506 – 512 Holt: Ch. 10-Sec. 3, p. 353-357; Hess's Law McDougal Littell: Ch. 10.3 B, pp. 335-338 GP: Section 10.3 Review Questions: 3, 4, 5, pp. 338 IP: pp. 354, HW: 32-35	or p 539 miniLab Examining Reaction Rate & Temperature, or P 960 Try at Home Lab # 17, Surface Area & Cooking Eggs.

7f* • Predict whether a chemical reaction would be spontaneous or not using Gibbs free energy equation.	M: Lab Manual Experiment 44: Heat of Reaction Glencoe: p. 516 – 519 Holt: Ch. 10-Sec. 2, p. 362-365; Gibb's Free Energy McDougal Littell: Gibbs free energy is not covered by this text. Please consult other resources.	(Need one using catalyst) Integrate I & E standards 1d, 1i, and 1l. Integrate I & E standards 1d and 1i.
8a • Explain rate of reaction by observing a change in concentration of reactants or products over time.	Glencoe: p. 539 – 541 Holt: Ch. 16-Sec. 1, p. 576; reaction rate defined Lab: Reaction Rates, p. 814 Start-Up Activity Temperature and Reaction Rate, p. 575	Integrate I & E standards 1d and 1i. Activation energy can be thought of as running or pushing a barrel up the hill on the reactant side in order to be ab.e to slide down the product.
8b • Explain and predict how changes in concentration, temperature, pressure, and surface area affect reaction rates by changing the rate of effective particle collisions.	Glencoe: p. 536 – 538, p. 532 Holt: Ch. 16-Sec. 2, p. 582; factors affecting reaction rate-temperature, pressure, and concentration. McDougal Littell: Ch. 17.1 A, B, C, pp. 596-600 GP: Section 17.1 Review Questions: 1, 3, 4, pp. 604 IP: pp. 628, HW: 3-6, 8, 9 HW: 3-6, 8,9	
8d* • Explain what activation energy is and its role in chemical reactions.	Glencoe: p. 532 – 534, p. 540 Ch. 16-Sec 2, p. 590-592; activation energy role, definition McDougal Littell: See 8b	
8c • Describe catalysts as substances that change activation energy as both promoters and inhibitors.	Glencoe: p. 539 – 541 Holt: Ch. 16-Sec. 2, p. 593-595; catalyst McDougal Littell: See 8b	

Standard Group 2 – Organic Chemistry
10b. *Students know* the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
10d*. *Students know* the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.
10e*.* *Students know* how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.
10a. *Students know* large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
10c. *Students know* amino acids are the building blocks of proteins.
10f*. *Students know* the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

Standard Group 2 Key Concept – Organic Chemistry

Analyzed Standards **10b, 10d*, 10e* 10a, 10c, 10f***	**Instructional Activities, Resources, and Performance Tasks**	**Connections and Notes**
10b • Recognize that carbon is associated with four bonds, either single, double or triple, and this variety in bonding results in myriad combination of carbon-containing compound.	Glencoe: p. 244 – 246, p. 698 – 701, p. 706 Holt:) Ch. 19-Sec. 1, p. 678-680 Ch. 19-Sec. 2, p. 687-692 McDougal Littell: Ch 20.1 A, B, pp. 700-704 GP: Section 20.1 Review Questions: 1, 2, 3, pp. 717 IP: pp. 744, HW: 1-8 M:	Integrate I & E standards 1a, 1c, 1g.
10d* • Name and categorize the ten simplest hydrocarbons and isomers that contain single bonds. • Name and categorize hydrocarbons with double and	Glencoe: p. 770 – 704, p. 711 – 715, p. 722 – 724 Holt: Ch. 19-Sec. 1, p. 680-682 McDougal Littell: Ch. 20.1 C, D, pp. 704-714; 20.2 A, B, C pp. 718-726 GP: Section 20.1 Review Questions: 4-8, pp. 717 Section 20.2 Review Questions: 1-6, pp. 726	Integrate I & E standards 1c and 1d. Chemistry: Matter & Change p 737 Discovery Lab, Making Slime, or P 766, ChemLab #23 Properties of Alchol, or

triple bonds, and simple molecules that contain a benzene ring. 10e* • Recognize and differentiate between functional groups: alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids. 10a • Recognize and associate repetitive combinations of subunits to the appropriate polymer, including proteins, nucleic acids, and starches. 10c • Describe proteins as large, single-stranded polymers of amino acids linked by peptide bonds. 10f* • Identify the R-group structure of amino acids and recognize their role in the formation of dipeptide, tripeptide, and polypeptide.	IP: pp. 744, HW: 9-17; pp. 745 HW: 27-37 Glencoe: p. 743 – 753 Holt: Ch. 19-Sec. 1-2, p. 683-686, 691-692 McDougal Littell: Ch. 20.3 A, B, 20.4 A, B, C, pp.727-738 GP: pp. 731 Section 20.3 Review Questions: 1-5 IP: pp. 746-747, HW: 38-43, 48-55 M: Lab Manual Experiment 87: Saponification Glencoe: p. 761 – 765, p. 775 – 778, p. 781 – 787 Holt: Ch. 19-Sec. 3, p. 698-702 McDougal Littell: Ch. 20.4 D, pp. 738-741 GP: Section 20.4: 1-4, pp. 741 IP: pp. 747, HW: 56-59 Glencoe: p. 775 – 778, p. 791 Holt: Ch. 20-Sec. 2, p. 717-718, 722 McDougal Littell: Ch. 21.1 A, B, pp. 752-756 GP: Section 21.1 Review Questions: 1, pp. 761 IP: pp. 778, HW: 5, 8, 9, 10 Glencoe: p. 775 - 778 Holt: Ch. 20-Sec. 2, p. 719-724 McDougal Littell: See 10 c	P 751 miniLab, Making an Ester, or P 786 miniLab, A Saponification Reaction, or Glencoe Lab Manual p 169 #22.1 Isomerism, or Glencoe Small-Scale Lab Manual, p 77 #20 Plants Produce Oxygen

Standard Group 3 – Nuclear Chemistry

11a. *Students know* protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.

11c. *Students know* some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.

11d. *Students know* the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.

11e. *Students know* alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.

11f*.* *Students know* how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.

Standard Group 3 Key Concept – Nuclear Chemistry

Analyzed Standards 11a, 11c, 11d, 11e, 11f*	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
11a • Explain the role of the strong nuclear force in overcoming the electromagnetic repulsion between protons and neutrons in a nucleus.	Glencoe: p. 805 – 812 Holt: Ch. 3-Sec. 1, p. 83; protons and neutrons Ch. 18-Sec. 2, p. 648-653; held together by nuclear force. McDougal Littell: mentioned in pp. 683	Integrate I & E standard 1d.
11c • Explain radioactivity as resulting form the instability of some isotopes of elements, either naturally occurring or formed in nuclear reactions.	Glencoe: p. 105 – 107, p. 806 – 807, p. 810 – 811 Holt: Ch. 18-Sec. 1, p. 642; radioactive isotopes McDougal Littell: See 11d	Integrate I & E standard 1d. Chemistry: Matter & Change, p 819 miniLab Modeling Radioactive Decay, or Glencoe Lab Manual, p 193 #25.1 Radioisotope Dating
11d • Describe alpha, beta, and gamma radiation, and write equations	Glencoe: p. 106 – 107, p. 807 – 809, p. 813 – 814 Holt: Ch. 18-Sec. 2, p. 648-653; types of decay, changes in	

illustrating alpha, beta, and gamma radioactive decay, including any nuclear changes and products. 11e • Differentiate the characteristics (e.g., penetrating ability) of alpha, beta, and gamma radiation, and explain consequences of exposure. 11f* • Calculate the amount of radioactive substance remaining after an integral number of half-lives have passed.	nucleus McDougal Littell: Ch. 19.1 A, B, pp. 668-675 GP: Section 19.1 Review Questions: 1, 2, 3, 4, pp. 678 IP: pp. 694, HW: 1-3, 6-15, Glencoe: p. 806 – 809, p. 829 – 831 Holt: Ch. 18-Sec. 2, p. 648-653; types of decay, changes in nucleus McDougal Littell: Barely mentioned in p 690 M: Lab Manual Expt 84: Investigating Radioactivity Glencoe: p. 817 – 820 Holt: Ch 18-Sec. 3, p. 658-660; half-life McDougal Littell: Ch. 19.1 C, pp. 676-678; Ch. 19.2 A, B, pp. 679-682 GP: Section 19.1 Review Questions: 5, 6, pp. 678 IP: pp. 694, HW: 20-26 M: Lab Manual Experiment 85: The Half-Life of Pennies	The alpha particle is simply a helium nucleus. Integrate I & E standard 1l.

Standard Group 4 – Nuclear Energy
11b. *Students know* the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.

Standard Group 4 Key Concept – Nuclear Energy

Analyzed Standards 11b	Instructional Activities, Resources, and Performance Tasks	Connections and Notes
11b • Differentiate the processes of fusion and fission, and explain why nuclear reactions release much more energy that chemical reactions, as determined by $E = mc^2$.	Glencoe: p. 821 – 826 Holt: Ch. 4-Sec. 4, p. 143; Einstein equation Ch 18-Sec. 1, p, 644; Einstein equation Ch. 18-Sec. 2, p. 654-656; energy difference in fission vs. fusion Ch. 4-Sec. 4, p. 142-144: energy difference in fission vs. fusion McDougal Littell: 19.3 A, B, D, pp. 683-688 GP: Section 19.3 Review Questions: 1, 3, 5, pp. 678 IP: pp. 695, HW: 34, 35	Integrate I & E standard 1d.

Standard Group 5 – Particle Physics
11g*. *Students know* protons and neutrons have substructures and consist of particles called quarks.

Standard Group 5 Key Concept – Particle Physics

Analyzed Standards 11g*	**Instructional Activities, Resources, and Performance Tasks**	**Connections and Notes**
11g* • Describe protons and neutrons as consisting of smaller particles called quarks.	Glencoe: p. 96 – 97 Holt: Ch. 18-Sec. 1, p. 643; quarks McDougal Littell: Not covered in this text.	

VI. Sample Immersion (Extended Investigation) Project for Chemistry

Under Construction

VII. Appendices

A. References and Suggested Readings

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B. Culturally Responsive Suggested Readings
Compiled by Dr. Noma LeMoine, Ph.D

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C. Mathematics Science Technology Centers

The District operates two mathematics science technology centers. Both centers are unique, but each has an extensive resource library and checkout materials that are available to District teachers. Center hours are Monday - Friday 8:00 am - 4:30 pm. (See page 7-5 for center locations)

• Individual Teacher Usage

Teachers may access any of the District centers and sign up to check out materials. Materials are on loan for 2 weeks and are to be returned by the teacher.

• Department Usage

Science departments may choose to transfer monies to the Van Nuys Mathematics Science Center for the purpose of obtaining science materials. The Van Nuys Center typically stocks live supplies and dissection materials. Contact the Van Nuys Center for the appropriate forms and list of current materials. When available, materials are delivered on the following schedule.

• Delivery Schedule for High Schools from the Van Nuys MST Center

Please note that delivery schedules will be revised every school year. Order forms can be obtained by calling 818-997-2574. Order forms must be received at the Science Materials Center at least ten (10) working days prior to the required delivery date.

D. Secondary SciencePersonnel

Los Angeles Unified School District
Science Branch
Los Angeles Urban Systemic Program
Mathematics/Science Department
333 South Beaudry Avenue, 25th Floor
Los Angeles, CA 90017
(213) 241-6880 Fax (213) 241-8469

David Brewer III
SUPERINTENDENT OF SCHOOLS

Shelly Weston
Assistant Superintendent
Secondary Instruction, Interim

Todd Ullah
Director Secondary Science

CENTRAL OFFICE STAFF

Todd Ullah, Director	213-241-6880
Don Kawano-Coordinator, Middle School Science	213-241-8000 x26508
Diane Watkins-Coordinator, High School Science	213-241-6876 x16876
KJ Walsh, Specialist, Middle School Science	213-241-6603
Thomas Yee, Coordinator, Secondary Science	213-241-4135
Myrna Estrada-Science Expert	213-241-6875 x16875
Elizabeth Garcia, Science Expert, Secondary	213-241-6873 x
Karen Jones, Administrative Analyst	213-241-6880 x26509
Hilda Tunstad, Todd's Secretary	213-241-6880 x26681
Augusto Moreno, Office Technician	213-241-6420 x26506

SAN PEDRO MST CENTER

Phone (310) 832-7573 Fax (310) 548-4407
2201 Barrywood, San Pedro 90731

Nanette Roeland, Science Technician
Edgar Sanchez, Math/Science Technician
Steve Kobashigawa, Math/Science Technician
Laurence Daniel, Math/Science Technician
Tim Brown, Math/Science Technician

VAN NUYS MST CENTER

Phone (818) 997-2574 Fax (818) 344-8379
6625 Balboa Boulevard, Van Nuys 91406

Nancy Bentov, Secretary
Betty Hersh, Office Assistant
Lynne Bernstein, Life Science Lab Technician
Ron Tatsui, Math/Science Technician
Robert Sosa, Math/Science Technician
Tim Weld, Light Truck Driver
Daniel Medina, Light Truck Driver

LOCAL DISTRICT SCIENCE EXPERT/SPECIALIST INFORMATION ROSTER

NAME/DISTRICT	TELEPHONE	OFFICE ADDRESS	E-MAIL ADDRESS
1 Robert Scott Specialist, Secondary Science	Office: 818-654-3641 Fax : 818-881-0772	6621 Balboa Blvd. Van Nuys, CA 91406	Robert.scott@lausd.net
2 Mercy Momary Secondary Science Advisor Barbara Donatella Secondary Science Advisor	Office: 818-755-5456 Fax: 818-755-2810 Office: 818.755.5332 Fax: 818.755.2810	5200 Lankershim Blvd. N. Hollywood, CA 91606	Mercy.momary@lausd.net Barbara.donatella@lausd.net
3 Karen Jin Science Specialist Valerie Cannon Secondary Science Advisor	Office: 310-253-7143 Fax: 310-842-9170 Office: 310-253-7158 Fax: 310-842-9170	3000 S. Robertson Blvd #100 Los Angeles CA 90034	Karen.jin@lausd.net
4 Marissa Hipol Science Specialist	Office: 323.932.2243 Fax: 323.932.2112	4201 Wilshire Blvd Los Angeles, CA 90010	marissa.hipol@lausd.net
5 Henry Ortiz Science Specialist David Hicks Science Expert	Office: 323-224-3350 Fax: 323-224-3184 Office: 323.224-3344 Fax: 323.224-3184	2151 N. Soto Street Los Angeles, CA 90032	henry.ortiz@lausd.net dave.hicks@lausd.net
6 Pamela Williams Science Expert Catherine Duong Science Advisor	Office: 323-278-3932 Fax: 323-720-9267 Office: 323.278.3996 Fax: 323.720.9267	5800 Eastern Ave Commerce, CA 90040	Pamela.williams@lausd.net catherine.duong@lausd.net
7 Tina Perry Science Advisor Ayham Dahi Secondary Science Advisor	Office : 323-242-1356 Fax: 323-242-1393 Office: 323-242-1381 Fax: 323-242-1393	10616 S. Western Ave. Los Angeles, CA 90047	Tina.perry@lausd.net Ayham.dahi@lausd.net
8 Gilberto Samuel Science Specialist	Office: 310-354-3447 Fax: 310-225-6928	1208 Magnolia Ave Gardena, CA 90247	Gilberto.samuel@lausd.net

E. Recommended Programs and Contacts

Program	Standard or Standard Set Covered	Grade Levels	Contact
Center for Marine Studies at Fort Mac-Arthur	Energy In the Earth System 5b, 5d, 5g, Chemistry Standard Set 6 Solutions 6a, 6d, Acids and Bases5b,5d	9-12	Todd Shattuck 310 547 9888

Three day program created by LAUSD teachers provides a marine setting for students to conduct field labs to investigate the marine environment. Provides exemplary marine science curricular journeys to students of all ages centered around the Marine Mammal Care Center at Fort MacArthur and the Los Angeles Oiled Bird and Education Center.

Program	Standard or Standard Set Covered	Grade Levels	Contact
Parks as Laboratories	Energy In the Earth System 4b, Acids and Bases 5d,5a Solutions 6a, 6d, Acids and Bases5b,5d	9-12	John Blankenship 805 498-0305

One day program with National Park Service staff and retired LAUSD teachers lets students investigate the biotic and abiotic factors that affect the different ecosystems in the Santa Monica Mountains. Students learn to use a multitude of science tools and receive data to take back to the classroom to analyze with their teacher.

Program	Standard or Standard Set Covered	Grade Levels	Contact
GLOBE	Energy In the Earth System 4b 4c, 5e, Solutions 6a, 6d, Acids and Bases5b,5d, Climate and Weather 6a,6b ,6d Biogeochemical Cycles 7b, 7c. Waves 4f. Ecology	9-12	Local District 5 Henry Ortiz 323-224-3350 www.globe.gov

Program involves students in ongoing scientific research with national and international scientists to investigate their environment. Program includes scientific protocols in Hydrology, Land Cover, Soil, Atmosphere, GPS. Students also learn how to analyze the reflection bands of satellite images using image processing and use GIS to make land cover maps.

Program	Standard or Standard Set Covered	Grade Levels	Contact
COSEE West Marine Science Activities	California geology 9a, 9c Energy in the Earth System Ocean and Atmospheric Circulation 5a,5b, 5c,5d	9-12	Dr, Judith Lemus 213 740-1965

Center for ocean Sciences Education Excellence (COSEE-West) activities use the marine sciences as a context for learning biology, chemistry, physics and earth science. Activities and trainings utilize university staff and experienced teachers to deliver content and pedagogy to

Program	Standard or Standard Set Covered	Grade Levels	Contact

teach about ongoing cutting edge research.

Program	Standard or Standard Set Covered	Grade Levels	Contact
Fluid Earth/Living Ocean Inquiry Training	Biogeochemical Cycles7a,7b 7c. Ecology 6e,6f Genetics 2d. Cell Biology 1a Chemical thermodynamics 7a,7b Solutions 6 a, 6b, 6d,6e*,6f* Gases and their properties 4b,4c,4e Chemistry 1a,1b,1c,1d,1e Waves 4a,4b,4c,4d,4f Energy in the Earth System Ocean and Atmospheric Circulation 5a,5b, 5c,5d Dynamic Earth Processes 3a,3b,3c,3d,3e*	9-12	Dr. Erin Baumgartner 800 799-8111 Henry Ortiz Westside MST Center 310 390 2441

Inquiry lessons in this program contain classroom-tested activities that successfully teach important concepts dealing with the marine environment.

Program	Standard or Standard Set Covered	Grade Levels	Contact
National Parks Wildland Fire Ecology	Solutions 6a, 6d, Acids and Bases5b,5d. Heat and Thermodynamics 3a Solutions 6 a, 6b, 6d,6e*,6f*	9-12	Barbara Applebaum 805 498 0305

Program takes students into environments that have burned in the National Park System to compare and contrast burn areas with non burn areas in the Santa Monica Mountains. Program utilizes national Park staff and experienced retired LAUSD science teachers.

Program	Standard or Standard Set Covered	Grade Levels	Contact
Bio-Technology Training	Genetics (Molecular Biology) 4a,4b,4c,4d Genetics (Biotechnology) 5a, 5b,5c,5d*	9-12	Lowman MST Center Dan McDonnell 818-759-5310

Program allows students the opportunity to use sophisticated biotechnology equipment and kits to investigate topics that address the science standards in genetics and cell biology. Students use restriction enzymes (endonucleases) to cut DNA into fragments and separate lengths using gel elecrophoresis.

Program	Standard or Standard Set Covered	Grade Levels	Contact
Trout In the Classroom	Ecology 6a,6b,6c,6d,6e,6f,6g*	9-12	Westside MST Center Henry Ortiz 310 390 2441

Partnership with the department of Fish and Game allows students the opportunity to raise

Program	Standard or Standard Set Covered	Grade Levels	Contact

trout in their own classroom to investigate the life cycle of organisms, biotic and abiotic factors that influence the health of Salmonids and the natural environmental conditions necessary to sustain populations in the wild. Students are involved in creating an artificial environment that will maintain the health of the trout.

Temescal Canyon Field Science Program	Energy In the Earth System 4b, Acids and Bases 5d,5a Solutions 6a, 6d, Acids **and Bases5b,5d**	9-12	Kristen Perry 310 454-1395 Ext. 151

Three day program uses the natural environment in Temescal Canyon for students to investigate the Natural environment using scientific tools. Students contribute data to a national database that can be investigated on the students return to their campus so that it can be compared to other data worldwide.

Channel Islands National Marine Sanctuary	**California Geology 9a, 9c** Ecology 6a,6b,6c,6d,6e,6f,6g*	**9-12**	Laura Francis 805 884-1463

The mission of the Channel Islands Marine Sanctuary is to protect the marine life, habitats and cultural resources in the waters surrounding the Channel Islands. This is accomplished through research, education and resource protection programs. The agency works in partnership with the center for Image Processing in Arizona and with other educational agencies such as LAUSD to conduct science teacher training programs.

The Channel Islands Marine Resource Institute			Wendy Mayea 805-488-3568 e-mail: CIMRI2002@yahoo.com

The Channel Islands Marine Resource Institute, founded in 1997 in partnership with Oxnard College, is a marine resource facility located at the entrance to the Port Hueneme Harbor. CIMRI's objectives focus on education, research, restoration, and conservation. Our non-profit facility has circulating ocean water with over 3000 sq. feet of wet lab space and a classroom area. CIMRI offers age-specific K-12 guided tours and a mobile touch tank. Tours may include videos, touch tank, and multi-tank experiences; including encounters with a variety of species of echinoderms, crustacea, mollusks, and fish. Students will see our continuing White Sea bass and white abalone restoration projects in progress. High school students can jumpstart their entrance to Oxnard College's Marine Studies Program by taking classes during their senior year. CIMRI also offers sabbatical

Program	Standard or Standard Set Covered	Grade Levels	Contact

opportunities for educators to develop their own project or participate in an ongoing project.

Cabrillo Marine Aquarium Education Program	Ocean and Atmospheric Circulation 5b,5d,5f**.** Ecology 6a,6b,6c,6d,6e 6f,6g*. California geology 9a, 9c	9-12	Linda Chilton 310 548 7562

Year-round after 1 pm: Outreach – brings the ocean to your school. Year-round: Sea Search – guided hands-on marine lab and field investigations. Year-round*customized programs are available. New Aquatic Nursery program – the science of aquaculture and how we do Science. New Exploration Center – an opportunity to explore and investigate coastal habitats and the processes that impact them through hands-on investigations

Roundhouse Marine Studies Lab & Aquarium	Ecology 6a,6b,6c,6d,6e, 6f,6g* California Geology 9a, 9c Ocean and Atmospheric Circulation 5b,5d,5f	9-12	

A non-profit teaching based aquarium.
Oceanographic Teaching Stations, Inc. (O.T.S.) was established in 1979 by our founding Board Member, Richard L. Fruin, and was incorporated as a California non-profit organization under section 501(c)(3) of the Internal Revenue Code in 1980. O.T.S. currently operates the Roundhouse Marine Studies Lab and Aquarium ("Roundhouse") located at the end of the Manhattan Beach Pier. As stated in its corporate articles, the specific and primary purposes of O.T.S. and the Roundhouse are to foster and promote the public study of, and interest in, the oceans, tidelands and beaches of Southern California, the marine life therein, and the impact of human populations on that environment.

Through its innovative educational programs, O.T.S. offers classes to schools located in the surrounding communities as well as throughout the greater Los Angeles area and teaches over **17,000 school children annually.** As marine education is our main focus, O.T.S. has endeavored to make its classes and programs available to all children, regardless of income. While the majority of classes are funded by the schools, O.T.S. does offer some grant classes and is constantly pursuing grants to provide classes, free of charge, to teachers & their students.

After a long relationship with the Los Angeles County of Education, all of our Marine Science Education Programs have been designed to meet statewide teaching standards for all age groups. Furthermore, and most importantly, our Co-Directors are also the teachers, the planners & the coordinators, which means, classes can all be catered to specifically meet teachers' needs!

Santa Monica Pier	Ecology 6a,6b,6c,6d,6e, 6f,6g* Ocean and Atmospheric Circulation 5b,5d,5f	9-12	Joelle Warren

Program	Standard or Standard Set Covered	Grade Levels	Contact
Aquarium			

Key to the Sea Curriculum--Key to the Sea is a revolutionary marine environmental education program designed for teachers and elementary school children throughout LA County. This program educates children (K-5) about watershed stewardship, storm water pollution prevention and marine conservation-through fun, hands-on and engaging educational activities. The program has an exciting Beach Exploration component, featuring outdoor education kits and trained naturalists.

Key to the Sea makes it possible for children to experience the wonder of nature and to learn about the important responsibility we all share in taking care of our coastal environment. Young people, as future stewards of the environment, need to become aware of how stormwater pollution affects the beaches and marine environment, how they can protect themselves from the

health risks of exposure to polluted waters, and how they and their families can make a difference by preventing pollution.

Aquarium of the Pacific	Ecology 6a, 6b, 6c, 6d, 6e, 6f, 6g*. Ocean and Atmospheric 1) Circulation 5b,5d,5f	9-12	Amy Coppenger 888 826-7257

Aquarium offers learning experiences for students of all ages. Conduct field trips for students and trainings for teachers

UCLA Sea World Marine Science Cruises	Ecology 6a, 6b, 6c, 6d, 6e	9-12	Peggy Hamner 310 206 8247

UCLA offers marine science Cruises for student groups to explore the world of an oceanographer and marine biologist. Cruises run four hours and take off from the Marina Del Rey harbor.

AP Readiness Program	Advanced Placement Exams Content Training for teachers		Priscilla Lee 310 206 6047

Teachers are instructed in the content and laboratory exercises for various Advanced Placement classes by master teachers and university staff. Teachers are given the opportunity to bring students so they can learn along with them.

Program	Standard or Standard Set Covered	Grade Levels	Contact
GLOBE In The City Air Quality Monitoring Program	Ecology 6a,6b,6c,6d,6e, 6f,6g* Gases and their properties 4b,4c,4e Chemistry 1a,1b,1c,1d,1e Waves 4a,4b,4c,4d,4f		Priscilla Lee 310 206 6047

Students in this program are given the opportunity to use sophisticated air quality monitoring systems to conduct research along with UCLA professors and students. The end product of the program is a student published scientific report on an air quality issue in California. Teachers receive instruction from professors from the Institute of the Environment at UCLA. Departments represented include the school of mathematics and Atmospheric Sciences, The School of public Health and the School of Engineering.

Ocean Explorers Program	Waves 4a,4b,4c,4d,4f California Geology 9a, 9c Ecology 6a,6b,6c,6d,6e, 6f,6g*.	9-12	Steven Moore, Ph.D. Executive Director Center for Image Processing in Education 520/322-0118,ext.205

This program teaches participants how to use GPS and GIS technology to help students gain a greater appreciation and knowledge of California's natural resources. The program emphasizes the 9-12 standards covering California Geology and utilizes state of the art programs to show students how to display more visually captivating scientific data on maps. The program also explores the nexus of science with language arts. Students are given the tools to strengthen and sharpen their presentation skills.