Standards Map - Basic Comprehensive Program
Grades Nine Through Twelve - Science

Pursuant to the State Board approved, *Science Content Standards for California Public Schools, Kindergarten Through Grade Twelve*

Standards that all students are expected to achieve in the course of their studies are unmarked.
Standards that all students should have the opportunity to learn are marked with an asterisk (*).

Standards Map for Kinetic Books "Conceptual Physics."
This document includes the physics standards as well as applicable chemistry standards. Each citation is in the form "C.S", where C represents the chapter number and S is the section number in that chapter. The section numbers for "Quizboard" and "Problems" sections at the end of every chapter are shown here as "Q" and "P" respectively.

Standard #	Text of Standard	Introduced	Practiced	Taught to Mastery
	DISCIPLINE: PHYSICS			
	Motion and Forces Newton's laws predict the motion of most objects. As a basis for understanding this concept:			
1a	Students know how to solve problems that involve constant speed and average speed.	2.3, 2.4	2.7, 2.P	2.3, 2.4, 2.6
1b	Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).	5.2	5.Q, 5.P	5.2
1c	Students know how to apply the law $F = ma$ to solve one-dimensional motion problems that involve constant forces (Newton's second law).	5.5	5.7 - 5.9, 5.19, 5.Q, 5.P	Chapter 2, 5.5, 5.6, 5.11 - 5.13, 5.20
1d	Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).	5.10	5.Q, 5.P	5.10, 5.13
1e	Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.	5.4, 12.1	5.7, 5.Q, 5.P, 12.Q, 12.P	5.4, 5.6, 12.1 - 12.7
1f	Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).	8.1, 8.3, 8.5	8.4, 8.7, 8.Q, 8.P	8.1, 8.3, 8.5, 12.9
1g	Students know circular motion requires the application of a constant force directed toward the center of the circle.	8.5	8.7, 8.Q, 8.P	12.9

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1h*	Students know Newton's laws are not exact but provide very good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important.	35.0	35.8, 35.Q, 35.P	Chapter 35
1i*	Students know how to solve two-dimensional trajectory problems.	4.3	4.5, 4.6, 4.9, 4.12, 4.13, 4.Q, 4.P	4.3, 4.4, 4.7, 4.8, 4.10, 4.11
1j*	Students know how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.	3.3, 3.4	3.Q, 3.P	3.3, 3.4
1k*	Students know how to solve two-dimensional problems involving balanced forces (statics).	11.1	11.4, 11.Q, 11.P	11.1, 11.2
1l*	Students know how to solve problems in circular motion by using the formula for centripetal acceleration in the following form: $a = v^2/r$.	8.3	8.4, 8.Q, 8.P	8.3
1m*	Students know 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).	12.1, 22.8	12.Q, 12.P, 22.10, 22.Q, 22.P	12.1, 22.8, 22.9
	Conservation of Energy and Momentum 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:			
2a	Students know how to calculate kinetic energy by using the formula $E = (1/2)mv^2$.	6.4	6.7, 6.8, 6.Q, 6.P	6.1, 6.4 - 6.6
2b	Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) = mgh (h is the change in the elevation).	6.10	6.13, 6.Q, 6.P	6.10 - 6.12
2c	Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.	6.16	6.17 - 6.19, 6.Q, 6.P	6.16
2d	Students know how to calculate momentum as the product mv.	7.1	7.Q, 7.P	7.1
2e	Students know momentum is a separately conserved quantity different from energy.	7.5	7.7, 7.Q, 7.P	7.5, 7.6
2f	Students know an unbalanced force on an object produces a change in its momentum.	7.2, 7.3	7.P	7.2 - 7.4
2g	Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.	7.8	7.10, 7.12, 7.Q, 7.P	7.8, 7.9, 7.11, 7.13

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2h*	Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.	12.17, 26.4	6.P, 12.Q, 12.P	5.23, 12.17, 12.18, 26.4
	Heat and Thermodynamics 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:			
3a	Students know heat flow and work are two forms of energy transfer between systems.	20.1, 20.2	20.P	20.0 - 20.3
3b	Students know that 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.	20.1, 20.3	20.Q, 20.P	20.1 - 20.3
3c	Students know the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.	18.6	18.Q, 18.P, 19.P	19.9
3d	Students know that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.	21.5	21.Q, 21.P	21.3 - 21.5
3e	Students know that entropy is a quantity that measures the order or disorder of a system and that this quantity is larger for a more disordered system.	21.4, 21.6	21.Q, 21.P	21.4, 21.6
3f*	Students know the statement "Entropy tends to increase" is a law of statistical probability that governs all closed systems (second law of thermodynamics).	21.5	21.Q, 21.P	21.3, 21.5
3g*	Students know how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.	21.2, 21.7	21.12, 21.Q, 21.P	21.0, 21.2, 21.7 - 21.9
	Waves Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:			
4a	Students know waves carry energy from one place to another.	15.1	16.Q, 16.P	16.4

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4b	Students know how to identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).	15.2	15.Q, 15.P	15.2
4c	Students know how to solve problems involving wavelength, frequency, and wave speed.	15.7	15.Q, 15.P	15.5 - 15.7
4d	Students know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.	16.1	16.Q, 16.P	
4e	Students know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3x108 m/s (186,000 miles/second).	30.1	30.Q, 30.P	30.1
4f	Students know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.	16.7, 17.8, 30.8, 32.1, 34.1, 34.5, 34.7, 35.10	16.Q, 16.P, 17.P, 30.P, 32.4, 32.7, 32.Q, 32.P, 34.P, 35.Q, 35.P	16.7, 16.8, 17.8, 30.8, Chapter 32, 34.1, 34.2, 34.4, 34.5, 34.7, 35.10
	Electric and Magnetic Phenomena Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:			
5a	Students know how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.	27.3, 27.5, 27.9	27.7, 27.8, 27.11, 27.Q, 27.P, 29.12, 29.13	Chapter 24, 25.1, 27.3, 27.5, 27.6, 27.9, 27.10, 27.12, 27.13
5b	Students know how to solve problems involving Ohm's law.	25.3	25.4, 25.Q, 25.P	25.3, 25.10
5c	Students know 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 = IR (potential difference) x I (current) = $I^2 R$.	25.7	25.P	25.7, 25.11
5d	Students know the properties of transistors and the role of transistors in electric circuits.	36.15	36.P	36.11 - 36.15
5e	Students know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.	23.1	22.Q, 22.P, 23.5, 23.Q, 23.Q, 23.P	22.8, 23.1, 23.4, 23.6
5f	Students know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.	28.1, 28.20	28.P	28.1 - 28.4, 28.6, 28.7, 28.20, 28.21

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5g	Students know how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.	28.20	28.P	28.20
5h	Students know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.	29.0	29.0, 29.2, 29.8, 29.10, 29.Q, 29.P	Chapter 29
5i	Students know plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity.	38.14		
5j*	Students know electric and magnetic fields contain energy and act as vector force fields.	23.1, 28.2	23.5, 23.Q, 23.P, 24.Q, 24.P, 28.Q, 28.P	23.1, 23.4, 23.8, Chapter 24, 28.2
5k*	Students know 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.	23.1	23.5, 23.9, 23.Q, 23.P	23.1, 23.8
5l*	Students know how to calculate the electric field resulting from a point charge.	23.2	23.3, 23.P	23.2, 23.6
5m*	Students know static electric fields have as their source some arrangement of electric charges.	23.1, 23.6	23.5, 23.Q, 23.P	23.1, 23.4, 23.6
5n*	Students know the magnitude of 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.	28.7	28.8, 28.9, 28.11, 28.Q, 28.P	28.7, 28.10
5o*	Students know how to apply the concepts of electrical and gravitational potential energy to solve problems involving conservation of energy.	6.10, 6.16, 24.1	24.12, 6.Q, 6.P, 24.Q, 24.P	6.10, 6.16, 24.1, 24.4, 24.7, 24.11, 24.12
	DISCIPLINE: CHEMISTRY			
	Atomic and Molecular Structure 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:			
1a	Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.			
1b	Students know how to use the periodic table to identify metals, semimetals, non-metals, and halogens.			

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1c	Students know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.			
1d	Students know how to use the periodic table to determine the number of electrons available for bonding.			
1e	Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.	38.2	38.Q, 38.P	38.2
1f*	Students know how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.			
1g*	Students know how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.			
1h*	Students know the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.	36.5, 36.8, 38.2	36.Q, 36.P, 38.Q, 38.P	36.5, 38.2
1i*	Students know the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.	36.8	36.Q, 36.P	36.8, 36.9
1j*	Students know that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$).	36.2, 36.3	36.10, 36.Q, 36.P	36.2 - 36.4, 36.8, 36.9
	Conservation of Matter and Stoichiometry 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:			
3a	Students know how to describe chemical reactions by writing balanced equations.			
3b	Students know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.	19.4	19.P	19.4

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3c	Students know one mole equals $6.02x10^{23}$ particles (atoms or molecules).	19.4	19.P	19.4
3d	Students know how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.			
3e	Students know how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.			
3f*	Students know how to calculate percent yield in a chemical reaction.			
3g*	Students know how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.			
	Gases and their Properties The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:			
4a	Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.	19.2	13.P	13.3, 13.4, 13.16, 19.1, 19.2
4b	Students know the random motion of molecules explains the diffusion of gases.			
4c	Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	19.3, 19.5	19.7, 19.8, 19.Q, 19.P	19.3, 19.5, 19.6
4d	Students know the values and meanings of standard temperature and pressure (STP).	19.1		
4e	Students know how to convert between the Celsius and Kelvin temperature scales.	18.2, 18.3	18.Q, 18.P	18.2, 18.3
4f	Students know there is no temperature lower than 0 Kelvin.	18.4		18.4
4g*	Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.	19.9	19.P	19.9
4h*	Students know how to solve problems by using the ideal gas law in the form $PV = nRT$.	19.5	19.7, 19.8, 19.Q, 19.P	19.5, 19.6

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4i*	Students know how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.			
	Chemical Thermodynamics Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:			
7a	Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).	18.5, 19.9	19.P	19.9
7b	Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.			
7c	Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	18.14	18.21, 18.Q, 18.P	18.14 - 18.16
7d	Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	18.12	18.21, 18.Q, 18.P	18.12, 18.13, 18.15 - 18.18
7e*	Students know how to apply Hess's law to calculate enthalpy change in a reaction.			
7f*	Students know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.			
	Nuclear Processes Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:			
11a	Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	38.5	38.P	38.5
11b	Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.	38.9	38.10, 38.Q, 38.P	38.9, 38.11 - 38.14
11c	Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	38.15	38.P	38.3, 38.15
11d	Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.	38.15	38.Q, 38.P	38.15, 38.16

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11e	Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.			
11f*	Students know how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.	38.17	38.18, 38.Q, 38.P	38.17
11g*	Students know protons and neutrons have substructures and consist of particles called quarks.	38.19		