1999

# Integrating the new California State Science Standards with successful middle school curriculum methodologies

Mary Catherine Ahearn

Kathleen Ryan Been

Paula Reynolds

# INTEGRATING THE NEW CALIFORNIA STATE SCIENCE STANDARDS WITH SUCCESSFUL MIDDLE SCHOOL CURRICULUM METHODOLOGIES

---

A Project

Presented to the

Faculty of

California State University,

San Bernardino

---

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education: Middle Grade Option

---

by

Mary Catherine Ahearn

Kathleen Ryan Been

Paula Reynolds

September 1999

# INTEGRATING THE NEW CALIFORNIA STATE SCIENCE STANDARDS WITH SUCCESSFUL MIDDLE SCHOOL CURRICULUM METHODOLOGIES

---

A Project

Presented to the

Faculty of

California State University,

San Bernardino

---

by

Mary Catherine Ahearn

Kathleen Ryan Been

Paula Reynolds

September 1999

Approved by:

[redacted]

Dr. Irvin Howard, First Reader

August 2, 1999

Date

[redacted]

Dr. Ellen L. Kronowitz, Second Reader

# ABSTRACT

Our project consists of three main parts. The first is an evaluation of the new California State Science Standards. We examined the creation, formation and science content. We then researched educational philosophies and methodologies as they relate to middle school students. Finally, using the compiled information, we created a science curriculum using the standards, yet acknowledging the particular learning styles of the middle school student. Palm Springs Unified School district middle school science teachers, examined our document and voted to use this form in their classrooms next year. Our project will be presented to the Palm Springs Unified Board of Education later this summer.

ACKNOWLEDGMENTS

Our Master's Project Team would like to thank our district administration, specifically Dr. Diane Kline and Jim Hurst, for supporting us and giving teachers the freedom to create the curriculum they teach. Also, Principal Anne Kalisek of Raymond Cree Middle School, for her help, support and enthusiasm. She also provided the computer, rooms for meetings and moral support.

We also would like to acknowledge the hard work of the K-12 Alliance and Director Kathy DiRanna. The Regional Directors of the Alliance, the Staff Developers and the scientists who work with them all, were also supportive and helpful.

Finally, we would like to thank Dr. Irvin Howard, for his guidance, knowledge, and confidence in us.

TABLE OF CONTENTS

# CHAPTER ONE

## Preview

With the adoption of California's Science Content Standards, teachers, and administrators are trying to make sense of the document. Statewide, educators are asking questions: Whose idea was this anyway? What effects will the standards have on our school's overall science program? What can we keep? What can we change? How will the standards effect our student's conceptual understanding of science? How can we insure the attainment of the standards for all students? (Restructuring Science Newsletter. Jan. 1999).

In October 1998, the California State Board of Education passed new science standards. This document lists objectives and facts, which students are to have mastered at the conclusion of the prescribed school year in science. Never before has California has prescribed standards, using before conceptual directions. These standards are to be aligned with a matrix test in the future.

School districts are now charged with taking these standards and creating their own standards which are "as rigorous or more rigorous" (Assembly Bill 265, 1998) than the state standards. After districts select textbooks, plan implementation, and inservice teachers, the state will develop and administer a content matrix test to hold teacher's accountable for student science knowledge mastery.

The adoption of these standards are an end product of a long and heated debate, not of science content, but of educational philosophies. Differences in educational philosophies, was the fulcrum of the debate. The standard's adoption was not a consensual, simple procedure, but a culmination of a public heated and divergent debate of existential versus progressivists in the collegiate science world. This same philosophical debate will be carried on throughout the implementation process.

The media has monitored and evaluated the new standards because of their political link. California Governor Gray Davis, ran a successful campaign on

education reform, "back to the basics" and teacher accountability.

During the past five years, reports of the United States world-wide inferiority in science alarmed the voting public. The TIMMS International Study Center printed a report which listed data from testing science comprehension of students from classrooms in countries around the world. The results showed that United States students ranked lowest in most science content knowledge. This report was published in many newspapers across the United States. Parents were outraged that their children were scoring lower in science, while our schools had more money than the schools of other countries. The voting public of the United States, and specifically California, urged change.

Colleges added to the pressure by quoting lower SAT scores and citing that incoming freshman are ill prepared for the college environment. When the California Department of Education (CDE), began to develop the new standards, they formed a committee of California college professors, teachers and industry

scientists. It became quickly apparent, that the committee consisted of two basic but very different educational philosophies.

In fact, the California Department of Education had each of the two philosophical groups create their own version of what the standards should look like. Dr. Glen Seaboard led one faction made up of scientists and engineers who believed in emphasizing facts. Like Professor Arthur Bestor, an essentialist, Seaboard believed the new standards should predominantly use convergent thinking, basic texts, and that the processes of learning are secondary. The second group emphatically believed the opposite. They believed that the divergent thinking of the existing curriculum was a more appropriate approach to teaching science. When the two very different documents were presented to the CDE the State Board of Education chose to not pick either one. The Board asked the two groups to join together and create a compromise document. The result was a document, which contains the listing of facts and an additional investigations

strand at each grade level. It was this document which became the California Science Standards.

California Science Standards are now policy. This is the first time California has had science standards. Now all four main curricular areas, language arts, mathematics, social studies and science have standards in the state of California.

## Significance of Project

Our project is significant, because it is going to attempt to evaluate the formation of the standards, analyze the standards themselves and create a template document for teachers in our district middle schools, to apply in their classroom.

Palm Springs Unified School District has four middle schools with a total of 45 teachers that teach science to approximately 4,000 students. Of the 45 teachers only 10 are single subject science teachers. The middle schools consist of $6^{th}$, $7^{th}$ and $8^{th}$ grade. In each grade, students have been offered, for the past five years, an integrated science experience. Students receive conceptual teaching in physical,

earth, and life science, in each of the three grades and which matched the district wide approved content matrix. This matrix was developed using the 1990 California State Science Framework for the California Public Schools. Palm Springs Unified middle schools selected the nineteen book Prentice Hall Science series, to use a tool for teaching the concepts. Because each of the nineteen books covered a different science topic, teachers could create a flexible curriculum. Teachers then could design their science curriculum to integrate with the interdisciplinary subject areas. Books like the Timetables of Science and Science Matters, assisted teachers in planning integrated units which led to connecting science to the rest of the students educational experience at each grade level.

A comparison of the science framework and the current science standards is difficult because they are two entirely different documents. The 1990 Science Framework was flexible enough to allow integration and concept based teaching of science. "It included what we should be teaching, how we should

be making our students scientifically literate, and outlined directions for the selection of materials and textbooks." (CLMS Newsletter, 1/99) The 1999 science standards state only knowledge and facts of science which students should know at the end of each grade level. There will be a new California Framework published in September of the year 2000. The framework will assist teachers in how to teach the standards through implementation.

Statement of Need

As school districts, including Palm Springs Unified, scramble to use the framework and the standards to create a new curriculum for the upcoming school year, which will align to the state standards, they are finding few resources and teachers who are knowledgeable in science curriculum and the new standards. Inexperienced teachers or non-science credentialed teachers, are predicting that they will just teach science using the standards as a chronological guide. These teachers, that believe in

an existential teaching philosophy, will also teach in a similar fact by fact fashion.

Teachers who believe in the effectiveness of the old curriculum and its progressive tenets, are frightened that science education will no longer carry meaning for their students. In our project, in chapter two, we will present both sides of the debate. However, our project plan will outline an implementation template which is a compromise of these two philosophies.

One of the systemic organizations in science in California, is the K-12 Science Alliance. This organization is a merging of the CSIN, the middle school version called SPAN, and the high school organization SS&C. CSIN, SPAN, and SS&C were all formed in 1990 as a network of educators and scientists to help implement the 1990 framework. In response to the 1999 standards adoption the Alliance has designed a model of implementation. It is this model that we will justify in chapter 2 and which serves as the outline for our project.

Project Plan

The outline for our project is the Alliances' 4 "A" Model which consists of **A**lignment, **A**ugmentation, **A**ccessibility, and **A**ssessment. First, in order to align the philosophies we are going to match the district/school guidelines with state documents. We are going to read carefully the $6^{th}$, $7^{th}$, and $8^{th}$ grade standards, to determine if the underlying conceptual statements in the standards flow developmentally and intellectually. We are going to rearrange the standards within each middle school grade level and then develop coherent, conceptual stories. These stories will teach the "standards in terms of level of importance, size of the concept, amount of teaching time, and developmental appropriateness." (Restructuring Science Newsletter, Jan. 1999). During the augmentation phase, we will fill in the blanks. In other words, we will have already created a conceptual storyline for the year. As we evaluate, the story there will be holes where we will need to insert information to build the students background to which will help them understand the story and thereby

learn the specific standard in context. Other activities during the augmentation phase will be to look at existing textbooks and instructional materials, which match the storyline, to integrate technology methodologies, and to begin to develop a teacher friendly instructional guide. This guide will be the bulk of our project.

The third aspect of the model is accessibility. In our project, this will be achieved by creating a staff development proposal for every middle school science teacher in the district. Finally, the assessment step of the plan will include several benchmark assessments at each grade level. These assessments are needed for program evaluation and to see if the students are understanding and learning the mandated state science standards.

## Author Responsibilities

This project is a huge undertaking in time. We had to divide the tasks between the three of us to assure that we would be doing a thorough job. Kathy Been is the Science Curriculum Facilitator for the

Palm Springs Unified School District. She also is a Staff Developer for the K - 12 Alliance. Kathy arranged for the Eisenhower grant funds for the teacher meetings we held. She facilitated those meetings. Paula Reynolds did the internet research for the background literature review and Cathy Ahearn spent days in the libraries at College of the Desert, California State San Bernardino and Palm Springs City Library, doing periodical searches for the literature review. Each of us studied the standards and then took a grade. Kathy aligned and presented 8th grade, Cathy Ahearn aligned and presented 7th grade and Paula aligned and presented 6th grade. Paula typed the reference section, Cathy Ahearn typed the curriculums and Kathy Been typed the body of the paper. All three of us interviewed teachers, administrators and attended standards conferences.

Limitations/Delimitations

Our project plan is to document research, hold discussion meetings with all other middle school teachers in the district, and complete a teacher

friendly document using the 4 "A" model. This document will be presented to the Palm Springs Board of Education as the new district standards, scope and sequence, and staff development model.

The process for implementation for any curriculum is time intensive and difficult to understand. Some of the difficulties of designing and implementing a standard document, which can effectively be used at any site are:

- Different interpretations of what is to be taught
- Different pedagogies and approaches to teaching
- Different administrative priorities such as math and reading
- Getting input and buy-in from each site and/or teacher
- Coordinating with the district office and the board of education
- The demographic make-up of our student population at the different school sites.
- Time limits and constraints
- In addressing some of these difficulties we decided to limit our parameters to only the science standards for the $6^{th}$, $7^{th}$, and $8^{th}$ grades. In our district the

content matrix for elementary and the text for elementary are not even closely aligned to the new standards. High school science curriculum is also far from being aligned with the new standards. The middle school curriculum is really close to what the state is requiring. Because of the flexible design of our texts we can just move books to the appropriate grade level. This flexibility is another reason we limited ourselves to the middle school grades.

Each one of us represents a different grade level at the middle school. In addition to teaching science, we also hold degrees in social studies, biochemistry, business, and psychology. We also have recently completed upper level coursework in educational philosophy, educational pedagogy. We have all participated in instructional strategy coursework. We have a wide age-span, and different levels of teaching experience. We are a small group, but we feel we represent fairly the demographics of our district science teachers.

We met with Dr. Diane Kline, the Director of Curriculum Development for Palm Springs Unified School

District and outlined our proposal. On our behalf, she presented our proposal to the executive council. We requested that our interpretation of the standards and our project be a template for all four middle schools. Palm Springs Unified has accepted the proposal with financial support for time and research. Dr. Kline did request that we create benchmark assessments for each of the three grade levels. She agrees with us that at every site different teachers will use different pedagogies and teaching strategies, even though the district standards are the same. The benchmark assessments serve as another limitation because it is difficult to assess that which has not been taught. The benchmark assessments will also be an eventual evaluation of our project's effectiveness.

Dr. Kline also set strict timelines for the completion of our project. Teachers are anxious to start teaching the new standards next year. She is hoping they will have our document in hand by September. In November, the Board of Education will be viewing our work. The new framework and the new textbooks will not be available until January of 2000,

four to five months into the new school year, and she is hoping that our document will serve as a transitional guide for teachers.

We also limited the scope of our project just to the new standards and delayed any inclusion of health science, safety education, and human development unless it is addressed in the standards. These topics are currently being taught in the middle school science classes, but are not specifically addressed in the standards.

Originally we had planned and organized three days of brainstorming, aligning, and augmenting of the standards by grade level. Due to a substitute shortage in our district and the administration of standardized tests with subsequent block scheduling, we were forced to cancel the meetings. We rescheduled three afternoon sessions, with volunteer attendance, and the same goals.

These afternoon meetings contribute to our first delimitation. The format of these meetings limits the in-depth contributions and analysis of other district teachers. We have also limited community and parent

contributions because of our time constraints. Parents will have a chance to view the district standards prior to the Board of Education approval of the curriculum.

We invited elementary principals, educators, high school principals, and high school science teachers to attend these afternoon sessions. Even limited, this articulation is more than we have had in the past. It is our hope that when the other grade levels begin to develop their curriculum they will use our template as a tool.

Even with district support we are making a major assumption that our projects' template will be used in every middle school in the district. If the standards themselves were not so strict we would not even attempt to standardize this curriculum. The nature of the standards allow us to be more focused and create a universal standard curriculum that meets the needs of all the middle schools in our district.

When we talk to other middle school teachers they are relieved to be able to look forward to a concrete direction. Our project will provide them with a

direction, instructions, and guidelines to effectively implement the new science standards that are required by the state of California, in their own classroom. The more experienced teachers are aware of the time, stress, and difficulty of aligning curriculum and most seem happy to not be involved in the nuts and bolts of alignment. The new teachers are just busy learning to survive as a middle school teacher. They have enthusiasm but not time to help develop curriculum. By providing both groups with a flexible template, which accomplishes the goal of meeting the standards, we have met their needs for the upcoming school year. Independent of our project, we will hold debrief meetings with all of the middle school science teachers in June of 2000 to re-evaluate the effectiveness of the template in their classrooms.

Definition of Terms

Accessibility: a strategy - schools review the teaching practices and the lesson designs to ensure that all students have an equal opportunity to achieve the standards. The access process includes a variety of instructional practices, sensibility to equity issues, use of literacy strategies, etc.

Alignment: reviewing current district/school guidelines for a match to the state and national standards

Assessment: a means of measuring student achievement in specific academic subjects; using multiple measures to provide educational data to help analyze if the program is producing the desired outcomes and to determine what changes still need to be made.

Augmentation: adding pieces to the existing curriculum; the standards are translated from the content to "conceptual stories" that students experience in each of their instructional units, within their grade level, grade span and in their overall K - 12 education.

Benchmark Assessment: an examination of student knowledge acquisition administered at a particular point. For example, administering an exam at the end of a unit or at the end of a grade level.

CLAD: Cross Cultural Language and Academic Development Certificate - A certificate to work with the Limited English Proficient

Concept Based Teaching: Instructional methodology used to teach students an understanding of the concept, and not necessarily a memorization of data.

California Content Matrix: A curriculum organizational tool presented in the 1990 California Science Framework on implementing curriculum.

CSIN: California Science Implementation Network

Curriculum: what is being taught in the classroom

Developmental Appropriateness: Curriculum and instructional strategies, which consider the cognitive development of the student.

Essentialism: an educational philosophy of "back to the basics" in educational curriculum

Existentialist: an educational philosopher who advocates personal introspection and self-awareness

Interdisciplinary Studies: those curricula that are woven among more than one discipline or subject area.

Pedagogy: the methods an instructor uses to convey information to students.

Progressivist: an education philosopher who advocates divergent thinking and the processes of learning.

SDAIE: Specially Designed Academic Instruction in English program is a sheltered teaching technique.

SPAN: Science Partnership for Articulation and Networking

SS&C: Scope, Sequence & Coordination, a National Science Foundation organization for science education in middle school.

Standards: anything recognized or accepted as correct or perfect and used as a basis for comparison. The science standards are expectations of what is to be taught.

Tenets: doctrine, principle, or belief held to be true by an individual or group

# CHAPTER TWO

## History of California

Skills in science are critical to economic progress in a technologically based society. Today's middle school students will be seeking jobs in a global economy requiring levels of technical competence and flexible thinking, that were required by only a few workers in the past. The Third International Mathematics and Science Study (TIMMSS) published in November 1996 by the International Association for the Evaluation of Educational Achievement (IEA) used this philosophy as the force behind their study of science and math education around the world. The report compared test scores, hours of television watched, student's attitudes about science and much more. The conclusion of the report, which was printed widely in the newspapers and journals around the country, was that the students of the United States tested at the bottom of the world. These same students watch too much television and have little interest in science studies.

The voting public used this report as a catalyst for education reform. In the state of California, the candidates for Governor in the 1998 election referred to TIMMSS and other reports which point to the need for reform in the way science was taught, reform in the accountability of information offered and the need for development of a state-wide standardized curriculum. Candidate Dan Lungren said, "The most critical issue facing K -12 today is the failure of our students across the board to match up against their counterparts in the rest of the country and world." (California Schools, Fall 1998). His opponent, and our current governor, Gray Davis was quoted in the same article saying, "I want to produce world-class students by holding them to world-class standards. We have to raise standards and develop more rigorous curriculums to meet those standards."

In 1995, the state legislature voted in a state law which ordered the California Board of Education to improve California's "declining public schools" (Sacramento Bee, Oct. 1998). The Commission for the Establishment of Academic Content and

Performance Standards, was established by Assembly Bill, AB 265. The commission's goal was to develop grade level standards for four subject areas: mathematics, English-language arts, social studies and science. It established that these standards would be the basis of statewide assessments. The Board approved the standards for English and Math, in 1997. The social studies and science standards were approved in October of 1998. The Board of Education "praised the standards as academically challenging but acknowledging that they are a first step in an uphill battle to improve student achievement statewide." (Sacramento Bee, October, 10. 1998)

The standards were written by a commission of scientists and educators headed by Nobel laureate and physicist Glenn T. Seaborg. Dr. Seaborg passed away in 1999. The panel was divided between those like Seaborg who wanted a back-to-basics emphasis on memorization and those who wanted a more experimental, hand-on approach. In fact, when the first draft was written it was in two forms. Dr. Seaborg's committee wrote one draft and the other draft was written by a

team of scientists and teachers including California State San Bernardino's professor Dr. Bonnie Brunkhorst. Over the Internet, the debate raged as the two sides put forward their views and suggestions, and the scientific and teaching community responded. The commission, which included all these people and their views, used as reference material: The California 1990 State Science Framework, The National Science Education Standards, the Benchmarks for Science Literacy, the National Assessment of Education Progress, Advance Placement Courses Descriptions, International Baccalaureate exams and of course, many other sources. All participants spent days, weeks and months researching, writing and discussing how science could best be taught in California.

The back-to-basics draft contained facts which students should memorize at each grade level. The concept was that students need to know more and use books more. That these standards will be a reference for what students statewide need to know and for what teachers need to teach. The next step then, is to hold the teachers and students accountable for test

scores, which reflect the knowledge acquisition. "It is believed by people within and outside of education that these standards will raise the level of expectation for what students know and are able to demonstrate at each grade by defining essential skills and knowledge." (CLMS News, Jan/Feb 1999)

"I think it would be unfortunate if children had to sacrifice their natural instinct for inquiry, which is fundamentally a scientific process, as a result of an emphasis on rote learning."(Internet) Pat Kurtz, a science resource teacher for the Oceanside Unified School District, summed up the views of the opposing ideology. Students will not have time to construct ideas if they are having to memorize a huge block of data. National Academy of Sciences (NAS) President, Bruce Alberts is concerned that the California standards don't align with the National Science Education Standards. He and others, believe that the state standards contain so much factual material, that teachers will be forced to skip more in-depth learning activities. Activities, he feels would give students a better understanding of the scientific process

(Science, Oct 1998), Diana Long, a fifth grader at Jefferson Elementary School in San Francisco was quoted in the Chronicle saying, "I like science. You make your hands messy."

National Association of Scientists, (which also includes Nobel Laureates as members), The American Association for the Advancement of Science, California State Science Systemic Organizations, like the K - 12 Alliance and West Ed Eisenhower Regional Consortium, California Science Teachers Association and educators, all feared the new standards would eliminate students chances to learn science through inquiry, and eliminate any relationship to what students learn, and the lives they lead.

After much stress, many public hearings and internet debate, a final draft was written. This draft includes an Investigation and Experiment section at each of the lower grades and middle grades. It still introduces difficult topics (like understanding the Periodic Table of Element) at young grades (third). The middle school grades were to originally have only one science taught. For example, sixth

grade was to be Earth Science exclusively. The final document does weave some life and physical science topics as they relate to Earth Science. Both the integration of sciences and the investigation strands were hard fought compromises.

Philosophical Debate

In analyzing the standards, and being avid observers of the controversy surrounding their adoption, a educational philosophical parallel is clearly evident. An essentialist philosophy encourages:

- Telling students experts views
- Hold students to convergent thinking (correct answers)
- Keeps students on the designed path
- Predominately uses basic texts
- Prescribes the curriculum
- Emphasizes learning facts - processes are secondary

Professor Arthur Bestor, an essentialist, outlines in one interview, that science is neglected in many schools. He felt (in 1956!) standards will force teachers at all schools to teach science. He

also feels that the curriculum is too loose. In an effort to be relevant to the child the fundamentals (facts/information) are not being taught.

He is echoed by Frank E. Armbruster who said at one point, "Many 'specialized' courses in elementary schools are of light academic content, of little proven value, and take up a significant part of the school day. They are also very expensive. A course like "ecology", particularly at the elementary level, is of very doubtful scholastic value." This Armbruster quote comes from an article titled, "Why Johnny's Learning,Less and Less and, Less; All That New-Fangled Teaching Has Flunked Out." He says "If money and home environment cannot fairly be blamed for the decline (in STA scores of wealthy children), what can? The factor that does appear to affect academic performance is the degree to which the schools sacrificed traditional disciplines and subject for the sake of 'innovative' teaching activities."

Dr. Seaborg, the voting public and the supporters of the science standards seem to be saying the same thing as Bestor and Armbruster. The NAS (which also

includes Nobel laureates as members), The American Association for the Advancement of Science, California State Science Systemic Organizations like the K - 12 Alliance and West Ed Eisenhower Regional Consortium, California Science Teachers Association and many educators mirror the tenets of a progressive educational philosophy.

A progressivist:

- Permits students to interpret material
- Fosters divergent thinking - solicits independent ideas from students
- Seizes students' unforeseen remarks to make point
- Selects materials other than basic text
- Curriculum develops from students' interactions
- Emphasizes learning processes (group interactions and inquiry thought processes)
- John Dewey (in 1916) said he believes that "if nine-tenths of the energy at present directed towards making the child learn certain things were spent in seeing to it that the child was forming proper images, the work of instruction would be indefinitely facilitated." More significant, he felt that next to

deadness and dullness, formalism and routine, our education is threatened with no greater evil than sentimentalism. Dewey and other progressivists, felt that education must mirror a student's life activities and experiences, be a progressive education, and that social development should be a bigger priority in education.

Educational Philosophy

This debate of philosophies which is illustrated in the development of the science standards (and all academic standards) is not new to California. In 1987, State Superintendent of Public Schools, Bill Honig, published a text called Caught in the Middles, Educational Reform for Young Adolescents in California Public Schools. This document was revolutionary in the methodologies, approaches and curriculum it recommends for middle school students. In fact, in 1987, there were no middle schools. The typical district in California had Junior High Schools. Students from grades 7, 8 and 9 attended the junior

high. In the new proposal, students from grades 6,7 and 8 would attend middle school.

Dr. Irvin Howard, California League of Middle School President, outlines the difference between a junior high and a middle school. He says, a junior high is "a high school for younger students." Junior highs offer a shopping mall curriculum, electives, and interscholastic sports. Middle schools, outlines Dr. Howard, have a flexible exploratory elective wheel, intermural sports, integrated subject area curriculum, small teams and families, and equal access to all classes, for all students. In contrasting the two school organizations, Dr. Howard argues that the middle school is better designed to address the needs of adolescents.

Honig and Caught in the Middle, agree. Middle school is the last chance to develop a personal commitment to educational goals. "Those who fail at the middle grade level often drop out of school." The program says the most critical aspect of these transitional years for students is the change from one teacher to many teachers. A middle school child must

be connected with the goals of their school. The goals of a middle school should be to prepare a child for high schools and secondly, to increase their self-esteem through a sense of belonging. Bottom line, students can be "turned on" or "turned off" to science in middle school.

With regard to curriculum, Caught in the Middle, outlines core curriculum for middle school students as a common, comprehensive, academically oriented curriculum. "The content of core curriculum subjects must be linked to the heightened curiosity of young adolescents about themselves - who they are, how they fit into the world around them, how that world functions, and what exciting prospects for their lives lie beyond the immediate horizons of their present knowledge and experience."

Standards in the Middle School

The AAS Benchmarks says that most middle schools students are more interested in working with nature than they are working with scientific theory. "They should continue to be engaged in doing science and

encouraged to reflect on the science they are engaged in, with the assumption that they will later acquire a more mature reflection on science as a world view." (AAAS, Benchmarks). Middle school is not, they say, too earlier to deal with questioning and the changing nature of science. Students should be aware that change occurs, but, not always be able to explain the reason why. Middle school students are still too developmentally immature to be able to rationalize the reason behind the occurrence.

At this level, students need to learn how to follow the scientific method. They need to understand that experiments take time. They also, need to be able to test things themselves and what components create a valid experiment. They should participate in many investigations and experiments, which they design. Their investigations should be a significant part of any successful middle school student's science experience.

Middle school students have documented success at learning using hands-on activities, inquiry based education and other progressivist pedagogies. How

then, is a middle school teacher supposed to teach the state standards? These standards are not conceptual in nature. The standards and their authors, come from a different philosophical tenet, then the philosophies, which have been proved successful in middle school. So, while standards overall might be a functional way of standardizing content, in middle school, the teachers should be encouraging conceptual understanding, experimentation and reading in science.

This dicotomy is easy to miss. Ross Arnold and Ed Steckley wrote an article in the California League of Middle Schools January 1999 Middle School News, entitled "Now That We have the State Science Standards, What Do We Do With Them?" They created an outline of the standards and have recommendations of how to implement them in your district which were very helpful, but, the authors do not address the special learning needs of the middle school student.

Kathy DiRanna, Director of the K - 12 Alliance, wrote an article entitled "Making Sense of the Standards" (Restructuring Science, March 1999). She questions: What effects will the standards have on our

school's overall science program? What can we keep? What ca we change? How will the standards effect our student's conceptual understanding of science? How can we insure the attainment of the standards for all students? "We need to constantly remind ourselves that the key to standards-based instruction is not simply the standards; it is their delivery." She offers as a method for translating the standards into classroom practice. While Ms. DiRanna doesn't not specifically mention middle school as a separate entity, she does address the progressive pedagogical tenets, which have been shown to best teach the middle school student science.

This method is called the "4 A MODEL". The for "A"s are alignment, augmentation, access and assessment. Alignment is outlined as taking the state standards and align them to your own district's needs. Aligning the standards is proposed to be matching the standards with the big story in science at each grade level. "It takes less time to teach for "awareness" versus "understanding; it takes less time to teach vocabulary than a concept."

In May and June, the K - 12 Alliance revised their alignment procedure. They recommended, at their June, Staff Developer Training, that districts or schools look first to their existing Content Matrix. The existing Palm Springs Unified Content Matrix is in Appendix C. The alignment can be then "standards to existing matrix" or "new matrix to new standards." Either way, the first step in the process is aligning curriculum with the standards.

After having done this at each grade level or subject level, the next step is to augment the material. Augmentation can be required because of student demographics, available supplies and textbooks, local ecosystems, local community partnerships, or what ever need your district has. Augmentation is the next process in translating the standards into classroom practice. The goal of augmentation is to determine the major concepts for instruction, and to indicate where the specific standards that you are responsible for teaching fit into the conceptual story.

Access is assurance that all students have an equal opportunity to achieve the standards. The access process includes a variety of instructional practices, sensitivity to equity issues, use of literacy strategies and creating a curriculum designed for middle school students. Part of access is assuring key to continuous school improvement. Grant Wiggins, is quoted in Results as saying "schools never 'pilot' new programs or processes; we just send them off and then 'wave at them from the pier, never to be seen again". The recommendations are that the foundation for results: meaningful teamwork; clear, measurable goals; and the regular collection and analysis of data.

Data and goal evaluation is also the final of the four steps, assessment. Assessment, using multiple measures, can provide educational data to help analyze if the program is producing the desired outcomes and to determine what changes still need to be made in your curriculum.

Even thought the nature of this project is not evaluating science assessment, literature shows that

assessment is the measure of success of each teachers science lessons. "In order to preserve and encourage the development of exciting, hands-on science courses, it becomes essential that standardized exams that will developed to assess students mastery of the of the new standards not dwell on excessive detail. If the exams stress the important concepts cited in the new standards, it is likely that teachers will not be fearful of hampered in providing the type of science of instruction that works best for them (and their students)." This editorial by Steven B. Oppenheimer, PhD., was printed in the CSTA Classroom Science Newsletter. Oppenheimer also says that many teachers are successfully teaching science in a way which in not compatible with the letter and law of the new standards.

Cathy Weisman, a physics teacher at Palm Spring High School, pointed out that the $8^{th}$ grade standards replace the existing $9^{th}$ grade class-Introduction to Chemistry and Physics. She is worried, that without district articulation, the high school will not be preparing science education lay-people and college

attendees correctly. She and her staff are distressed at having to totally redo their curriculum and then be held accountable for the design.

The Southern California Association of Science Specialists (SCAS2) conducted two seminars on all these issues. The first two in March of 1999 sold out, with hundreds of attendees being turned away. They held a third seminar on May 4, 1999, and it was too sold out. They plan on presenting other seminars to help districts address the science standards. At these seminars, the symposium sessions included Getting to Know the Science Standards, Making Sense of the Standards, Science Standards-Classroom Analysis and Designing Professional Development for Standards-Based Reform. In the afternoon, participants broke into grade groups. The 6-8 group was asked how the new standards will effect them. How did they see the standards effecting the following areas: The round-robin responses were as follows:

Also present that day, was Gayland Jordan of the California Department of Education. Jordan outlines the dates and events upcoming during the science

reform. He reminded the teachers that the California Senate has allocated $12.78 per student for one-time materials/equipment purchases for teachers, in order to facilitate teaching the new standards. The assembly has also passed AB2041, a bill which provides staff development money for teachers, in order to facilitate teaching the new standards. He also offered the participants a Science Timeline for California. This timeline indicates that the new framework (and how to teach the document) will be completed in the Spring of 2000. The textbook companies will have approved texts to sell in February of 2000. The year 2001, will be the first assessment, grade by grade, of the success of standards education. Grades tested will be $5^{th}$, $8^{th}$, and $10^{th}$. His recommendation was that schools read the standards, compare existing courses to the standards, discuss articulation and timeline, pay attention to State Assessment decisions and adjust courses when appropriate as needed.

Weisman, of Palm Springs High School, says the new high school standards will require writing the

curriculum all over. Frank Tinney, principal of an elementary school, Vista Del Monte, in Palm Springs, says that the new elementary standards are irrationally rigorous. He feels that teachers don't teach science in elementary school, because of the emphasis on reading and mathematics, and other curricula demands on their classroom lesson time. He can't see any way that the new standards will be successful in the elementary school, the way they are written.

Back at middle school, principals are urging teachers to teach the standards using the pedagogies and methods of the 1990 Framework. If they can't feel it, touch it, then they will not understand it. Principal, Anne Kalisek, Raymond Cree Middle School, says, "I hope that the new standards don't change the way my teachers are teaching because they are already doing a great job now!"

Jim Jones, CSTA Intermediate Director and classroom science teacher says, "We look to creativity, flexibility, and resourcefulness to ensure a complete education."

## CHAPTER THREE

### Developmental Process

After reviewing the history of the standards, and the 4 - A model of implementation, the team developed our system for curriculum development.

We examined the current Palm Springs Unified Content Matrix in Science. This is the 1993 approved matrix. The matrix had an integrated approach, which offered Earth, Life and Physical Science in each of the three middle grades. Dr. Diane Kline, our district guide, and Jim Hurst the Director of Special Projects for the district, explained that we needed to follow the content strands in the standards. We decided then to not use the matrix and match the standards to the existing curriculum. There were many reasons for this decision.

First, much of the new content did not exist in our old standards. Secondly, when textbooks are available to purchase in March of 2000, they will be primarily by grade level and not by content strands.

Our team then each took a grade level and cut every standard from that grade into strips of paper.

We then examined them for whether the standard was a fact, a lesson or a concept. We labeled the strips. How long would it take to teach this standard, was the criteria we used.

Then we took the standards, the California Science Framework (1990), and the AAAS Benchmarks and research each standard. We began to rearrange them into the most logical sense scientifically. This was not a challenge to the existing standards, certainly they were composed by experts, but, an effort to create a flow of reason: a logical series of steps which could tell a story. After each of us finished this task at our grade level, we met as a group. We evaluated the stories or concepts we had created. We questioned the logical, the sequencing and the adaptability to the existing textbooks.

We decided on the following concepts:

$6^{th}$ grade:

1. Energy is neither created nor destroyed.
2. Forces within the Earth Cause stress, which in turn alters the Earth's surface.

3. Living and non-living resources are partners in keeping an ecosystem in balance.

7th grade:

1. The non-living resources of the Earth have changed over time and evidence from rocks allows observation of those changes.

2. Living things have structures, which perform specific tasks to help the organisms live, grow, and interact with the environment.

3. Living organisms are descended, with modifications, from other organisms.

8th grade:

1. The universe is dynamic. Everything in the universe is moving and is interconnected.

2. The motion of an object is always judged with respect to some other object or point.

3. Matter is made of smaller parts, which are perpetually in motion.

We then took each concept and created smaller sub-concepts. These completed the story of the concept in each grade level.

For example, in the 8th grade, the concept (The motion of an object is always judged with respect to some other object or point. The sub-concepts which would sequentially teach this storyline are: Unbalanced forces cause changes in velocity, the velocity of an object is the rate of change of its position and all fluids are made up of particles and these particles have energy in terms of mass and acceleration.

These concepts fit the need to teach the standards, but offer the classroom teacher the flexibility to design units which use other, augmenting materials and activities. They also offer the classroom teacher the flexibility to align and weave their science curriculum with the other disciplines on their inter-disciplinary team. The National Science Foundation has endorsed a unit from the Illinois State University, entitled Systems. This replacement unit offers technology, math and science. It would be a wonderful integrated unit to use in the 8th grade.

How can we be sure that we are teaching all the standards?

Our writing team then took each concept and the related sub-concepts, and matched them to the standards. We assured ourselves that each standard would be addressed. But, because of the accountability of the standards, we created a list of sub-concepts, and a list of the standards which needed to be taught, under each sub-concept.

8th Grade Conceptually Aligned Standards

I. Conceptual Story: The universe is dynamic. Everything in the universe is moving and is interconnected by the universal force of gravity.

Supporting Standards:

- Students should know the role of gravity in forming and maintaining planets, stars and the solar system.
- The structure and composition of the universe can be learned from the study of stars and galaxies, and their evolution.
- Galaxies are clusters of billions of stars, and may have different shapes.

- The sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color.
- How to use astronomical units and light years as measure of distance between the sun, stars and Earth.
- Stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light.
- The (appearance, general composition) relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

II. Conceptual Story: The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.

IIA. Sub Concept with supporting standards: Unbalanced forces cause changes in velocity.

- A force has both direction and magnitude
- When an object is subject two or more forces at once, the effect is the cumulative effect of all the forces

- When the forces on an object are balanced, the motion of the object does not change
- How to identify separately two or more forces acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
- When the forces on an object are unbalanced the object will change its motion (that is, speed up, slow down, or change direction).
- The greater the mass of an object the more force is needed to achieve the same change in motion.

IIB. Sub Concept with supporting standards: The velocity of an object is the rate of change of its position.

- Position is defined relative to some choice of standard reference point and a set of reference directions.
- Average speed is the total distance traveled divided by the total time elapsed. The speed of an object along the path traveled can vary.
- How to solve problems involving distance, time and average speed

- To describe the velocity of an object one must specify both direction and speed.
- Changes in velocity can be changes in speed, directions, or both.

IIC. Sub Concept: All fluids are made up of particles and that these particles have energy in terms of mass and acceleration.

- All objects experience a buoyant force when immersed in a fluid.
- Density is mass per unit volume
- How to calculate the density of substances (regular and irregular solids, and liquids) from measurements of mass and volume.
- The buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced.
- How to predict whether an object will float or sink.

III. Conceptual Story: All matter is made of smaller parts, which are perpetually in motion, and that a wide variety of phenomena can be explained by alternative arrangements of vast numbers of these invisibly tiny, moving parts.

IIIA. Sub Concept with supporting standards: Matter is made of atoms. The atoms of any element are alike but are different from atoms of other elements.

- Elements have distinct properties and atomic structure.
- All matter is comprised of one or more of over 100 elements.
- The structure of the atom and how it is composed of proton, neutrons and electrons.

- Compounds are formed by combining two or more different elements.
- Compounds have properties that are different from the constituent elements.

IIIB. Sub Concept with supporting standards: Matter exists in different states, depending on the motion of its atoms.

- Atoms and molecules form solids by building up repeating patterns such as the crystal structure of NaCl or long chain polymers.
- The states (solid, liquid, gas) of matter depend on molecular motion.

- In solids the atoms are closely locked in position and can only vibrate, in liquids the atoms and molecules are more loosely connected and can collide with and move past one another, while in gases the atoms or molecules are free to move independently, colliding frequently.

  IIIC. Sub Concept with supporting standards: Atoms may stick together in well-defined molecules or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances.

- Chemical reactions are processes in which atoms are rearranged into different combination of molecules.
- Reactant atoms and molecules interact to form products with different chemical properties.
- The idea of atoms explains the conservation of matter: in chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
- Chemical reactions usually liberate heat or absorb heat.

- Principles of chemistry underlie the functioning of biological systems.

IIID. Sub Concept with supporting standards: The elements (atoms) of matter are organized into a Periodic Table based on their periodic functions and properties.

- The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms.
- How to identify regions corresponding to metals, nonmetals and inert gases The organization of the periodic table is based on the properties of the elements and.
- Elements are defined by the number of protons in the nucleus, which is called the atomic number. Different isotopes of an element have a different number of neutrons in the nucleus.
- Substances can be classified by their properties, including melting temperature, density, hardness heat, and electrical conductivity.

IIIE. Sub Concept with supporting standards: The principles of chemistry underlie the functioning of biological systems.

- Principles of chemistry underlie the functioning of biological systems.
- Carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
- Living organisms are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
- Living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins, and DNA.

7th Grade Conceptually Aligned Standards

I. Conceptual Story: The non-living resources of the Earth have changed over time and evidence from rocks allows us to observe those changes. (Evolution is studied through independent lines of evidence.)

IA. Sub Concepts with supporting standards:

Geological Time is a long time.

- Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
- Evidence from geologic layers and radioactive dating indicate the Earth is approximately 4.6 billion years old, and that life has existed for more than 3 billion years.

IB. Sub Concepts with supporting standards: Fossils and Rocks Evidence Geological History.

- The history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impact of an asteroid.
- The rock cycle includes the formation of new sediment and rocks.
- Rocks are often found in layers with the oldest generally on the bottom.
- Fossils provide evidence of how life and environmental conditions have changed.
- How movements of the Earth's continental and oceanic plates through time, with associated changes in

climate and geographical connections, have affected the past and present distribution of organisms.

- Independent lines of evidence from geology, fossils and comparative anatomy provide a basis for the theory of evolution.

II. Conceptual Story: Living things have structures, which perform specific tasks to help the organisms live and grow and meet their needs as they interact with the environment.

IIA. Sub Concept with supporting standards: Living things are made of cells, which have specialized component structures.

- Cells function similarly in all living things.
- The characteristics that distinguish plant cells from animal cells including chloroplasts and cell walls.
- The nucleus is the respiratory for genetic information in plant and animal cells.
- Mitochondria liberate energy for the work that cells do, and chloroplasts capture sunlight energy for photosynthesis.

- Cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.
- As multi-cellular organisms develop, their cells differentiate.

IIB. Sub Concept with supporting standards: All but the simplest organisms have specialized cells, tissues, organs, and organ systems.

- Plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
- Organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
- How bones and muscles work together to provide a structural framework for movement.
- How the reproductive organs of the human female and male generate eggs and sperm, and how sexual activity may lead to fertilization and pregnancy.
- The function of the umbilicus and placenta during pregnancy.

- The structures and processes by which flowering plants generate pollen and ovules, seeds and fruit.
- How to relate the structures of the eyes and ears to their functions.

IIC. Sub-Concept with supporting standards: DNA is the genetic material of living organisms and is located in the chromosomes of the cells.

- The differences between the life cycles and reproduction
- Sexual and asexual organisms.
- Sexual reproduction produces offspring that inherit half their genes from each parent.
- An inherited trait can be determined by one or more genes.
- Plant and animal cells contain many thousands of different genes, and typically have two copies of every gene.
- The two copies (or alleles) of the gene may or may not be dominant in determining the phenotype while the other is recessive.
- DNA is the genetic material of living organisms, and is located in the chromosomes of each cell.

IID. Sub Concept with supporting standards: Genetic mutation and recombination of genetic material are one modification.

- Both genetic variation and environmental factors are causes of evolution and diversity of organisms.

IIE. Sub Concept with supporting standards: Populational processes of migration, natural selection, and genetic drift are other processes which cause diversity of successive generation (evolution).

- Both genetic variation and environmental factors are causes of evolution and diversity of organisms.
- The reasoning used by Darwin in making his conclusion that natural selection is the mechanism of evolution.
- How to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics, and expand the diagram to include fossil organisms.
- Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

6th Grade Conceptually Aligned Standards

I. Conceptual Story: Energy, is neither created, nor destroyed.

IA. Sub Concepts with supporting standards: Energy can be carried from one place to another by heat flow, waves, or movement.

- The utility of energy sources is determined by factors that are involved in converting these
- Sources to useful forms and the consequences of the conversion process.
- Different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forest, and classify them as renewable or nonrenewable.
- Natural origin of the materials used to make common objects.
- Energy can be carried from one place to another by heat flow, or by waves including water waves, light and sound, or by moving objects.

IB. Sub Concepts with supporting standards: Heat, which is one form of energy, moves in predictable flow

from warmer objects to cooler objects until all objects are at the same temperature.

- Heat moves in a predictable flow from warmer objects to cooler objects until all objects are at the same temperature.
- When fuel is consumed, most of the energy released becomes heat energy.
- Heat energy is also transferred between objects by radiation; radiation can travel through space.
- IC. Sub Concepts with supporting standards: Energy is required for any natural forces to initiate change in the Earth and its structures.
- Heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and also by convection (which involves flow of matter).

ID. Sub Concepts with supporting standards: Many phenomena on the Earth's surface, are effected by the transfer of energy through radiation and convection currents.

- The sun is the major source of energy for phenomena on the Earth's surface, powering winds, ocean currents, and the water cycle.

- Solar energy reaches Earth through radiation, mostly in the form of visible light.
- Heat from Earth's interior reaches the surface primarily though convection.
- Convection currents distribute heat in the atmosphere and oceans.
- Differences in pressure, heat, air movement, and humidity result in changes of weather.

II. Conceptual Story: Forces within the Earth itself causes stress, which in turn alters the Earth's surface.

IIA. Sub Concepts with supporting standards: Any stress or change in a plate or boundaries affect all other plates and boundaries in the Earth.

- The fit of the continents, location of earthquakes, volcanoes, and mid-ocean ridges, and the distribution of fossils, rock types, and ancient climatic zones provide evidence for plate tectonics.
- The solid Earth is layered with cold, brittle lithosphere; hot convecting mantle; and dense metallic core.

- Lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movement in the mantle.

IIB. Sub Concepts with supporting standards: As a result of these changes, major geological events occur like earthquakes, mountain movement, and volcanic eruptions.

- Earthquakes are sudden motions along breaks in the crust called faults, and volcanoes/fissures are locations where magma reaches the surface.
- Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from plate motions.
- How to determine the epicenter of an earthquake and that the effects of an earthquake vary with its size, distance from the epicenter, local geology, and the type of construction involved.

IIC. Sub Concepts with supporting standards: California has unique topography as a result of plate tectonic movement.

How to explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes).

III. Conceptual Story: Living and non-living things are equal partners in keeping an ecosystem in balance.

IIIA. Sub Concepts with supporting standards: As the topography of the Earth's surface changes, an adjustment in the ecosystem is required.

- Topography is reshaped by weathering of rock and soil and by the transportation and deposition of sediment.
- Water running downhill is the dominant process in shaping the landscape, including California's landscape.
- Rivers and streams are dynamic systems that erode and transport sediment, change course, and flood their banks in natural and recurring patterns.
- Beaches are dynamic systems in which sand is supplied by rivers and move along the coast by wave action.
- Earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

IIIB. Sub-Concepts with supporting standards: In an ecosystem, no matter the size, the same energy transfer path is followed.

- Organisms in ecosystems exchange energy and nutrients among themselves and with the environment.
- Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis, and then from organism to organism in food webs.
- Overtime, matter is transferred from one organism to others in food web, and between organisms and the physical environment.

IIIC. Sub Concepts with supporting standards: Communities are specific to the areas and the resources available:

- Populations of organisms can be categorized by the functions they serve in an ecosystem.
- Different kinds of organisms may play similar ecological roles in similar biomes.
- The number and types of organisms and ecosystem can support depends on the resources available and the

abiotic factor, such as quantity of light and water, range of temperatures, and soil composition.

Implementation Strategies

After the concepts, sub-concepts and standards match were completed, we were ready to present the document to Palm Springs Unified District Middle School Teachers. As we sat to plan the inservice, we realized the document we had was not in a readable, teacher-friendly form. We developed a matrix form to use. The form has three columns. The left-hand column is the concepts and sub-concepts. The center column is the aligned standards, which match the concepts. The right-hand column we placed the Prentice Hall Books, already adopted, which match the columns.

We invited all middle school science teachers to a session in March. The teachers were enthusiastic and excited. They wanted to take the document with them and work on finding other activities and lessons which would teach the concepts. They requested a further meeting by grade level.

Our team wrote an Eisenhower Grant request for the funds to pay the teachers to attend. Each middle school could send two teachers, to each grade level meeting. The grant was approved.

June 20, 21 and 22nd we conducted these grade level meetings. The 8th grade science teachers suggested creating a fourth column. They proposed the fourth column be placed on the right side and contain supplemental instructional ideas. The teachers are collecting activities and lessons which would meet the concepts, standards and match the books, throughout the summer. They will fax the fourth column to the team during the school year and we will create this unique document. David Zemek, a single subject science teacher from James Workman Middle School, suggested that we have a Saturday seminar in September. Only half of the invited teachers came in June and the left-over Eisenhower Money could fund this seminar. He suggested that the instructors be the current 7th grade teachers. The physical science which is now in the 8th grade curriculum, was in the 7th

grade for years. The seminar is scheduled for the second school year Saturday.

The 8th grade teachers also created a reference list of single subject credentialed teachers. This guide could assist the non-science, credentialed teacher. That is primarily the case in the 6th grade, where teachers are usually liberal arts educated.

One member of our team took minutes at the meeting. One of the conditions the district place on us was, that all teachers meet and approve the curriculum. Teachers then moved, voted and signed the minutes to indicate their approval.

The 7th grade meeting was a bit easier to facilitate. The 7th grade proposed curriculum is primarily life science and most middle school teachers are very familiar with life science issues. We reviewed the documents, wrote up minutes and signed approval.

August 25th, there is to be a K -12 Science Content Day for 6th grade teachers. Another Eisenhower Grant funded event, this was designed to meet the needs of the 6th grade teachers not knowing geology and

earth science. Not only has it not been taught at the middle school level in our district, it is not usually the basic science required in a liberal arts education. The 6th grade participants in June, came to the meeting knowing this content day was ahead. Even so, they barely looked through the content. They simply don't understand the science. Our team scrambled and found some labs and activities and background material in our classrooms. We copied them and gave them to the teachers. This seemed to ease their discomfort. They reviewed the outline of the curriculum document and signed approval. They expressed relief that the curriculum was so clearly outlined.

Our team had a preliminary meeting with Dr. Diane Kline. We shared all that had been done so far. She is going to take the curriculums and review them. She will then submit to the Board of Education for their approval. She reminded the team, that this is a transitional document because of the new textbook selection this coming school year. She also brought the issue of health in the middle school science

classroom and will be bringing our writing team in to help compose those sections of the curriculum. She also is planning on using us as facilitators for the high school and elementary school science adoptions.

The upcoming school year, the three middle school grade will be begin content training. Our writing team helped establish the speakers, funding and locations. The task of running the meetings will then become the Palm Springs Unified School District's Science Coordinator. The 8th grade is having a physical science content workshop in September. 7th grade teachers (who used to teach physical science) are inservicing the teachers along with three high school physics teachers. The 7th grade will have a life science inservice in October. The weekend after attending the California Science Teachers Association Science Convention, the 7th grade teachers will meet with a biotechnology engineer. Also invited are the high school biology teachers in order to keep the articulation between grade levels, begun with our project, occuring.

The 6th grade teachers are attending a full day workshop on August 25. This is a geology workshop. A high school teacher, two geologist and a geophysicist, will be inservicing the teachers on earth science content. Because of the requirements of the new standards, they will be focusing on regional, Coachella Valley geography and techtonics. Also working with the presenters will be a trained staff developer. This trainer is to bring the higher level content to the sixth grade classroom.

The district has also enrolled two teachers from each middle school in the K - 12 Alliance organization which is called HUB. This offers the teachers a chance to attend nine Saturdays of education through out the year. Each middle school in the district is sending a teacher to the two week summer training in physical science.

Kathy Been, one of our project authors, was hired by the San Diego County Office of Education this July to teach science standards and implementation at their county office. The four day event included some content, but primarily used the implementation and

planning methodologies outlined in our project. The participants all gave positive evaluations about the method of understanding the new standards.

All of these events came about because of the organization and implementation suggestions of our project. As we have been undergoing revisions and sharing with schools and districts what we have done, many teachers have invited all our team members to come to their districts and work with their teachers. Every district in California is having to adjust their curriculum to meet the new standards and most are inexperienced and unsure of how to do it. Our project offers a technique to them all.

This curriculum project has been exciting. It is a real, living curriculum in our district and grew beyond a template for the future. This curriculum project also created a document, which assists the skeptics of the California State Science Standards in seeing the validity of the state document. It also serves as a template for future curriculum alignment, augmentation and accessibility to all schools.

Finally, the last "A", in the four "A" model is assessment. At the suggestion of the 8th grade teachers, the benchmark assessment composition will be started after textbook selection. They felt that this would assure alignment with the new text, as well as the curriculum, and would save the district money for authoring new benchmark assessments.

# APPENDIX A

# Palm Springs Unified School District

## Middle School Science Committee

## INSTRUCTIONAL GUIDE for

## 6th GRADE SCIENCE CURRICULUM



Resources for this document:
California State San Bernardino Master's Project: Kathy Been, Paula Reynolds, Cathy Ahearn
Published 1999
California State Science Standards - Approved 10/98
Prentice-Hall Science System - Approved 6/93, PSUSD Board of Education
(During 1999-2000 School Year - Transition)
Science Framework for California Public Schools - California State Board of Ed, 1990, 8/93

PALM SPRINGS UNIFIED SCHOOL DISTRICT

BOARD OF EDUCATION
Meredy Schoenberg, President
Andrew Green, Clerk
Donald Aiken, Member
Michael McCabe, Member
Leslie DeMersseman, Member

DISTRICT ADMINISTRATION
William Diedrich, Ph.D., Superintendent
Lorain Becker, Ed.D, Ass't. Superintendent, Educational Services
David Costner, Ass't. Superintendent, Business Services
Michael Sellwood, Ed.D., Ass't. Superintendent, Personnel Services
Craig Borba, Ed.D., Director, Pupil Personnel Services

Middle School Science Review Committee
Desert Springs Middle School
Victoria Carrillo and William Chilner
James Workman Middle School
Sherry Garcia, Greg Lonborg and David Zemek
Nellie Coffman Middle School
Phyllis Burgess, JoAnna Edwards, Kathy Hansel, and Jerry Reylek
Raymond Cree Middle School
Denise Aguanno, Stacy Brennan, Maureen Ferriter, Debbie Romig, Molly Thomas
CSUSB Master's Writing Team and Raymond Cree Teachers
Cathy Ahearn, Kathy Been and Paula Reynolds
Dr. Diane Kline, Ed.D, Palm Springs Unified School District
Director of Curriculum and Instruction

| 8th Grade Conceptual Units | 7th Grade Conceptual Units | 6th Grade Conceptual Units |
|---|---|---|
| The universe is dynamic. Everything in the universe is moving and is interconnected. | The non-living resources of the Earth have changed over time and evidence from rocks allows observation of those changes. | Energy is neither created nor destroyed. |
| The motion of an object is always judged with respect to some other object or point. | Living things have structures, which perform specific tasks to help the organisms live, grow, and interact with the environment. | Forces within the Earth cause stress, which in turn alters the Earth's surface. |
| Matter is made of smaller parts, which are perpetually in motion. | Living organisms are descended, with modifications, from other organisms. | Living and non-living resources are partners in keeping an ecosystem in balance. |

**6th Grade Instructional Materials (Transition until the purchase of new books in the spring of 2000)**

Prentice Hall Science Integrated Learning Systems. (Textbooks, transparencies, test generator, Spanish texts, videodisks, and VHS videos). This series was approved by the PSUSD Board of Education June of 1993 for use in Middle School Science Classrooms.

Component I - Exploring Planet Earth
J - Dynamic Earth
K - Exploring Earth's Weather
L - Ecology: Earth's Natural Resources

Other components of the series can be used as needed to complete integration of Interdisciplinary Topics.

Additional materials including, but not limited to:
Project Wild and Project Learning Tree Materials, K - 12 Science Alliance Materials, RIMS Activities, GEMS units, NatureScope Units, and technology units.

Assessment Methods:
Performance Based Tests Of Each Grade Level Concept - To be District Standard
SAT 9 Exam

**6th Grade Conceptual/Standards Based Science Unit**

**Energy is neither created nor destroyed.**

Sub-Concept: Energy can be carried from one place to another by heat flow, waves, or movement.

Sub-Concept: Heat, which is one form of energy, moves in predictable flow From warmer objects to cooler objects until all objects are at the same temperature.

Sub-Concept: Energy is required for any natural forces to initiate change in the Earth and its structures.

**Forces within the Earth itself causes stress, which in turn alters the Earth's surface.**

Sub-Concept: Any stress or change in a plate or boundaries affect all other plates and boundaries in the Earth.

Sub-Concept: As a result of these changes, major geological events occur, like Earthquakes, mountain movement and volcanic eruptions.

Sub-Concept: California has unique topography as a result of plate tectonic Movement.

**Living and non-living resources are partners in keeping an ecosystem in balance.**

Sub-Concept: As the topography of the Earth's surface changes, an adjustment in the ecosystem is required.

Sub-Concept: In an ecosystem, no matter the size, the same energy transfer path is followed.

Sub-Concept: Communities are specific to the areas and the resources available.

**Investigative Standards will be used as instructional strategies and objectives while teaching the above concepts.**

## 6th Grade Conceptually Aligned Standards

**I. Conceptual Story:**
**Energy is neither created nor destroyed.**

**IA. Sub Concepts with supporting standards:**
**Energy can be carried from one place to another by heat flow, waves, or movement.**

- The utility of energy sources is determined by factors that are involved in converting these
- Sources to useful forms and the consequences of the conversion process.
- Different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forest, and classify them as renewable or nonrenewable.
- Natural origin of the materials used to make common objects.
- Energy can be carried from one place to another by heat flow, or by waves including water waves, light and sound, or by moving objects.

**IB. Sub Concepts with supporting standards:**
**Heat, which is one form of energy, moves in predictable flow from warmer objects to cooler objects until all objects are at the same temperature.**

- Heat moves in a predictable flow from warmer objects to cooler objects until all objects are at the same temperature.
- When fuel is consumed, most of the energy released becomes heat energy.
- Heat energy is also transferred between objects by radiation; radiation can travel through space.

**IC. Sub Concepts with supporting standards:**
**Energy is required for any natural forces to initiate change in the Earth and its structures.**

- Heat flows in solids by conduction (which involves no flow of matter) and in fluids

by conduction and also by convection (which involves flow of matter).

**ID. Sub Concepts with supporting standards: Many phenomena on the Earth's surface are effected by the transfer of energy through radiation and convection currents.**

- The sun is the major source of energy for phenomena on the Earth's surface, powering winds, ocean currents, and the water cycle.
- Solar energy reaches Earth through radiation, mostly in the form of visible light.
- Heat from Earth's interior reaches the surface primarily though convection.
- Convection currents distribute heat in the atmosphere and oceans.
- Differences in pressure, heat, air movement, and humidity result in changes of weather

**II. Conceptual Story: Forces within the Earth itself causes stress, which in turn alters the Earth's surface.**

**IIA. Sub Concepts with supporting standards: Any stress or change in a plate or boundaries affect all other plates and boundaries in the Earth.**

- The fit of the continents, location of earthquakes, volcanoes, and mid-ocean ridges, and the distribution of fossils, rock types, and ancient climatic zones provide evidence for plate tectonics.
- The solid Earth is layered with cold, brittle lithosphere; hot convecting mantle; and dense metallic core.
- Lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movement in the mantle.

**IIB. Sub Concepts with supporting standards: As a result of these changes, major geological events occur like earthquakes, mountain movement, and volcanic eruptions.**

- Earthquakes are sudden motions along breaks in the crust called faults, and volcanoes/fissures are locations where magma reaches the surface.
- Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from plate motions.
- How to determine the epicenter of an earthquake and that the effects of an earthquake vary with its size, distance from the epicenter, local geology, and the type of construction involved.

**IIC. Sub Concepts with supporting standards: California has unique topography as a result of plate tectonic movement**

- How to explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes).

**III. Conceptual Story: Living and non-living things are equal partners in keeping an ecosystem in balance.**

**IIIA. Sub Concepts with supporting standards: As the topography of the Earth's surface changes, an adjustment in the ecosystem is required.**

- Topography is reshaped by weathering of rock and soil and by the transportation and deposition of sediment.
- Water running downhill is the dominant process in shaping the landscape, including California's landscape.
- Rivers and streams are dynamic systems that erode and transport sediment, change

course, and flood their banks in natural and recurring patterns.

- Beaches are dynamic systems in which sand is supplied by rivers and move along the coast by wave action.
- Earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

**IIIB. Sub Concepts with supporting standards: In an ecosystem, no matter the size, the same energy transfer path is followed.**

- Organisms in ecosystems exchange energy and nutrients among themselves and with the environment.
- Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis, and then from organism to organism in food webs.
- Overtime, matter is transferred from one organism to others in food web, and between organisms and the physical environment.

**IIIC. Sub Concepts with supporting standards: Communities are specific to the areas and the resources available:**

- Populations of organisms can be categorized by the functions they serve in an ecosystem.
- Different kinds of organisms may play similar ecological roles in similar biomes.
- The number and types of organisms and ecosystem can support depends on the resources available and the abiotic factor, such as quantity of light and water, range of temperatures, and soil composition.

6th Grade

| I. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Energy is neither created nor destroyed.**<br><br>**A. Sub – Concept**<br>Energy can be carried from one place to another by heat flow, waves, or movement. | **Heat moves in a predictable flow from warmer objects to cooler objects until all objects are at the same temperature. As a basis for understanding this concept, students know:**<br>a. Energy can be carried from one place to another by heat flow, or by waves, including water waves, light and sound, or by moving objects. (IA)<br>b. The utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process. (IA)<br>c. Different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forest, and classify them as renewable or nonrenewable. (IA)<br>d. Natural origin of the materials used to make common objects. (IA) | Prentice Hall (1990)<br>Motion, Forces and Energy, Chapter 5<br>CSIN Energy Unit<br><br>Prentice Hall (1990)<br>Heat Energy, Chapter 1<br>GEMS "Convection"<br><br>Prentice Hall (1990)<br>Dynamic Earth, Chapter 1 |

| I. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Energy is neither created nor destroyed.**<br><br>**B. Sub – Concept**<br>Heat, which is one form of energy, moves in predictable flow from warmer objects to cooler objects until all objects are at the same temperature.<br><br>**C. Sub – Concept**<br>Energy is required for any natural forces to initiate change in the Earth and its structures. | **Sources of Energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students know:**<br>a. When fuel is consumed, most of the energy released becomes heat energy. (IB)<br>b. Heat energy is also transferred between objects by radiation; radiation can travel through space. (IB)<br>c. Heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and also by convection (which involves flow of matter). (IC) | Prentice Hall (1990)<br>Motion, Forces and Energy, Chapter 5<br>CSIN Energy Unit<br><br>Prentice Hall (1990)<br>Heat Energy, Chapter 1<br>GEMS "Convection"<br><br>Prentice Hall (1990)<br>Dynamic Earth, Chapter 1 |

| I. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Energy is neither created nor destroyed.**<br><br>**D. Sub-Concept**<br>Energy is required for any natural forces to initiate change in the Earth. | **Many phenomena on the Earth's surface are effected by the transfer of energy through radiation and convection currents.**<br><br>a. The sun is the major source of energy for phenomena on the Earth's surface, powering winds, ocean currents, and the water cycle. (ID)<br>b. Solar energy reaches Earth through radiation, mostly in the form of visible light. (ID)<br>c. Heat from Earth's interior reaches the surface primarily through convection. (ID)<br>d. Convection currents distribute heat in the atmosphere and oceans. (ID)<br>e. Differences in pressure, heat, air movement, and humidity result in changes of weather. (ID) | |
| | | |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Forces within the Earth itself causes stress, which in turn alters the Earth's surface.**<br><br>**A. Sub – Concept**<br>Any stress or change in a plate or boundaries affect all other plates and boundaries in the earth.<br><br>**B. Sub – Concept**<br>As a result of these changes, major geological events occur like earthquakes, mountain movement, and volcanic eruptions.<br><br>**C. Sub – Concept**<br>California has unique topography as a result of plate tectonic movement. | **1. Plate Tectonics explains important features of the Earth's surface and major geological events. As a basis for understanding this concept, students know:**<br>a. The fit of the continents, location of earthquakes, volcanoes, and midocean ridges, and the distribution of fossils, rock types, and ancient climatic zones provide evidence for plate tectonics. (IIA)<br>b. The solid Earth is layered with cold, brittle lithosphere; hot convecting mantle; and dense metallic core. (IIA)<br>c. Lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movement in the mantle. (IIA)<br>d. Earthquakes are sudden motions along breaks in the crust called faults, and volcanoes/fissures are locations where magma reaches the surface. (IIB)<br>e. Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from plate motions. (IIB)<br>f. How to explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes). (IIB)<br>g. How to determine the epicenter of an earthquake and that the effects of an earthquake vary with its size, distance from the epicenter, local geology, and the type of construction involved. (IIC) | Prentice Hall (1990)<br>Dynamic Earth, Chapter 1<br><br>Prentice Hall (1990)<br>Dynamic Earth, Chapter 2<br><br>Prentice Hall (1990)<br>Dynamic Earth, pages 31-33 |

| III. Conceptual Story | State/ District Standards | Instructional Coordination |
|---|---|---|
| **Living and non-living things are equal partners in keeping an ecosystem in balance.**<br><br>**A. Sub – Concept**<br>As the topography of the Earth's surface changes, an adjustment in the ecosystem is required. | **2. Topography is reshaped by weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept, students know:**<br>a. Water running downhill is the dominant process in shaping the landscape, including California's landscape. (IIIA)<br>b. Rivers and streams are dynamic systems that erode and transport sediment, change course, and flood their banks in natural and recurring patterns. (IIIA)<br>c. Beaches are dynamic systems in which sand is supplied by rivers and move along the coast by wave action. (IIIA)<br>d. Earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats. (IIIA) | Prentice Hall (1990)<br>Exploring the Universe, Chapter 1,2 |
| | | |

| III. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Non-living resources of the Earth and living Organisms are interconnected.**<br><br>**B. Sub – Concept**<br>In an ecosystem, no matter the size, the same energy transfer path is followed.<br><br>**C. Sub – Concept**<br>Communities are specific to the areas and the resources available. | **8. Organisms in ecosystems exchange energy and nutrients among themselves ad with the environment. As a basis for understanding this concept, students know:**<br>a. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis, and then from organism to organism in food webs. (IIIB)<br>b. Overtime, matter is transferred from one organism to others in food web, and between organisms and the physical environment. (IIIB)<br>c. Populations of organisms can be categorized by the functions they serve in an ecosystem. (IIIC)<br>d. Different kinds of organisms may play similar ecological roles in similar biomes. (IIIC)<br>e. The number and types of organisms an ecosystem can support depends on the resources available and the abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. (IIIC) | Prentice Hall (1990)<br>Ecology, Chapter 1 and Chapter 2 |

# The California State Science Standards Investigation and Experimentation Strand for 6th Grade Standards Curriculum

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in the other three strands, students should **develop their own questions** and **perform investigations**. Student will:

a. Develop a hypothesis.

b. Select and use appropriate tools and technology(including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.

Communicate the steps and results from an investigation in Heat (Thermal Energy) (Physical Science)

Teachers can use these methodologies anywhere in their unit. A few suggestions have been marked.

# Palm Springs Unified School District

## Middle School Science Committee

## INSTRUCTIONAL GUIDE for

## 7th GRADE SCIENCE CURRICULUM



Resources for this document:
California State San Bernardino Master's Project: Kathy Been, Paula Reynolds, Cathy Ahearn
Published 1999
California State Science Standards - Approved 10/98
Prentice-Hall Science System - Approved 6/93, PSUSD Board of Education
(During 1999-2000 School Year - Transition)
Science Framework for California Public Schools - California State Board of Ed, 1990, 8/93

PALM SPRINGS UNIFIED SCHOOL DISTRICT

BOARD OF EDUCATION
Meredy Schoenberg, President
Andrew Green, Clerk
Donald Aiken, Member
Michael McCabe, Member
Leslie DeMersseman, Member

DISTRICT ADMINISTRATION
William Diedrich, Ph.D., Superintendent
Lorain Becker, Ed.D, Ass't. Superintendent, Educational Services
David Costner, Ass't. Superintendent, Business Services
Michael Sellwood, Ed.D., Ass't. Superintendent, Personnel Services
Craig Borba, Ed.D., Director, Pupil Personnel Services

Middle School Science Review Committee
Desert Springs Middle School
Victoria Carrillo and William Chilner
James Workman Middle School
Sherry Garcia, Greg Lonborg and David Zemek
Nellie Coffman Middle School
Phyllis Burgess, JoAnna Edwards, Kathy Hansel, and Jerry Reylek
Raymond Cree Middle School
Denise Aguanno, Stacy Brennan, Maureen Ferriter, Debbie Romig, Molly Thomas
CSUSB Master's Writing Team and Raymond Cree Teachers
Cathy Ahearn, Kathy Been and Paula Reynolds
Dr. Diane Kline, Ed.D, Palm Springs Unified School District
Director of Curriculum and Instruction

| 8th Grade Conceptual Units | 7th Grade Conceptual Units | 6th Grade Conceptual Units |
|---|---|---|
| The universe is dynamic. Everything in the universe is moving and is interconnected. | The non-living resources of the Earth have changed over time and evidence from rocks allows observation of those changes. | Energy is neither created nor destroyed. |
| The motion of an object is always judged with respect to some other object or point. | Living things have structures, which perform specific tasks to help the organisms live, grow, and interact with the environment. | Forces within the Earth cause stress, which in turn alters the Earth's surface. |
| Matter is made of smaller parts, which are perpetually in motion. | Living organisms are descended, with modifications, from other organisms. | Living and non-living resources are partners in keeping an ecosystem in balance. |

7th Grade Conceptual/Standards Based Science Unit

**The non-living resources of the Earth have changed over time and evidence from rocks allows observations of those changes.**
Sub-Concept: Geological Time is a long time.
Sub-Concept: Fossils and rocks evidence geological history

**Living things have structures, which perform specific tasks to help the organisms live, grow and interact with the environment.**
Sub-Concept: Living thins are made of cells, which have specialized component structures.
Sub-Concept: All but the simplest organisms have specialized cells, tissues, organs and organ systems.

**Living organisms are descended, with modifications, from other organisms.**
Sub-Concept: DNA is the genetic material of living organisms and is located in the Chromosomes of the living thing's cells.
Sub-Concept: Genetic mutation and recombination of genetic material are one modification.
Sub-Concept: Populational processes of migration, natural selection, and Genetic drift, are other processes which cause diversity of successive Generation.

**Investigative Standards will be used as instructional strategies and objectives while teaching the above concepts.**

**7th Grade Instructional Materials (Transition until the purchase of new books in the spring of 2000)**

Prentice Hall Science Integrated Learning Systems. (Textbooks, transparencies, test generator, Spanish texts, videodisks, and VHS videos). This series was approved by the PSUSD Board of Education June of 1993 for use in Middle School Science Classrooms.

Component B - Parade of Life: Monerans, Protists, Fungi and Plants
C - Parade of Life: Animals
D - Cells: Building Blocks of Life
E - Heredity
H - Human Biology and Health

Other components of the series can be used as needed to complete integration of Interdisciplinary Topics.

Additional materials including, but not limited to:
Project Wild and Project Learning Tree Materials, K - 12 Science Alliance Materials, RIMS Activities, GEMS units, NatureScope Units, and technology units.

Assessment Methods:
Performance Based Tests Of Each Grade Level Concept - To be District Standard
SAT 9 Exam

## 7th Grade Conceptually Aligned Standards

I. **Conceptual Story:**
**The non-living resources of the Earth have changed over time and evidence from rocks allows us to observe those changes.** (Evolution is studied through independent lines of evidence.)

IA. **Sub Concepts with supporting standards:**
**Geological Time is a long time.**

- Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
- Evidence from geologic layers and radioactive dating indicate the Earth is approximately 4.6 billion years old, and that life has existed for more than 3 billion years.

IB. **Sub Concepts with supporting standards:**
**Fossils and Rocks Evidence Geological History**

- The history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impact of an asteroid.
- The rock cycle includes the formation of new sediment and rocks. Rocks are often found in layers with the oldest generally on the bottom.
- Fossils provide evidence of how life and environmental conditions have changed.
- How movements of the Earth's continental and oceanic plates through time, with associated changes in climate and geographical connections, have affected the past and present distribution of organisms.
- Independent lines of evidence from geology, fossils and comparative anatomy provide a basis for the theory of evolution.

II. **Conceptual Story:**
**Living things have structures, which perform specific tasks to help the organisms live and grow and meet their needs as they interact with the environment.**

IIA. **Sub Concept with supporting standards:**
**Living things are made of cells, which have specialized component structures.**

- Cells function similarly in all living things.
- The characteristics that distinguish plant cells from animal cells including chloroplatsts and cell walls.
- The nucleus is the respiratory for genetic information in plant and animal cells.
- Mitochondria liberate energy for the work that cells do, and chloroplasts capture sunlight energy for photosynthesis.
- Cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.
- As multi-cellular organisms develop, their cells differentiate.

IIB. **Sub Concept with supporting standards:**
**All but the simplest organisms have specialized cells, tissues, organs, and organ systems.**

- Plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
- Organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
- How bones and muscles work together to provide a structural framework for movement.
- How the reproductive organs of the human female and male generate eggs and sperm,

and how sexual activity may lead to fertilization and pregnancy.
- The function of the umbilicus during pregnancy.
- The structures and processes by which flowering plants generate pollen and ovules, seeds and fruit.
- How to relate the structures of the eyes and ears to their functions.

**IIC. Sub Concept with supporting standards: DNA is the genetic material of living organisms and is located in the chromosomes of the cells.**

- The differences between the life cycles and reproduction sexual and asexual organisms.
- Sexual reproduction produces offspring that inherit half their genes from each parent.
- An inherited trait can be determined by one or more genes.
- Plant and animal cells contain many thousands of different genes, and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be dominant in determining the phenotype while the other is recessive.
- DNA is the genetic material of living organisms, and is located in the chromosomes of each cell.

**IID. Sub Concept with supporting standards: Genetic mutation and recombination of genetic material are one modification.**

- Both genetic variation and environmental factors are causes of evolution and diversity of organisms.

**IIE. Sub Concept with supporting standards: Populational processes of migration, natural selection, and genetic drift are other processes which cause diversity of successive generation (evolution).**

- Both genetic variation and environmental factors are causes of evolution and diversity of organisms.
- The reasoning used by Darwin in making his conclusion that natural selection is the mechanism of evolution.
- How to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics, and expand the diagram to include fossil organisms.
- Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

Palm Springs Unified School District

| I. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **The nonliving resources of the Earth have changed over time and the evidence from rocks allows us to observe those changes.**<br><br>**A. Sub - Concept**<br>Geological time is a long time.<br><br>**B. Sub – Concept**<br>Fossils in rocks evidence geological history. | Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept, students know:<br>a. Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time. (IA)<br>b. Evidence from geologic layers and radioactive dating indicate the Earth is approximately 4.6 billion years old, and that life has existed for more than 3 billion years. (IA)<br>c. The history of life on earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impact of an asteriod. (IB)<br>d. The rock cycle includes the formation of new sediment and rocks. Rocks are often found in layers with the oldest generally on the bottom. (IB)<br>e. Fossils provide evidence of how life and environmental conditions have changed. (IB)<br>f. How movements of the Earth's continental and oceanic plates through time, with associated changes in climate and geographical connections, have affected the past and present distribution of organisms. (IB) | Prentice Hall (1990)<br>Evolution, Change Over Time, Ch. 1<br><br>AAAS Benchmarks<br><br>Benchmark Assessment Concept One/7th Grade should be administered at the end of this unit. |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Living things have structures, which perform specific tasks to help them organisms live and grow, and meet their needs as they interact with the environment.**<br><br>**A. Sub – Concept**<br>Living things are made of cells, which have specialized component structures. | 1. All living organisms are composed of cells. As a basis for understanding this concept, students know:<br>a. Cells function similarly in all living things. (IIA)<br>b. The characteristics that distinguish plant cells from animal cells including chloroplasts and cell walls. (IIA)<br>c. The nucleus is the repository for genetic information in plant and animal cells. (IIA)<br>d. Mitochondria liberate energy for the work that cells do, and chloroplasts capture sunlight energy for photosynthesis. (IIA)<br>e. Cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes. (IIA)<br>f. As multicellular organisms develop, their cells differentiate. (IIA) | Prentice Hall (1990)<br>CELLS, Building Blocks of Life, Chapters 1 – 4.<br><br>AAAS Benchmarks, |

| II. Conceptual Story | State/ District Standards | Instructional Coordination |
|---|---|---|
| **Living things have structures, which perform specific tasks to help them organisms live and grow, and meet their needs as they interact with the environment.**<br><br>**B. Sub – Concept**<br>All but the simplest cells have specialized cells, tissues, organs, organ systems which perform life functions. | The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept, students know:<br>a. Plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism. (IIB)<br>b. Organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system. (IIB)<br>c. How bones and muscles work together to provide a structural framework for movement. (IIB)<br>d. How the reproductive organs of the human female and male generate eggs and sperm, and how sexual activity may lead to fertilization and pregnancy. (IIB)<br>e. The function of the umbilicus and placenta during pregnancy. (IIB)<br>f. The structures and processes by which flowering plants generate pollen and ovules, seeds and fruit. (IIB)<br>g. How to relate the structures of the eyes and ear to their functions. (IIB)<br>h. How independent lines of evidence from geology, fossils, | Prentice Hall (1990)<br><br>AAAS Benchmarks |

| | | |
|---|---|---|
| | and comparative anatomy provide a basis for the theory of evolution | |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Living things have structures, which perform specific tasks to help them organisms live and grow, and meet their needs as they interact with the environment.**<br><br>**C. Sub – Concept**<br>DNA is the genetic material of living organisms and is located in the chromosomes of the cells. | Those traits may be modified by environmental influences. As a basis for understanding this concept, students know:<br>a. The differences between the life cycles and reproduction sexual and asexual organisms. (IIC)<br>b. Sexual reproduction produces offspring that inherit half their genes from each parent. (IIC)<br>c. An inherited trait can be determined by one or more genes. (IIC)<br>d. Plant and animal cells contain many thousands of different genes, and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive. (IIC)<br>e. DNA is the genetic material of living organisms, and is located in the chromosomes of each cell. (IIC) | Prentice Hall (1990)<br>CELLS, Building Blocks<br>HUMAN, HEALTH & BIOLOGY<br>HEREDITY |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **Living things have structures, which perform specific tasks to help them organisms live and grow, and meet their needs as they interact with the environment.**<br><br>**D. Sub – Concept**<br>Genetic mutation recombination of genetic material are mechanism of diversity.<br><br>**E. Sub – Concept**<br>Populational processes of migration, natural selection, and genetic drift are other processes which cause diversity of successive generations (evolution). | Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept, students know:<br>a. Both genetic variation and environmental factors are causes of evolution and diversity of organisms. (IID)<br>b. The reasoning used by Darwin in making his conclusion that natural selection is the mechanism of evolution. (IIE).<br>c. How to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics, and expand the diagram to include fossil organisms. (IIE)<br>d. Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival. (IIE) | Prentice Hall (1990) |

# The California State Science Standards Investigation and Experimentation Strand for 7th Grade Standards Curriculum

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in the other three strands, students should **develop their own questions** and **perform investigations**. Student will:

a. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

b. Utilize a variety of print and electronic resources (including World Wide Web) to collect information as evidence as part of a research project.

c. Communicate the logical connection among hypothesis, science concepts, tests conducted, and conclusions drawn from the scientific evidence.

d. Construct scale models, maps and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).

e. Communicate the steps and results from an investigation in written reports and verbal presentations.

Teachers can use these methodologies anywhere in their unit. A few suggestions have been marked.

# Palm Springs Unified School District

## Middle School Science Committee

## INSTRUCTIONAL GUIDE for

## 8th GRADE SCIENCE CURRICULUM



Resources for this document:
California State San Bernardino Master's Project: Kathy Been, Paula Reynolds, Cathy Ahearn
Published 1999
California State Science Standards - Approved 10/98
Prentice-Hall Science System - Approved 6/93, PSUSD Board of Education
(During 1999-2000 School Year - Transition)
Science Framework for California Public Schools - California State Board of Ed, 1990, 8/93

PALM SPRINGS UNIFIED SCHOOL DISTRICT

BOARD OF EDUCATION
Meredy Schoenberg, President
Andrew Green, Clerk
Donald Aiken, Member
Michael McCabe, Member
Leslie DeMersseman, Member

DISTRICT ADMINISTRATION
William Diedrich, Ph.D., Superintendent
Lorain Becker, Ed.D, Ass't. Superintendent, Educational Services
David Costner, Ass't. Superintendent, Business Services
Michael Sellwood, Ed.D., Ass't. Superintendent, Personnel Services
Craig Borba, Ed.D., Director, Pupil Personnel Services

Middle School Science Review Committee
Desert Springs Middle School
Victoria Carrillo and William Chilner
James Workman Middle School
Sherry Garcia, Greg Lonborg and David Zemek
Nellie Coffman Middle School
Phyllis Burgess, JoAnna Edwards, Kathy Hansel, and Jerry Reylek
Raymond Cree Middle School
Denise Aguanno, Stacy Brennan, Maureen Ferriter, Debbie Romig, Molly Thomas
CSUSB Master's Writing Team and Raymond Cree Teachers
Cathy Ahearn, Kathy Been and Paula Reynolds
Dr. Diane Kline, Ed.D, Palm Springs Unified School District
Director of Curriculum and Instruction

| 8th Grade Conceptual Units | 7th Grade Conceptual Units | 6th Grade Conceptual Units |
|---|---|---|
| The universe is dynamic. Everything in the universe is moving and is interconnected. | The non-living resources of the Earth have changed over time and evidence from rocks allows observation of those changes. | Energy is neither created nor destroyed. |
| The motion of an object is always judged with respect to some other object or point. | Living things have structures, which perform specific tasks to help the organisms live, grow, and interact with the environment. | Forces within the Earth cause stress, which in turn alters the Earth's surface. |
| Matter is made of smaller parts, which are perpetually in motion. | Living organisms are descended, with modifications, from other organisms. | Living and non-living resources are partners in keeping an ecosystem in balance. |

**8th Grade Conceptual/Standards Based Science Unit**

**The universe is dynamic. Everything in the universe is moving and is interconnected.**

**The motion of an object is always judged with respect to some other object or point.**
Sub-Concept: Unbalanced forces cause changes in velocity.
Sub-Concept: The velocity of an object is the rate of change of its position.
Sub-Concept: All fluids are made up of particles and that these particles have energy in terms of mass and acceleration.

**Matter is made of smaller parts, which are perpetually in motion.**
Sub-Concept: Matter is made of atoms. The atoms of any element are alike but, are different from atoms of other elements.
Sub-Concept: Matter exists in different states.
Sub-Concept: Atoms may stick together in well-defined molecules or they may be packed together in large arrays.

**Investigative Standards will be used as instructional strategies and objectives in teaching the above concepts.**

**8th Grade Instructional Materials (Transition until the purchase of new books in the spring of 2000)**

Prentice Hall Science Integrated Learning Systems. (Textbooks, transparencies, test generator, Spanish texts, videodisks, and VHS videos). This series was approved by the PSUSD Board of Education June of 1993 for use in Middle School Science Classrooms.

Component M - Exploring the Universe
N - Matter: Building Blocks of the Universe
P - Electricity and Magnetism
S - Motion, Forces and Energy

Other components of the series can be used as needed to complete integration of Interdisciplinary Topics.

Additional materials including, but not limited to:
Project Wild and Project Learning Tree Materials, K - 12 Science Alliance Materials, RIMS Activities, GEMS units, NatureScope Units, and technology units.

Assessment Methods:
Performance Based Tests Of Each Grade Level Concept - To be District Standard
SAT 9 Exam

8th Grade Conceptually Aligned Standards

I. **Conceptual Story:**
**The universe is dynamic. Everything in the universe is moving and is interconnected by the universal force of gravity.**

Supporting Standards:

- Students should know the role of gravity in forming and maintaining planets, stars and the solar system.
- The structure and composition of the universe can be learned from the study of stars and galaxies, and their evolution.
- Galaxies are clusters of billions of stars, and may have different shapes.
- The sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color.
- How to use astronomical units and light years as measure of distance between the sun, stars and Earth.
- Stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light.
- The (appearance, general composition) relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

II. **Conceptual Story:**
**The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.**

IIA. **Sub Concept with supporting standards:**
**Unbalanced forces cause changes in velocity**

- A force has both direction and magnitude
- When an object is subject two or more forces at once, the effect is the cumulative effect of all the forces
- When the forces on an object are balanced, the motion of the object does not change

- How to identify separately two or more forces acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
- When the forces on an object are unbalanced the object will change its motion (that is, speed up, slow down, or change direction).
- The greater the mass of an object the more force is needed to achieve the same change in motion.

**IIB. Sub Concept with supporting standards: The velocity of an object is the rate of change of its position.**

- Position is defined relative to some choice of standard reference point and a set of reference directions.
- Average speed is the total distance traveled divided by the total time elapsed. The speed of an object along the path traveled can vary.
- How to solve problems involving distance, time and average speed
- To describe the velocity of an object one must specify both direction and speed.
- Changes in velocity can be changes in speed, directions, or both.

**IIC. Sub Concept**
**All fluids are made up of particles and that these particles have energy in terms of mass and acceleration.**

- All objects experience a buoyant force when immersed in a fluid.
- Density is mass per unit volume
- How to calculate the density of substances (regular and irregular solids, and liquids) from measurements of mass and volume.
- The buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced.

- How to predict whether an object will float or sink.

**III. Conceptual Story**
**All matter is made of smaller parts, which are perpetually in motion, and that a wide variety of phenomena can be explained by alternative arrangements of vast numbers of these invisibly tiny, moving parts.**

**IIIA. Sub Concept with supporting standards:**
**Matter is made of atoms. The atoms of any element are alike but are different from atoms of other elements.**

- Elements have distinct properties and atomic structure.
- All matter is comprised of one or more of over 100 elements.
- The structure of the atom and how it is composed of proton, neutrons and electrons. Compounds are formed by combining two or more different elements. Compounds have properties that are different from the constituent elements.

**IIIB. Sub Concept with supporting standards:**
**Matter exists in different states, depending on the motion of its atoms.**

- Atoms and molecules form solids by building up repeating patterns such as the crystal structure of NaCl or long chain polymers.
- The states (solid, liquid, gas) of matter depend on molecular motion.
- In solids the atoms are closely locked in position and can only vibrate, in liquids the atoms and molecules are more loosely connected and can collide with and move past one another, while in gases the atoms or molecules are free to move independently, colliding frequently.

**IIIC. Sub Concept with supporting standards: Atoms may stick together in well-defined molecules or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances.**

- Chemical reactions are processes in which atoms are rearranged into different combination of molecules.
- Reactant atoms and molecules interact to form products with different chemical properties.
- The idea of atoms explains the conservation of matter: in chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
- Chemical reactions usually liberate heat or absorb heat.
- Principles of chemistry underlie the functioning of biological systems.

**IIID. Sub Concept with supporting standards: The elements (atoms) of matter are organized into a Periodic Table based on their periodic functions and properties.**

- The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms.
- How to identify regions corresponding to metals, nonmetals and inert gases.
- Elements are defined by the number of protons in the nucleus, which is called the atomic number. Different isotopes of an element have a different number of neutrons in the nucleus.
- Substances can be classified by their properties, including melting temperature, density, hardness heat, and electrical conductivity.

**IIIE. Sub Concept with supporting standards: The principles of chemistry underlie the functioning of biological systems.**

- Principles of chemistry underlie the functioning of biological systems.
- Carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
- Living organisms are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
- Living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins, and DNA.

| I. Conceptual Story | State/ District Standards | Instructional Coordination |
|---|---|---|
| **The universe is dynamic. Everything in the universe is moving and is interconnected by the universal force of gravity.** | 2g. Students should know the role of gravity in forming and maintaining planets, stars and the solar system<br>4.The structure and composition of the universe can be learned from the study of stars and galaxies, and their evolution. As a basis for understanding this concept, students know:<br>a. Galaxies are clusters of billions of stars, and may have different shapes.<br>b. The sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color.<br>c. How to use astronomical units and light years as measure of distance between the sun, stars and Earth.<br>d. Stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light.<br>e. The (appearance, general composition) relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids | Prentice Hall (1990)<br>Exploring the Universe, Chapter 1,2 and 3<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br><br>Isaac Newton's system was based on the concepts of mass, force, and acceleration, his three laws of motion relating them and a physical law stating that the force of gravity between any two objects in the universe depends on ly upon their masses and the distance between them.<br>Although overtaken in the 20th century by Einstein's relativity theory, Newton's ideas persist and are widely used.<br>AAAS Benchmarks, pg. 243 |

8th Grade

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.**<br><br>**A. Sub – Concept**<br>Unbalanced forces cause changes in velocity | Unbalanced forces cause changes in velocity. As a basis for understanding this concept, students know:<br>a. a force has both direction and magnitude (IIA)<br>b. when an object is subject to two or more forces at once, the effect is the cumulative effect of all the forces (IIA)<br>c. when the forces on an abject are balanced, the motion of the object does not change (IIA)<br>d. How to identify separately two or more forces acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction. (IIA)<br>e. When the forces on an object are unbalanced the object will change its motion (that is, speed up, slow down, or change direction. (IIA)<br>f. The greater the mass of an object the more force is needed to achieve the same change in motion. (IIA) | Prentice Hall (1990)<br>Motion, Forces and Energy, Chapter 2<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br><br>For good many school years, force may be treated as the originator of motion, and an explanation of force itself may be postponed. In helping students broaden their understanding of the fundamental forces of nature, the emphasis should be on gravitational and electromagnetic forces.<br>AAAS Benchmarks, pg. 93<br><br>Benchmark Assessment Concept One/8th Grade should be administered at the end of this unit. |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **The motion of an object is always judged with respect to some other object or point and so the idea of absolute motion or rest is misleading.**<br><br>**B. Sub – Concept**<br>The velocity of an object is the rate of change of its position | 1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept, students know:<br>a. Position is defined relative to some choice of standard reference point and a set of reference directions. (IIB)<br>b. Average speed is the total distance traveled divided by the total time elapsed. The speed of an object along the path traveled can vary. (IIB)<br>c. How to solve problems involving distance, time and average speed. (IIB)<br>d. To describe the velocity of an object one must specify both direction and speed. (IIB)<br>e. Changes in velocity can be changes in speed, direction, or both. (IIB) | Prentice Hall (1990)<br>Motion, Forces and Energy, Chapter 1<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br><br>Limitations in describing motion may keep students from learning about the effect of forces. Students tend to think in terms of motion or no motion. So, the first task may be to help students divide the category of motion into steady motion, speeding up and slowing down. AAAS Benchmarks, pg. 87<br>What is to be done? Students should have lots of experience to shape their intuition about motion and forces long before encountering laws. Especially helpful are experimentation and discussion of what happens as surfaces become more elastic or more free of friction. AAAS Benchmarks, pg. 88 |

| II. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.**<br><br>**C. Sub – Concept**<br><br>All fluids are made up of particles and that these particles have energy in terms of mass and acceleration.<br><br>** This sub-concept could be taught as part of the above unit or the following conceptual story.<br><br>**III. Conceptual Story**<br>All matter is made of smaller parts, which are perpetually in motion, and that a wide variety of phenomena can be explained by alternative arrangements of vast numbers of these invisibly tiny, moving parts. | 8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept, students know:<br>a. Density is mass per unit volume. (IIC)<br>b. How to calculate the density of substances (regular and irregular solids, and liquids) from measurements of mass and volume. (IIC)<br>c. The buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced. (IIC)<br>d. How to predict whether an object will float or sink. (IIC) | Prentice Hall (1990)<br>Motion, Forces and Energy, Chapter 3<br>And<br>Matter, Building Blocks of the Universe, Chapter 1<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br>CSIN Activities |

| III. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **All matter is made of smaller parts, which are perpetually in motion, and that a wide variety of phenomena can be explained by alternative arrangements of vast numbers of these invisibly tiny, moving parts.**<br><br>**A. Sub – Concept**<br>**Matter is made of atoms. The atoms of any element are alike but are different from atoms of other elements.**<br><br>**B. Sub – Concept**<br>**Matter exists in different states, depending on the motion of its atoms.** | 3. Elements have distinct properties and atomic structure. All matter is comprised of one or more of over 100 elements. As a basis for understanding this concept, students know:<br>a. The structure of the atom and how it is composed of protons, neutrons and electrons. (IIIA)<br>b. Compounds are formed by combining two or more different elements. Compounds have properties that are different from the constituent elements. (IIIC)<br>c. Atoms and molecules form solids by building up repeating patterns such as the crystal structure of NaCl or long chain polymers. (IIIB)<br>d. The states (solid, liquid, gas) of matter depend on molecular motion. (IIIB)<br>e. In solids the atoms are closely locked in position and can only vibrate, in liquids the atoms and molecules are more loosely connected and can collide with and move past one another, while in gases the atoms or molecules are free to move independently, colliding frequently. (IIIB) | Prentice Hall (1990)<br>Matter, Building Blocks of the Universe, Chapter 1, 2 and 4<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br>CSIN Activities<br><br>This unit appears deceptively short. The standards make a few unrelated standards. To teach this unit, there are other basics, which need to be addressed. Chapter 1, 2 and 3 discuss these basics if the teacher is not familiar with chemistry. The alignment is based on the standards choices. |

| III. Conceptual Story | State/District Standards | Instructional Coordination |
|---|---|---|
| **All matter is made of smaller parts, which are perpetually in motion, and that a wide variety of phenomena can be explained by alternative arrangements of vast numbers of these invisibly tiny, moving parts.**<br><br>**C. Sub – Concept**<br>Atoms may stick together in well-defined molecules or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances.<br><br>**D. Sub – Concept**<br>The elements (atoms) of matter are organized into a Periodic Table based on their periodic functions and properties. | 5. Chemical reactions are processes in which atoms are rearranged into different combination of molecules. As a basis for understanding this concept, students know:<br>a. Reactant atoms and molecules interact to form products with different chemical properties. (IIIC)<br>b. The idea of atoms explains the conservation of matter: in chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same. (IIIC)<br>c. Chemical reactions usually liberate heat or absorb heat. (IIIE)<br>6. Principles of chemistry underlie the functioning of biological systems. (IIIE)<br>a. Carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organism. (IIIE)<br>b. Living organisms are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur. (IIIE)<br>c. Living organisms have many different kinds of molecules | Prentice Hall (1990)<br>Matter: Building Blocks of the Universe,<br>Human, Health and Biology, Chapter 3<br>Earth's Natural Resources<br>GEMS Activities<br>AIMS Activities<br>NASA Teacher Materials<br>K – 12 Alliance Content Materials<br>CSTA Convention Materials<br>CSIN Activities<br><br>This unit appears deceptively short. The standards make a few unrelated standards. To teach this unit, there are other basics, which need to be addressed. Chapter 1, 2 and 3 discuss these basics if the teacher is not familiar with chemistry. The alignment is based on the standards choices. |

| | | |
|---|---|---|
| | including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins and DNA. (IIIE)<br>d. How to identify regions corresponding to metals, nonmetals and inert gases. (IIID)<br>e. Elements are defined by the number of protons in the nucleus, which is called the atomic number. Different isotopes of an element have a different number of neutrons in the nucleus. (IIID)<br>f. Substances can be classified by their properties, including melting temperature, density, hardness heat, and electrical conductivity. (IIID) | |

# The California State Science Standards Investigation and Experimentation Strand for 8th Grade Standards Curriculum

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in the other three strands, students should **develop their own questions** and **perform investigations**. Student will:

a. plan and conduct a scientific investigation to test a hypothesis

b. evaluate the accuracy and reproducibility of data.

c. Distinguish between variable and controlled parameters in a test

a. Recognize the slope of the linear graph as the constant in the relationship y =kx and Apply this to interpret graphs constructed from data.

b. Construct appropriate graphs from data and develop quantitative statements about The relationships between variables.

c. apply simple mathematical relationships to determine one quantity given the other two including (speed = distance/time, density = mass/volume, force = pressure X area, volume = area X height)

d. distinguish between linear and non – linear relationships on a graph of data.

Teachers can use these methodologies anywhere in their unit. A few suggestions have been marked.

# APPENDIX B

State of California
State Board of Education

# Science Content Standards Grades K-12

*PRE-PUBLICATION VERSION*

COPIED WITH PERMISSION FROM THE C.D.E.

State Board of Education
721 Capitol Mall
Fifth Floor
Sacramento, California 95814

Telephone: 916-657-5478
Fax: 916-653-7016
Web: www.cde.ca.gov\board\board.html

**ysical Sciences**

1. Properties of materials can be observed, measured and predicted. As a basis for understanding this concept, students know:
   a. objects can be described in terms of the materials they are made of (clay, cloth, paper, etc.) and their physical properties (color, size, shape, weight, texture, flexibility, attraction to magnets, floating and sinking, etc.).
   b. water can be a liquid or a solid and can be made to change back and forth from one form to the other.
   c. water left in an open container evaporates (goes into the air), but water in a closed container does not.

**Life Sciences**

2. Different types of plants and animals inhabit the Earth. As a basis for understanding this concept, students know:
   a. how to observe and describe similarities and differences in the appearance and behavior of plants and of animals (e.g., seed-bearing plants, birds, fish, insects).
   b. stories sometimes give plants and animals attributes they do not really have.
   c. how to identify major structures of common plants and animals (e.g., stems, leaves, roots, arms, wings, legs)

**Earth Sciences**

3. The Earth is composed of land, air and water. As a basis for understanding this concept, students know:
   a. characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms.
   b. changes in weather occur from day to day and over seasons, affecting the Earth and its inhabitants.
   c. how to identify resources from the Earth that are used in everyday life, and that many resources can be conserved.

**Investigation and Experimentation**

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in the other three strands, students should develop their own questions and perform investigations. Students will:
   a. observe common objects using the five senses.
   b. describe the properties of common objects.
   c. describe the relative position of objects using one reference (e.g., above or below).
   d. compare and sort common objects based on one physical attribute (including color, shape, texture, size, weight).
   e. communicate observations orally and in drawings.

# Grade 1

**Physical Sciences**

1. Materials come in different forms (states) including solids, liquids, and gases. As a basis for understanding this concept, students know:
   a. solids, liquids, and gases have different properties.
   b. the properties of substances can change when the substances are mixed, cooled, or heated.

**Life Sciences**

2. Plants and animals meet their needs in different ways. As a basis for understanding this concept, students know:
   a. different plants and animals inhabit different kinds of environments and have external features that help them thrive in different kinds of places.
   b. plants and animals both need water; animals need food, and plants need light.
   c. animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting.
   d. how to infer what animals eat from the shapes of their teeth (e.g., sharp teeth: eats meat; flat teeth: eats plants).
   e. roots are associated with the intake of water and soil nutrients, green leaves with making food from sunlight.

**Earth Sciences**

3. Weather can be observed, measured and described. As a basis for understanding this concept, students know:
   a. how to use simple tools (e.g., thermometer, wind vane) to measure weather conditions and record changes from day to day and over the seasons.
   b. the weather changes from day to day, but trends in temperature or of rain (or snow) tend to be predictable during a season.
   c. the sun warms the land, air, and water.

**Investigation and Experimentation**

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. draw pictures that portray some features of the thing being described.
   b. record observations and data with pictures, numbers, and/or written statements.
   c. record observations on a bar graph.
   d. describe the relative position of objects using two references (e.g., above and next to, below and left of).
   e. make new observations when discrepancies exist between two descriptions of the same object or phenomena.

# Grade 2

## Physical Sciences

1. The motion of objects can be observed and measured. As a basis for understanding this concept, students know:
   a. the position of an object can be described by locating it relative to another object or the background.
   b. an object's motion can be described by recording the change in its position over time.
   c. the way to change how something is moving is to give it a push or a pull. The size of the change is related to the strength, or the amount of "force," of the push or pull.
   d. tools and machines are used to apply pushes and pulls (forces) to make things move.
   e. objects near the Earth fall to the ground unless something holds them up.
   f. magnets can be used to make some objects move without being touched.
   g. sound is made by vibrating objects and can be described by its pitch and volume.

## Life Sciences

2. Plants and animals have predictable life cycles. As a basis for understanding this concept, students know:
   a. organisms reproduce offspring of their own kind. The offspring resemble their parents and each other.
   b. the sequential stages of life cycles are different for different animals, for example butterflies, frogs, and mice.
   c. many characteristics of an organism are inherited from the parents. Some characteristics are caused by, or influenced by, the environment.
   d. there is variation among individuals of one kind within a population.
   e. the germination, growth, and development of plants can be affected by light, gravity, touch, or environmental stress.
   f. in plants flowers and fruits are associated with reproduction.

## Earth Sciences

3. Earth is made of materials that have distinct properties and provide resources for human activities. As the basis for understanding this concept, students know:
   a. how to compare the physical properties of different kinds of rocks and that rock is composed of different combinations of minerals.
   b. smaller rocks come from the breakage and weathering of larger rocks.
   c. soil is made partly from weathered rock and partly from organic materials, and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.
   d. fossils provide evidence about the plants and animals that lived long ago, and scientists learn about the past history of Earth by studying fossils.
   e. rock, water, plants and soil provide many resources including food, fuel, and building materials that humans use.

**Investigation and Experimentation**

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. make predictions based on patterns of observation rather than random guessing.
   b. measure length, weight, temperature, and liquid volume with appropriate tools and express measurements in standard and non-standard units.
   c. compare and sort common objects based on two or more physical attributes (including color, shape, texture, size, weight).
   d. write or draw descriptions of a sequence of steps, events, and observations.
   e. construct bar graphs to record data using appropriately labeled axes.
   f. write or draw descriptions of a sequence of steps, events and observations, and include the use of magnifiers or microscopes to extend senses.
   g. follow verbal instructions for a scientific investigation.

## Grade 3

### Physical Sciences

1. Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept, students know:
   a. energy comes from the sun to the Earth in the form of light.
   b. sources of stored energy take many forms, such as food, fuel, and batteries.
   c. machines and living things convert stored energy to motion and heat.
   d. energy can be carried from one place to another by waves, such as water waves and sound, by electric current, and by moving objects.
   e. matter has three forms: solid, liquid and gas.
   f. evaporation and melting are changes that occur when the objects are heated.
   g. when two or more substances are combined a new substance may be formed that can have properties that are different from those of the original materials.
   h. all matter is made of small particles called atoms, too small to see with our eyes.
   i. people once thought that earth, wind, fire, and water were the basic elements that made up all matter. Science experiments show that there are over 100 different types of atoms which are displayed on the Periodic Table of the Elements.

2. Light has a source and travels in a direction. As a basis for understanding this concept, students know:
   a. sunlight can be blocked to create shadows.
   b. light is reflected from mirrors and other surfaces.
   c. the color of light striking an object affects how our eyes see it.
   d. we see objects when light traveling from an object enters our eye.

### Life Sciences

3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept, students know:
   a. plants and animals have structures that serve different functions in growth, survival, and reproduction.
   b. examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
   c. living things cause changes in the environment where they live; some of these changes are detrimental to the organism or other organisms, whereas others are beneficial.
   d. when the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.
   e. some kinds of organisms that once lived on Earth have completely disappeared; some of these resembled others that are alive today.

### Earth Sciences

4. Objects in the sky move in regular and predictable patterns. As a basis for understanding this concept, students know:
   a. the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.
   b. how the moon's appearance changes during the four-week lunar cycle.
   c. telescopes magnify the appearance of some distant objects in the sky, including the moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than can be seen by the unaided eye.
   d. the Earth is one of several planets that orbit the sun, and the moon orbits the Earth.
   e. the position of the sun in the sky changes during the course of the day and from season to season.

**Investigation and Experimentation**

5. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. repeat observations to improve accuracy, and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods being used, or uncertainty in the observation.
   b. differentiate evidence from opinion, and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
   c. use numerical data in describing and comparing objects, events and measurements.
   d. predict the outcome of a simple investigation, and compare the result to the prediction.
   e. collect data in an investigation and analyze them to develop a logical conclusion.

**Physical Sciences**

1. Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept, students know:
   a. how to design and build simple series and parallel circuits using components such as wires, batteries, and bulbs.
   b. how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
   c. electric currents produce magnetic fields and how to build a simple electromagnet.
   d. the role of electromagnets in the construction of electric motors, electric generators, and simple devices such as doorbells and earphones.
   e. electrically charged objects attract or repel each other.
   f. magnets have two poles, labeled north and south, and like poles repel each other while unlike poles attract each other.
   g. electrical energy can be converted to heat, light and motion.

**Life Sciences**

2. All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:
   a. plants are the primary source of matter and energy entering most food chains.
   b. producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.
   c. decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:
   a. ecosystems can be characterized in terms of their living and nonliving components.
   b. for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
   c. many plants depend on animals for pollination and seed dispersal, while animals depend on plants for food and shelter.
   d. most microorganisms do not cause disease and many are beneficial.

**Earth Sciences**

4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept, students know:
   a. how to differentiate among igneous, sedimentary, and metamorphic rocks by their properties and methods of formation (the rock cycle).
   b. how to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals using a table of diagnostic properties.

5. Waves, wind, water, and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know:
   a. some changes in the Earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
   b. natural processes, including freezing/thawing and growth of roots, cause rocks to break down into smaller pieces.

c. moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

**Investigation and Experimentation**

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. differentiate observation from inference (interpretation), and know that scientists' explanations come partly from what they observe and partly from how they interpret their observations.
   b. measure and estimate weight, length, or volume of objects.
   c. formulate predictions and justify predictions based on cause and effect relationships.
   d. conduct multiple trials to test a prediction and draw conclusions about the relationships between results and predictions.
   e. construct and interpret graphs from measurements.
   f. follow a set of written instructions for a scientific investigation.

## Physical Sciences

1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept, students know:
   a. during chemical reactions, the atoms in the reactants rearrange to form products with different properties.
   b. all matter is made of atoms, which may combine to form molecules.
   c. metals have properties in common, such as electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), gold (Au), are pure elements while others, such as steel and brass, are composed of a combination of elemental metals.
   d. each element is made of one kind of atom. These elements are organized in the Periodic Table by their chemical properties.
   e. scientists have developed instruments that can create images of atoms and molecules showing that they are discrete and often occur in well ordered arrays.
   f. differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
   g. properties of solid, liquid, and gaseous substances, such as sugar ($C_6H_{12}O_6$), water ($H_2O$) helium (He), oxygen ($O_2$), nitrogen ($N_2$), and carbon dioxide ($CO_2$).
   h. living organisms and most materials are composed of just a few elements.
   i. common properties of salts, such as sodium chloride (NaCl).

## Life Sciences

2. Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept, students know:
   a. many multicellular organisms have specialized structures to support the transport of materials.
   b. how blood circulates through the heart chambers, lungs, and body, and how carbon dioxide ($CO_2$) and oxygen ($O_2$) are exchanged in the lungs and tissues.
   c. the sequential steps of digestion, and the roles of teeth and mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.
   d. the role of the kidney in removing cellular wastes from blood and converting them into urine, which is stored in the bladder.
   e. how sugar, water, and minerals are transported in a vascular plant.
   f. plants use carbon dioxide ($CO_2$) and energy from sunlight to build molecules of sugar and release oxygen.
   g. plant and animal cells break down sugar to obtain energy, forming carbon dioxide ($CO_2$) and water (respiration).

**Earth Sciences**

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept, students know:
   a. most of the Earth's water is present as salt water in the oceans, which cover most of the Earth's surface.
   b. when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water.
   c. water moves in the air from one place to another in the form of clouds or fog, which are tiny droplets of water or ice, and falls to the Earth as rain, hail, sleet, or snow.
   d. the amount of fresh water, located in rivers, lakes, underground sources, and glaciers, is limited, and its availability can be extended through recycling and decreased use.
   e. the origin of water used by their local communities.

4. Energy from the sun heats the Earth unevenly, causing air movements resulting in changing weather patterns. As a basis for understanding this concept, students know:
   a. uneven heating of the Earth causes air movements (convection currents).
   b. the influence of the ocean on weather, and the role of the water cycle in weather.
   c. causes and effects of different types of severe weather.
   d. how to use weather maps and weather forecasts to predict local weather, and that prediction depends on many changing variables.
   e. the Earth's atmosphere exerts a pressure that decreases with distance above the Earth's surface, and is the same in all directions.

5. The solar system consists of planets and other bodies that orbit the sun in predictable paths. As a basis for understanding this concept, students know:
   a. the sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium.
   b. the solar system includes the Earth, moon, sun, eight other planets and their satellites, and smaller objects such as asteroids and comets.
   c. the path of a planet around the sun is due to the gravitational attraction between the sun and the planet.

**Investigation and Experimentation**

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. classify objects (e.g., rocks, plant, leaves) based on appropriate criteria.
   b. develop a testable question.
   c. plan and conduct a simple investigation based on a student-developed question, and write instructions others can follow to carry out the procedure.
   d. identify the dependent and controlled variables in an investigation.
   e. identify a single independent variable in a scientific investigation and explain what will be learned by collecting data on this variable.
   f. select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
   g. record data using appropriate graphic representation (including charts, graphs, and labeled diagrams), and make inferences based on those data.
   h. draw conclusions based on scientific evidence and indicate whether further information is needed to support a specific conclusion.

i. write a report of an investigation that includes tests conducted, data collected or evidence examined, and conclusions drawn.

PLATE TECTONICS AND EARTH'S STRUCTURE

1. Plate tectonics explains important features of the Earth's surface and major geologic events. As the basis for understanding this concept, students know:
   a. the fit of the continents, location of earthquakes, volcanoes, and midocean ridges, and the distribution of fossils, rock types, and ancient climatic zones provide evidence for plate tectonics.
   b. the solid Earth is layered with cold, brittle lithosphere; hot, convecting mantle; and dense, metallic core.
   c. lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
   d. earthquakes are sudden motions along breaks in the crust called faults, and volcanoes/fissures are locations where magma reaches the surface.
   e. major geologic events, such as earthquakes, volcanic eruptions, and mountain building result from plate motions.
   f. how to explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes).
   g. how to determine the epicenter of an earthquake and that the effects of an earthquake vary with its size, distance from the epicenter, local geology, and the type of construction involved.

SHAPING THE EARTH'S SURFACE

2. Topography is reshaped by weathering of rock and soil and by the transportation and deposition of sediment. As the basis for understanding this concept, students know:
   a. water running downhill is the dominant process in shaping the landscape, including California's landscape.
   b. rivers and streams are dynamic systems that erode and transport sediment, change course, and flood their banks in natural and recurring patterns.
   c. beaches are dynamic systems in which sand is supplied by rivers and moved along the coast by wave action.
   d. earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

HEAT (THERMAL ENERGY) (PHYSICAL SCIENCE)

3. Heat moves in a predictable flow from warmer objects to cooler objects until all objects are at the same temperature. As a basis for understanding this concept, students know:
   a. energy can be carried from one place to another by heat flow, or by waves including water waves, light and sound, or by moving objects.
   b. when fuel is consumed, most of the energy released becomes heat energy.
   c. heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and also by convection (which involves flow of matter).
   d. heat energy is also transferred between objects by radiation; radiation can travel through space.

ENERGY IN THE EARTH SYSTEM

4. Many phenomena on the Earth's surface are affected by the transfer of energy through radiation and convection currents. As a basis for understanding this concept, students know:
   a. the sun is the major source of energy for phenomena on the Earth's surface, powering winds, ocean currents, and the water cycle.
   b. solar energy reaches Earth through radiation, mostly in the form of visible light.
   c. heat from Earth's interior reaches the surface primarily through convection.
   d. convection currents distribute heat in the atmosphere and oceans.
   e. differences in pressure, heat, air movement, and humidity result in changes of weather.

ECOLOGY (LIFE SCIENCE)

5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept, students know:
   a. energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis, and then from organism to organism in food webs.
   b. over time, matter is transferred from one organism to others in the food web, and between organisms and the physical environment.
   c. populations of organisms can be categorized by the functions they serve in an ecosystem.
   d. different kinds of organisms may play similar ecological roles in similar biomes.
   e. the number and types of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.

RESOURCES

6. Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students know:
   a. the utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process.
   b. different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and classify them as renewable or nonrenewable.
   c. natural origin of the materials used to make common objects.

**Investigation and Experimentation**

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations Students will:
   a. develop a hypothesis.
   b. select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
   c. construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
   d. communicate the steps and results from an investigation in written reports and verbal presentations.
   e. recognize whether evidence is consistent with a proposed explanation.
   f. read a topographic map and a geologic map for evidence provided on the maps, and construct and interpret a simple scale map.

g. interpret events by sequence and time from natural phenomena (e.g., relative ages of rocks and intrusions).
h. identify changes in natural phenomena over time without manipulating the phenomena (e.g., a tree limb, a grove of trees, a stream, a hillslope).

# Grade 7
# Focus on Life Science

CELL BIOLOGY

1. All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept, students know:
   a. cells function similarly in all living organisms.
   b. the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.
   c. the nucleus is the repository for genetic information in plant and animal cells.
   d. mitochondria liberate energy for the work that cells do, and chloroplasts capture sunlight energy for photosynthesis.
   e. cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes
   f. as multicellular organisms develop, their cells differentiate.

GENETICS

2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept, students know:
   a. the differences between the life cycles and reproduction of sexual and asexual organisms.
   b. sexual reproduction produces offspring that inherit half their genes from each parent.
   c. an inherited trait can be determined by one or more genes.
   d. plant and animal cells contain many thousands of different genes, and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
   e. DNA is the genetic material of living organisms, and is located in the chromosomes of each cell.

EVOLUTION

3. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept, students know:
   a. both genetic variation and environmental factors are causes of evolution and diversity of organisms.
   b. the reasoning used by Darwin in making his conclusion that natural selection is the mechanism of evolution.
   c. how independent lines of evidence from geology, fossils, and comparative anatomy provide a basis for the theory of evolution.
   d. how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics, and expand the diagram to include fossil organisms.
   e. extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

EARTH AND LIFE HISTORY (EARTH SCIENCE)

4. Evidence from rocks allows us to understand the evolution of life on Earth. As the basis for understanding this concept, students know:
   a. Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
   b. the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impact of an asteroid.
   c. the rock cycle includes the formation of new sediment and rocks. Rocks are often found in layers with the oldest generally on the bottom.
   d. evidence from geologic layers and radioactive dating indicate the Earth is approximately 4.6 billion years old, and that life has existed for more than 3 billion years.
   e. fossils provide evidence of how life and environmental conditions have changed.
   f. how movements of the Earth's continental and oceanic plates through time, with associated changes in climate and geographical connections, have affected the past and present distribution of organisms.
   g. how to explain significant developments and extinctions of plant and animal life on the geologic time scale.

STRUCTURE AND FUNCTION IN LIVING SYSTEMS

5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept, students know:
   a. plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
   b. organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
   c. how bones and muscles work together to provide a structural framework for movement.
   d. how the reproductive organs of the human female and male generate eggs and sperm, and how sexual activity may lead to fertilization and pregnancy.
   e. the function of the umbilicus and placenta during pregnancy.
   f. the structures and processes by which flowering plants generate pollen and ovules, seeds, and fruit.
   g. how to relate the structures of the eye and ear to their functions.

PHYSICAL PRINCIPLES IN LIVING SYSTEMS (PHYSICAL SCIENCE)

6. Physical principles underlie biological structures and functions. As a basis for understanding this concept, students know:
   a. visible light is a small band within a very broad electromagnetic spectrum.
   b. for an object to be seen, light emitted by or scattered from it must enter the eye.
   c. light travels in straight lines except when the medium it travels through changes.
   d. how simple lenses are used in a magnifying glass, the eye, camera, telescope, and microscope.
   e. white light is a mixture of many wavelengths (colors), and that retinal cells react differently with different wavelengths.
   f. light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection).
   g. the angle of reflection of a light beam is equal to the angle of incidence.
   h. how to compare joints in the body (wrist, shoulder, thigh) with structures used in machines and simple devices (hinge, ball-and-socket, and sliding joints).
   i. how levers confer mechanical advantage and how the application of this principle applies to the musculoskeletal system.
   j. contractions of the heart generate blood pressure, and heart valves prevent backflow of blood in the circulatory system.

**Investigation and Experimentation**

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
   b. utilize a variety of print and electronic resources (including the World Wide Web) to collect information as evidence as part of a research project.
   c. communicate the logical connection among hypothesis, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
   d. construct scale models, maps and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).
   e. communicate the steps and results from an investigation in written reports and verbal presentations.

# Grade 8
# Focus on Physical Science

MOTION

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept, students know:
   a. position is defined relative to some choice of standard reference point and a set of reference directions.
   b. average speed is the total distance traveled divided by the total time elapsed. The speed of an object along the path traveled can vary.
   c. how to solve problems involving distance, time, and average speed.
   d. to describe the velocity of an object one must specify both direction and speed.
   e. changes in velocity can be changes in speed, direction, or both.
   f. how to interpret graphs of position versus time and speed versus time for motion in a single direction.

FORCES

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept, students know:
   a. a force has both direction and magnitude.
   b. when an object is subject to two or more forces at once, the effect is the cumulative effect of all the forces.
   c. when the forces on an object are balanced, the motion of the object does not change.
   d. how to identify separately two or more forces acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
   e. when the forces on an object are unbalanced the object will change its motion (that is, it will speed up, slow down, or change direction).
   f. the greater the mass of an object the more force is needed to achieve the same change in motion.
   g. the role of gravity in forming and maintaining planets, stars and the solar system.

STRUCTURE OF MATTER

3. Elements have distinct properties and atomic structure. All matter is comprised of one or more of over 100 elements. As a basis for understanding this concept, students know:
   a. the structure of the atom and how it is composed of protons, neutrons and electrons.
   b. compounds are formed by combining two or more different elements. Compounds have properties that are different from the constituent elements.
   c. atoms and molecules form solids by building up repeating patterns such as the crystal structure of NaCl or long chain polymers.
   d. the states (solid, liquid, gas) of matter depend on molecular motion.
   e. in solids the atoms are closely locked in position and can only vibrate, in liquids the atoms and molecules are more loosely connected and can collide with and move past one another, while in gases the atoms or molecules are free to move independently, colliding frequently.
   f. how to use the Periodic Table to identify elements in simple compounds

EARTH IN THE SOLAR SYSTEM (EARTH SCIENCE)

4. The structure and composition of the universe can be learned from the study of stars and galaxies, and their evolution. As a basis for understanding this concept, students know:
   a. galaxies are clusters of billions of stars, and may have different shapes.
   b. the sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color.
   c. how to use astronomical units and light years as measures of distance between the sun, stars, and Earth.
   d. stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light.
   e. the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

REACTIONS

5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept, students know:
   a. reactant atoms and molecules interact to form products with different chemical properties.
   b. the idea of atoms explains the conservation of matter: in chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
   c. chemical reactions usually liberate heat or absorb heat.
   d. physical processes include freezing and boiling, in which a material changes form with no chemical reaction.
   e. how to determine whether a solution is acidic, basic or neutral.

CHEMISTRY OF LIVING SYSTEMS (LIFE SCIENCE)

6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept, students know:
   a. carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
   b. living organisms are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur.
   c. living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins and DNA.

PERIODIC TABLE

7. The organization of the Periodic Table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept, students know:
   a. how to identify regions corresponding to metals, nonmetals and inert gases.
   b. elements are defined by the number of protons in the nucleus, which is called the atomic number. Different isotopes of an element have a different number of neutrons in the nucleus.
   c. substances can be classified by their properties, including melting temperature, density, hardness, heat, and electrical conductivity.

DENSITY AND BUOYANCY

8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept, students know:
   a. density is mass per unit volume.
   b. how to calculate the density of substances (regular and irregular solids, and liquids) from measurements of mass and volume.
   c. the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced.
   d. how to predict whether an object will float or sink.

**Investigation and Experimentation**

9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other three strands, students should develop their own questions and perform investigations. Students will:
   a. plan and conduct a scientific investigation to test a hypothesis.
   b. evaluate the accuracy and reproducibility of data.
   c. distinguish between variable and controlled parameters in a test.
   d. recognize the slope of the linear graph as the constant in the relationship y=kx and apply this to interpret graphs constructed from data.
   e. construct appropriate graphs from data and develop quantitative statements about the relationships between variables.
   f. apply simple mathematical relationships to determine one quantity given the other two (including speed = distance/time, density = mass/volume, force = pressure x area, volume=area x height).
   g. distinguish between linear and non-linear relationships on a graph of data.

## Physics

MOTION AND FORCES

1. Newton's laws predict the motion of most objects. As a basis for understanding this concept, students know:
   a. how to solve problems involving constant speed and average speed.
   b. when forces are balanced no acceleration occurs, and thus an object continues to move at a constant speed or stays at rest (Newton's First Law).
   c. how to apply the law F=ma to solve one-dimensional motion problems involving constant forces (Newton's Second Law).
   d. when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and opposite direction. (Newton's Third Law).
   e. the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of the Earth.
   f. applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (for example, the Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
   g. circular motion requires application of a constant force directed toward the center of the circle.

   *h.* Newton's Laws are not exact but they provide very good approximations unless an object is moving close to the speed of light or is small enough that the quantum effects are important.*
   *i.* how to solve two-dimensional trajectory problems.*
   *j.* how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.*
   *k.* how to solve two-dimensional problems involving balanced forces (statics).*
   *l.* how to solve problems in circular motion, using the formula for centripetal acceleration in the following form: $a=v^2/r$.*
   *m.* how to solve problems involving the forces between two electric charges at a distance (Coulomb's Law) or the forces between two masses at a distance (Universal gravitation).*

CONSERVATION OF ENERGY AND MOMENTUM

2. The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept, students know:
   a. how to calculate kinetic energy using the formula $E=(1/2)mv^2$.
   b. how to calculate changes in gravitational potential energy near the Earth using the formula (change in potential energy) =mgh (change in the elevation).
   c. how to solve problems involving conservation of energy in simple systems such as falling objects.
   d. how to calculate momentum as product mv.
   e. momentum is a separately conserved quantity, different from energy.
   f. an unbalanced force on an object produces a change in its momentum.
   g. how to solve problems involving elastic and inelastic collisions in one dimension using the principles of conservation of momentum and energy.

   *h.* how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.*

HEAT AND THERMODYNAMICS

3. Energy cannot be created or destroyed although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept, students know:
   a. heat flow and work are two forms of energy transfer between systems.
   b. the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (First Law of Thermodynamics) and that this is an example of the law of conservation of energy.
   c. thermal energy (commonly called heat) consists of random motion and the vibrations and rotations of atoms and molecules. The higher the temperature, the greater the atomic or molecular motion.
   d. most processes tend to decrease the order of a system over time, and energy levels are eventually distributed uniformly.
   e. entropy is a quantity that measures the order or disorder of a system, and is larger for a more disordered system.
   *f.* the statement "entropy tends to increase" is a law of statistical probability that govems all closed systems (Second Law of Thermodynamics).*
   *g.* how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines have some heat flow out.*

WAVES

4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept, students know:
   a. waves carry energy from one place to another.
   b. how to identify transverse and longitudinal waves in mechanical media such as springs, ropes, and the Earth (seismic waves).
   c. how to solve problems involving wavelength, frequency, and wave speed.
   d. sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
   e. radio waves, light and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in vacuum is approximately $3x10^8$ m/s (186,000 miles/second).
   f. how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.

ELECTRONIC AND MAGNETIC PHENOMENA

5. Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept, students know:
   a. how to predict the voltage or current in simple direct current electric circuits constructed from batteries, wires, resistors, and capacitors.
   b. how to solve problems involving Ohm's law.
   c. any resistive element in a DC circuit dissipates energy which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = (potential difference IR) times (current I) = $I^2R$.
   d. the properties of transistors and their role in electric circuits.
   e. charged particles are sources of electric fields and experience forces due to the electric fields from other charges.
   f. magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and experience forces due to magnetic fields of other sources.
   g. how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.

h. changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.

i. plasmas, the fourth state of matter, contain ions and/or free electrons and conduct electricity.

*j.* electric and magnetic fields contain energy and act as vector force fields.*

*k.* the force on a charged particle in an electric field is qE, where E is the electric field at the position of the particle and q is the charge of the particle.*

*l.* how to calculate the electric field resulting from a point charge.*

*m.* static electric fields have as their source some arrangement of electric charges.*

*n.* the force on a moving particle (with charge q) in a magnetic field is qvB sin(a) where a is the angle between v and B (v and B are the magnitudes of vectors v and B, respectively), and students use the right-hand rule to find the direction of this force.*

*o.* how to apply the concepts of electrical and gravitational potential energy to solve problems involving conservation of energy.*

**Chemistry**

ATOMIC AND MOLECULAR STRUCTURE

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, students know:
   a. how to relate the position of an element in the Periodic Table to its atomic number and atomic mass.
   b. how to use the Periodic Table to identify metals, semimetals, nonmetals, and halogens.
   c. how to use the Periodic Table to identify alkali metals, alkaline earth metals and transition metals, and trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.
   d. how to use the Periodic Table to determine the number of electrons available for bonding.
   e. the nucleus is much smaller in size than the atom yet contains most of its mass.

   *f.* how to use the Periodic Table to identify the lanthanides and actinides, and transactinide elements, and know that the transuranium elements were man made*

   *g.* how to relate the position of an element in the periodic table to its quantum electron configuration, and reactivity with other elements in the table.*

   *h.* 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.* 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.* spectral lines are a result of transitions of electrons between energy levels. Their frequency is related to the energy spacing between levels using Planck's relationship (E=hν).*

CHEMICAL BONDS

2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds based on electrostatic forces between electrons and protons, and between atoms and molecules. As a basis for understanding this concept, students know:
   a. atoms combine to form molecules by sharing electrons to form covalent or metallic bonds, or by exchanging electrons to form ionic bonds.

b. 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. salt crystals such as NaCl are repeating patterns of positive and negative ions held together by electrostatic attraction.
d. in a liquid the inter-molecular forces are weaker than in a solid, so that the molecules can move in a random pattern relative to one-another.
e. how to draw Lewis dot structures.

*f.* how to predict the shape of simple molecules and their polarity from Lewis dot structures.*
*g.* how electronegativity and ionization energy relate to bond formation.*
*h.* 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.*

CONSERVATION OF MATTER AND STOICHIOMETRY

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, students know:
   a. how to describe chemical reactions by writing balanced equations.
   b. the quantity one mole is defined so that one mole of carbon 12 atoms has a mass of exactly 12 grams.
   c. one mole equals $6.02 \times 10^{23}$ particles (atoms or molecules).
   d. how to determine 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. 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.* how to calculate percent yield in a chemical reaction.*
   *g.* how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.*

GASES AND THEIR PROPERTIES

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, students know:
   a. the random motion of molecules and their collisions with a surface create the observable pressure on that surface.
   b. the random motion of molecules explains the diffusion of gases.
   c. 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. the values and meanings of standard temperature and pressure (STP).
   e. how to convert between Celsius and Kelvin temperature scales.
   f. there is no temperature lower than 0 Kelvin

   *g.* the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.*
   *h.* how to solve problems using the ideal gas law in the form PV=nRT.*
   *i.* how to apply Dalton's Law of Partial Pressures to describe the composition gases, and Graham's Law to describe diffusion of gases.*

ACIDS AND BASES

5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept, students know:
   a. the observable properties of acids, bases and salt solutions.
   b. acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
   c. strong acids and bases fully dissociate and weak acids and bases partially dissociate.
   d. how to use the pH scale to characterize acid and base solutions.

   *e.* the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.*
   *f.* how to calculate pH from the hydrogen ion concentration.*
   *g.* buffers stabilize pH in acid-base reactions.*

SOLUTIONS

6. Solutions are homogenous mixtures of two or more substances. As a basis for understanding this concept, students know:
   a. definitions of solute and solvent.
   b. how to describe the dissolving process as a result of random molecular motion.
   c. temperature, pressure, and surface area affect the dissolving process.
   d. how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million and percent composition

   *e.* the relationship between the molality of solute in a solution, and the solution's depressed freezing point or elevated boiling point.*
   *f.* how molecules in solution are separated or purified by the methods of chromatography and distillation.*

CHEMICAL THERMODYNAMICS

7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept, students know:
   a. how to describe temperature and heat flow in terms of the motion of molecules (or atoms)
   b. chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.

c. energy is released when a material condenses or freezes and absorbed when a material evaporates or melts.
d. how to solve problems involving heat flow and temperature changes, using known values of specific heat, and latent heat of phase change.

*e.* how to apply Hess's Law to calculate enthalpy change in a reaction.*
*f.* how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.*

REACTION RATES

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

   *d.* the definition and role of activation energy in a chemical reaction*

CHEMICAL EQUILIBRIUM

9. Chemical equilibrium is a dynamic process at the molecular level. As a basis for understanding this concept, students know:
   a. how to use LeChatelier's Principle to predict the effect of changes in concentration, temperature and pressure.
   b. equilibrium is established when forward and reverse reaction rates are equal.

   *c.* how to write and calculate an equilibrium constant expression for a reaction.*

ORGANIC AND BIOCHEMISTRY

10. The bonding characteristics of carbon lead to many different molecules with varied sizes, shapes, and chemical properties, providing the biochemical basis of life. As a basis for understanding this concept, students know:
   a. large molecules (polymers) such as proteins, nucleic acids, and starch are formed by repetitive combinations of simple sub-units.
   b. the bonding characteristics of carbon lead to a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
   c. amino acids are the building blocks of proteins.

   *d.* the system for naming the ten simplest linear hydrocarbons and isomers containing single bonds, simple hydrocarbons with double and triple bonds, and simple molecules containing a benzene ring.*
   *e.* how to identify the functional groups which form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.*
   *f.* the R-group structure of amino acids and how they combine to form the polypeptide backbone structure of proteins.*

NUCLEAR PROCESSES

11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and man-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept, students know:
    a. protons and neutrons in the nucleus are held together by strong nuclear forces which are stronger than the electromagnetic repulsion between the protons.
    b. the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions: change in mass (calculated by $E=mc^2$) is small but significant in nuclear reactions.
    c. many naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.
    d. the three most common forms of radioactive decay (alpha, beta, gamma) and how the nucleus changes in each type of decay.
    e. alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.
    *f.* how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.*
    *g.* protons and neutrons have substructure and consist of particles called quarks.*

## Biology/Life Sciences

CELL BIOLOGY

1. Fundamental life processes of plants and animals depend on a variety of chemical reactions that are carried out in specialized areas of the organism's cells. As a basis for understanding this concept, students know:
    a. cells are enclosed within semi-permeable membranes that regulate their interaction with their surroundings.
    b. enzymes are proteins and catalyze biochemical reactions without altering the reaction equilibrium. The activity of enzymes depends on the temperature, ionic conditions and pH of the surroundings.
    c. how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.
    d. the Central Dogma of molecular biology outlines the flow of information from transcription of RNA in the nucleus to translation of proteins on ribosomes in the cytoplasm.
    e. the role of the endoplasmic reticulum and Golgi apparatus in secretion of proteins.
    f. usable energy is captured from sunlight by chloroplasts, and stored via the synthesis of sugar from carbon dioxide.
    g. the role of the mitochondria in making stored chemical bond energy available to cells by completing the breakdown of glucose to carbon dioxide.
    h. most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.
    *i. how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.*
    *j. how eukaryotic cells are given shape and internal organization by a cytoskeleton and/or cell wall.*

GENETICS

2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept, students know:
   a. meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.
   b. only certain cells in a multicellular organism undergo meiosis
   c. how random chromosome segregation explains the probability that a particular allele will be in a gamete.
   d. new combinations of alleles may be generated in a zygote through fusion of male and female gametes (fertilization).
   e. why approximately half of an individual's DNA sequence comes from each parent.
   f. the role of chromosomes in determining an individual's sex.
   g. how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.

3. A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept, students know:
   a. how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).
   b. the genetic basis for Mendel's laws of segregation and independent assortment.
   c.* *how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.*
   d.* *how to use data on frequency of recombination at meiosis to estimate genetic distances between loci, and to interpret genetic maps of chromosomes.*

4. Genes are a set of instructions, encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept, students know:
   a. the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
   b. how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.
   c. how mutations in the DNA sequence of a gene may or may not affect the expression of the gene, or the sequence of amino acids in an encoded protein.
   d. specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.
   e. proteins can differ from one another in the number and sequence of amino acids.
   f.* *why proteins having different amino acid sequences typically have different shapes and chemical properties.*

5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept, students know:
   a. the general structures and functions of DNA, RNA, and protein.
   b. how to apply base-pairing rules to explain precise copying of DNA during semi-conservative replication, and transcription of information from DNA into mRNA.
   c. how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.

d.* *how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.*

e.* *how exogenous DNA can be inserted into bacterial cells in order to alter their genetic makeup and support expression of new protein products.*

ECOLOGY

6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept, students know:
   a. biodiversity is the sum total of different kinds of organisms, and is affected by alterations of habitats.
   b. how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of non-native species, or changes in population size.
   c. how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.
   d. how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles via photosynthesis and respiration.
   e. a vital part of an ecosystem is the stability of its producers and decomposers.
   f. at each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment as heat and this can be represented in a food pyramid.

   g.* *how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.*

EVOLUTION

7. The frequency of an allele in a gene pool of a population depends on many factors, and may be stable or unstable over time. As a basis for understanding this concept, students know:
   a. why natural selection acts on the phenotype rather than the genotype of an organism.
   b. why alleles that are lethal in a homozygous individual may be carried in a heterozygote, and thus maintained in a gene pool.
   c. new mutations are constantly being generated in a gene pool.
   d variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

   e.* *the conditions for Hardy-Weinberg equilibrium in a population, and why these conditions are not met in nature.*

   f.* *how to solve the Hardy-Weinberg equation to determine the predicted frequency of genotypes in a population, given the frequency of phenotypes.*

8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept, students know:
   a. how natural selection determines the differential survival of groups of organisms.
   b. a great diversity of species increases the chance that at least some organisms survive large changes in the environment.
   c. the effects of genetic drift on the diversity of organisms in a population.
   d. reproductive or geographic isolation affects speciation.
   e. how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.

*f.* how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources to create a branching diagram (cladogram) that shows probable evolutionary relationships.*

*g.* how several independent molecular clocks, calibrated against each other and using evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from each other.*

PHYSIOLOGY

9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic), despite changes in the outside environment. As a basis for understanding this concept, students know:
   a. how the complementary activity of major body systems provides cells with oxygen and nutrients, and removes toxic waste products such as carbon dioxide.
   b. how the nervous system mediates communication between different parts of the body and interactions with the environment.
   c. how feedback loops in the nervous and endocrine systems regulate conditions within the body.
   d. the functions of the nervous system, and the role of neurons in transmitting electrochemical impulses.
   e. the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.

   *f.* the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.*

   *g.* the homeostatic role of the kidneys in the removal of nitrogenous wastes, and of the liver in blood detoxification and glucose balance.*

   *h.* the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, $Ca^{+2}$, and ATP.*

   *i.* how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.*

10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response, students know:
   a. the role of the skin in providing nonspecific defenses against infection.
   b. the role of antibodies in the body's response to infection.
   c. how vaccination protects an individual from infectious diseases.
   d. there are important differences between bacteria and viruses, with respect to their requirements for growth and replication, the primary defense of the body against them, and effective treatment of infections they cause.
   e. why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections of microorganisms that are usually benign.

   *f.* the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.*

EARTH'S PLACE IN THE UNIVERSE

1. Astronomy and planetary exploration reveal the structure, scale, and change of the solar system over time. As a basis for understanding this concept, students know:
   a. how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system.
   b. evidence from Earth and moon rocks for the solar system's formation from a nebular cloud of dust and gas approximately 4.6 billion years ago.
   c. evidence from geological studies of the Earth and other planets that the early Earth was very different from today.
   d. evidence that the planets are much closer than the stars.
   e. the sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.
   f. evidence for the dramatic effects of asteroid impacts in shaping the surface of planets and their moons, and in mass extinctions of life on Earth.

   *g.* evidence for the existence of planets orbiting other stars.*

2. Earth-based and space-based astronomy reveals the structure, scale, and change over time of stars, galaxies and the universe. As a basis for understanding this concept, students know:
   a. the solar system is located in an outer edge of the disc-shaped Milky Way galaxy which spans 100,000 light years.
   b. galaxies are made of billions of stars and form most of the visible mass of the universe.
   c. evidence that all elements with an atomic number greater than that of Lithium have been formed by nuclear fusion in stars.
   d. stars differ in their life cycles, and visual, radio, and X-ray telescopes collect data that reveal these differences.

   *e.* accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in early history of the universe before stars formed.*
   *f.* evidence that the color, brightness and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion.*
   *g.* how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years.*

DYNAMIC EARTH PROCESSES

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on the Earth's surface. As the basis for understanding this concept, students know:
   a. features of the ocean floor (magnetic patterns, age, and sea floor topography) provide evidence for plate tectonics.
   b. the principal structures that form at the three different kinds of plate boundaries.
   c. how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.
   d. why and how earthquakes occur, and the scales used to measure their intensity and magnitude.
   e. two kinds of volcanoes, one with violent eruptions producing steep slopes and the other with voluminous lava flows producing gentle slopes.

f.* *explanation for the location and properties of volcanoes that are due to hot spots and those that are due to subduction.*

ENERGY IN THE EARTH SYSTEM

4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept, students know:
   a. the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.
   b. the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
   c. the different atmospheric gases that absorb the Earth's thermal radiation, and the mechanism and significance of the greenhouse effect.
   d.* *the different greenhouse conditions on Earth, Mars, and Venus, their origins and climatic consequences.*

5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept, students know:
   a. how differential heating of the Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
   b. the relationship between the rotation of the Earth and the circular motion of ocean currents and air in pressure centers.
   c. the origin and effects of temperature inversions.
   d. properties of ocean water such as temperature and salinity can be used to explain the layered structure of the oceans, generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
   e. the distribution of rain forests and deserts on Earth in bands at specific latitudes.
   f.* *the interaction of wind patterns, ocean currents, and mountain ranges that results in the global pattern of latitudinal bands of rain forests and deserts.*
   g.* *features of the ENSO cycle (El Niño) in terms of sea-surface and air temperature variations across the Pacific, and some climatic results of this cycle.*

6. Climate is the long term average of a region's weather and depends on many factors. As a basis for understanding this concept, students know:
   a. weather (in the short run) and climate (in the long run) involve the transfer of energy in and out of the atmosphere.
   b. effects on climate of latitude, elevation, topography, as well as proximity to large bodies of water and cold or warm ocean currents.
   c. how the Earth's climate has changed over time, corresponding to changes in the Earth's geography, atmospheric composition and/or other factors (solar radiation, plate movement, etc.).
   d.* *use of computer models to predict the effects of increasing greenhouse gases on climate for the planet as a whole and for specific regions.*

BIOGEOCHEMICAL CYCLES

7. Each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of biogeochemical cycles. As a basis for understanding this concept, students know:
   a. the carbon cycle of photosynthesis and respiration, and the nitrogen cycle.
   b. the global carbon cycle in terms of the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, and fossil fuels, and the movement of carbon among these reservoirs.

c. movement of matter among reservoirs is driven by the Earth's internal and external sources of energy.

*d.* the relative residence times and flows of carbon in and out of its different reservoirs.*

STRUCTURE AND COMPOSITION OF THE ATMOSPHERE

8. Life has changed Earth's atmosphere and changes in the atmosphere affect conditions for life. As a basis for understanding this concept, students know:
   a. the thermal structure and chemical composition of the atmosphere.
   b. how the composition of the Earth's atmosphere has evolved over geologic time including outgassing, the origin of atmospheric oxygen, and variations in carbon dioxide concentration.
   c. the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation and how it varies both naturally and in response to human activities.

CALIFORNIA GEOLOGY

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept, students know:
   a. the resources of major economic importance in California and their relation to California's geology.
   b. the principal natural hazards in different California regions, and the geological basis of those hazards.
   c. the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.

   *d.* how to analyze published geologic hazard maps of California and use the map information to identify evidence of geological events of the past and predict geological changes in the future*

**Investigation and Experimentation**

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content 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, spread sheets, 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 using logic and evidence.
   e. solve scientific problems using quadratic equations, and simple trigonometric, exponential, and logarithmic functions.
   f. distinguish between hypothesis and theory as science terms.
   g. recognize the use and limitations of models and theories as scientific representations of reality.
   h. read and interpret topographic and geologic maps.
   i. analyze the locations, sequences, or time intervals 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 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, sometimes the observation is mistaken or fraudulent (e.g., Piltdown Man fossil or unidentified flying objects), and sometimes the theory is wrong (e.g., Ptolemaic model of the movement of the sun, moon and planets).

# APPENDIX C

Inservice Information

# Middle School School Science Curriculum
# School Year 1999-2000 Articulation

**In April, the science teachers from all middle schools got together and discussed the new curriculum. As a group, they decided summer was an excellent time to look at the standards based curriculum. Two teachers from each middle school, at each grade level are encouraged to attend. You will be given a timecard and paid your hourly rate.**

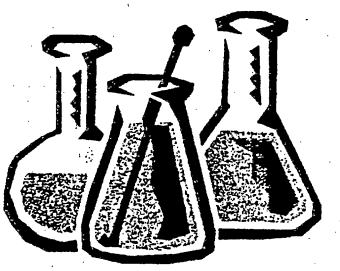
**RSVP. Kathy Been, Cree - 416-8283, Home - 322-3083 or DKBeen@aol.com**
**Be sure to coordinate with your principal**

**WHAT:** New Science Standards Curriculum

**WHEN:**

| | | |
|---|---|---|
| Grade | June 21 1 - 5 pm | 8th |
| Grade | June 22 1 - 5 pm | 7th |
| Grade | June 23 1 - 5 pm | 6th |

**WHERE:** Room 303 Raymond Cree Middle School



**SUMMER 6th GRADE SCIENCE**
**NEW STANDARDS BASED**
**CURRICULM TRAINING**

**All Middle School 6th grade science teachers, are invited to attend an August 25th inservice for the new standards based curriculum. The day will include a review of the standards, the PSUSD transitional curriculum, lab activities and geology content education. New and experienced teachers are invited. You will receive a $100 stipend for attending.**

**Please check with your principal and then RSVP to Kathy Been, Science Facilitator, Raymond Cree Middle School, 416-8283 or at home 322-3083 or on email DKBeen@aol.com.**

## What: Science Inservice 6th grade

## When: August 25, 1999

## Where: Raymond Cree Middle School

## Who: Kathy Been and local geology Folks

# MEMO

**To:** **Middle School Principals**
**Dr. Diane Kline and Mr. Jim Hurst**

**From:** **Kathy Been**

**Re:** **Summer Middle School Science Opportunities**

Hello! Below I have outlined several opportunities for your science teachers to articulate and become familiar with the new California State Science Standards. For each event, I have attached a flyer which explains the event for your staff.

**Articulation Afternoons**

June 21 - 1 - 5 pm at Raymond Cree Middle School 8th grade
June 22 - 1 - 5 pm at Raymond Cree Middle School 7th grade
June 23 - 1 - 5 pm at Raymond Cree Middle School 6th grade

Two teachers from each school, for each grade, are invited to come and see the end result of a curriculum writing team. We met with many of your teachers in April and they had a chance to view the standards and the teacher-friendly-documents a Masters Project team from Cal State San Bernardino has put together. At the April meeting, your teachers requested a chance to review the document and add their input. This is an excellent articulation opportunity. Teachers will be paid their hourly rate. Please select two teachers from each grade (science teachers) and then send a list to me at Cree. After this day, the transition document will be sent to the Board of Education for approval through the office of Dr. Kline. It is only transitional because the new texts are not available until March 2000. Meanwhile, at middle school, we will have this document and our Prentice Hall books as a transition to a standards based science education.

**6th Grade teachers In-Service on Geology and Earth Science - August 25**

Dr. Kline, Jim Hurst and I have planned a science day for 6th grade teachers. The thought was that 7th and 8th grade teachers are usually single subject, science educated people, and should be able to work with the new curriculum. In addition, the 7th and 8th grade subjects (life and physical science) have been taught recently. In 6th grade, the geology and earth science is new to many liberal arts educated teachers. This day will pay a $100 stipend. Please forward the names and number of attendees to Dr. Kline's office. The location will be announced, but, is most likely Raymond Cree's cafeteria. New teachers in 6th grade are especially encouraged to come.

**K - 12 Alliance Summer Institute**

As I was working the numbers for the summer science education, I realized that the middle schools could be included in the summer and year-long program. The attached flyer explains that the training in the summer is from August 8 - 20 (with the weekend off). The training is one-third science content (physical science), one-third leadership and one-third instructional strategies for the new standards. Participants will then come back to your campus and spend ten hours inservicing your staff about the new standards based curriculum. This is a wonderful opportunity to gain a lead teacher on site, a staff developer available to help (me) and state-wide resources. One teacher from each site can attend. They will receive a $1000 stipend, room and board for the two weeks, supplies, ideas and curriculum strategies. They will be at the Rancho Cucamonga San Bernardino County Office, and will be using the computer labs for technology integration. The science content is taught by a cadre, which consists of a physicist, a high school teacher and a staff developer expert. The subject this summer is physical science, so, ideally, your participant should be an 8th grade teacher. Last year, the three middle school participants from PSUSD received the stipend and $250 worth of classroom materials. I do not know if the SPAN (NSF middle school grant) contains that this year, but, it seems logical.

Please contact me with questions. I am very excited about the money saving, and networking opportunities provided by the Eisenhower Grant money and NSF grant money.
We will be having an orientation meeting in Room 303 at Cree on June 3, 1999 from 3:30 - 5 pm. My hope is to hear from you before that, and have you and your teacher attend the meeting. There are two administrative days during the training, August 19 and 20th. These days are for you to meet with your teacher, your staff developer and your regional educator in science, and plan the year. I understand that those are administrative council days. We can arrange another time at your convenience.

If you need more reference type information, please contact Frank Tinney at Vista Del Monte. His school participated in the elementary program this year and they are continuing next year.

Looking forward to a great science summer!

Kathy Been

Minutes of Curriculum Meetings

June 23, 1999
6th Grade Teacher Curriculum Meeting
Minutes

Attendees: Raymond Cree Middle School
Maureen Ferriter,
Debbie Romig,
Kathy Been, Biochem and Physical
Molly Thomas, Biology
Desert Springs Middle School
Vicka Carillo
Nellie Coffman Middle School
Phyllis Burgess
James Workman Middle School
Sherry Garcia

Palm Springs Unified School District
Dr. Diane Kline's Office - Kathy Been

Agenda:

M. Introductions and Background
N. Review the Proposed Interim Curriculum
O. Decide whether to create a fourth column or separate document for teacher activities
P. Benchmark Assessment Discussion
Q. Anything the group decides we need to talk about
R. Creating a resource book of teachers/scientists locally

Minutes

IX. Meeting was called to order at

X. Attendees are listed above.

XI. The attendees reviewed the proposed curriculum and suggested the following changes:

XII. The attendees voted to approve this interim 8th grade Instructional Guide for standards based curriculum, and to forward the document to the Board of Education for approval.

Minutes

IX. Meeting was called to order at 1:03

X. Attendees are listed above.

XI. The attendees reviewed the proposed curriculum and suggested the following changes: None, just a request for resources, which will be Aug 25.

XII. The attendees voted to approve this interim 6th grade Instructional Guide for standards based curriculum, and to forward the document to the Board of Education for approval.

Signed,

Phyllis Burgess, NNC

Maureen Ferriter, RC

Debbie Romig, RC

Victoria Carillo, DSMS

Sherry Garcia, JWMS

Kathy Hansel, NNC

June 22, 1999
7th Grade Teacher Curriculum Meeting
Minutes

Attendees: Raymond Cree Middle School
Stacy Brennan, SDC
Kathy Been, Biochem and Physical
Molly Thomas, Biology
Desert Springs Middle School
Bill Chilner, Geology
Nellie Coffman Middle School
Jerry Reylek, Biology
James Workman Middle School
Greg Lonborg,

Palm Springs Unified School District
Dr. Diane Kline's Office - Kathy Been

Agenda:

G. Introductions and Background
H. Review the Proposed Interim Curriculum
I. Decide whether to create a fourth column or separate document for teacher activities
J. Benchmark Assessment Discussion
K. Anything the group decides we need to talk about
L. Creating a resource book of teachers/scientists locally

Minutes

V. Meeting was called to order at

VI. Attendees are listed above.

VII. The attendees reviewed the proposed curriculum and suggested the following changes:

VIII. The attendees voted to approve this interim 8th grade Instructional Guide for standards based curriculum, and to forward the document to the Board of Education for approval.

June 21, 1999
8th Grade Teacher Curriculum Meeting
Minutes

Attendees:

Raymond Cree Middle School
Kathy Been, Biochem and Physical
Molly Thomas, Biology
Desert Springs Middle School
No one
Nellie Coffman Middle School
JoAnna Edwards, Chemistry
James Workman Middle School
David Zemek, Earth Science
Palm Springs Unified School District
Dr. Diane Kline's Office - Kathy Been, rep

Agenda:

A. Introductions and Background
B. Review the Proposed Interim Curriculum
C. Decide whether to create a fourth column or separate document for teacher activities
D. Benchmark Assessment Discussion
E. Anything the group decides we need to talk about
F. Creating a resource book of teachers/scientists locally

Minutes

I. Meeting was called to order at 1:02 p.m.

II. Attendees are listed above.

III. The attendees reviewed the proposed curriculum and suggested the following changes:

Add a fourth column for teacher activities and Ideas.

IV. The attendees voted to approve this interim 8th grade Instructional Guide for standards based curriculum, and to forward the document to the Board of Education for approval.

V. On September 18, 1999, at Room 504 at JWMS, 8th grade teachers will get together and be inserviced on labs and content.

Approved,

Molly Thomas

Kathy Beer

Joann Richardson

David Zemsh

# Palm Springs Unified School District
# Middle School Science Content Element Matrix

| Grade | Themes | Earth Science | Physical | Life Science | General Science |
|---|---|---|---|---|---|
| | | The Earth is constantly changing at different rates in recurring cycles. | Matter and energy can be changed but not created or destroyed. | All living things are interrelated, interdependent and constantly changing. | |
| 6 | Energy Systems and Interactions | Matter, interactions and energy in the universe are similar to matter, interacting and energy on Earth | Matter and its parts are constantly moving and changing. Changes are caused by energy. | Organisms are affected by the living and non-living parts of their environments and the environment's energy. | Matter and energy can be measured and are interrelated. Scientific method is used as a problem-solving approach. |
| 7 | Patterns of Change Adaptations | Earth is a planet with unique features that are constantly changing. | Matter and energy interact at different levels. | Living things can be grouped by their structure and are inter-dependent with their environment. | Matter and energy can be measured and are interrelated. Scientific method is used as a problem-solving approach. |
| 8 | Systems and Interactions Energy | The sun's energy interacts with the Earth to create energy changes in the form of the changing earth. | Energy and matter can both be changed into different forms. | Humans, like all living things, need energy to perform their specific life activities. Humans are affected and affect their environment. | Matter and energy can be measured and are interrelated. Scientific method is used as a problem-solving approach |

REFERENCES

American Association for the Advancement of Science. (1993). Benchmarks for science literacy. New York: Oxford University Press.

Arnold, R.(1991). Now that we have state science standards, what will we do with them. The Middle Level News, 42, 3.

Asimov, N. (1998). Flap over state standards for teaching kids science. San Francisco Chronicle, pp. 3, 24.

Author Unknown. (1998). California adopts controversial standards. Science, 23, 178-179.

Author Unknown. (1999). Curriculum and instruction middle grade schools. Science, 27, 12-14.

Author unknown. (1990). Curriculum framework committee begins work. Phi Delta Kappan, 450-457.

Battin, J. (1999). Education reform in California. California Legislative Assembly.

Beane, J. (1995). Curriculum integration and disciplines of knowledge. Phi Delta Kappan, 616-628.

Beaton, A., Gonzalez, E. Kelly, D. Martin, M. Mullis, I. & Smith, T. (1996). Science achievments in the middle school years: third international mathematics and science study. Chestnut Hill, MA: TIMMS International Study Center.

Been, K. (1999). Conference summation paper. Dr. Howard, California State University, San Bernardino.

Bordeen, M. & Lederman, L. (1998). Coherence in scienc education. Science, 24, 178-179.

Brand, S., Felner, R. Flowers, N. Jackson, A. Kasak, D. & Mulhal, P. (1997). The impact of school reform for the middle years. Phi Delta Kappan, 12-16.

Bunch, B., & Helleman, A. (1988). The timetables of science. New York, NY: Simon and Schuster.

California Department of Education. (1987). Caught in

the middle: Educational reform for young adolescents in California's public schools. Sacramento, CA.

California Department of Education. (1994). 1994 guide and criteria for program quality review. Sacramento, CA.

Campbell, B., Lazonby, J., Millar, R., Nicolson, P., Ramsden, J., & Waddington, D. (1994). Science: The Salters' Approach - A case study of the process of large scale curriculum development. Science Education, 78, 194.

Cooke, G. (1994). Tug of war. California Schools, 53, 48-54.

Feder, T. (1998). California pulls together a science standards writing team. Physics Today, 51, 79-81.

Feder, T. (1998). California's science standards slammed for demanding too much, too early. Physics Today, 59, 54.

Howe, A. (1998). Turning activities into inquiry lessons. Science Activities, 34, 3-5.

Johnson, T., & Reed, R. (1996). Philosophical documents in education. White Plains, NY: Longman Publishers.

K-12 Alliance. (1998). Facilitating learning communities conference. Pasadena, CA.

Kalisek, A. (1999). California school recognition program 1999 middle school application: Raymond Cree Middle School.

Lafontaine, P., & Topps, J. (1999). Data to the rescue. Restructuring Science, 8, 3-9.

Lungren, D. (1998). A conversation with Gray Davis and Dan Lungren. California Schools, 57, 13-18.

National Research Council. (1998). Every child a scientist: Achieving scientific literacy for all. Washington DC: National Academy Press.

National Research Council. (1996). National science education standards. Washington DC: National Academy Press.

Richardson, J. (1999). Top-notch programs for middle schools. Results, 47, 1,6.

Science standards of achievement. (1993). San Jose, CA: Evergreen School District.

Schmoker, M. (1996). Results: The key to continuous school improvement. Alexandria, VA: Association for supervision and Curriculum Development.

Schurr, S., Thomason, J., & Thompson, M. (1996). Teaching at the middle level: A professionals handbook. Lexington, MS: D.C. Heath and CO.

Science and Environmental Education. (1993). Literature for science and mathematics. Sacramento, CA: California Department of Education.

Science Curriculum Framework and Criteria Committee. (1990). Science framework for California. Sacramento, CA: California Department of Education.

Staff. (1999). Making sense of the standards: Augmentation. Restructuring Science, 9, 3.

Staff. (1999). Middle Ground, 2, 10.

State of California. (1998). Science content standards: Pre-publication version. Sacramento, CA: Board of Education.

Taylor, N. (1999). Delivering the California science standards: Getting to know the science standards. San Diego County Office of Education Conference, Pasadena, CA.

Vogel, G. (1998). California adopts controversial standards. Science, 24, 387.

Wolfe, A. (1999). Philosophical and historical foundations of American education: Philosophical readings. San Bernardino, CA: California State University, School of Education.