



California Subject Examinations for Teachers®

TEST GUIDE

MULTIPLE SUBJECTS SUBTEST II

Subtest Description

This document contains the Multiple Subjects content specifications arranged according to the domains covered by Subtest II of CSET: Multiple Subjects. In parentheses after each named domain is the CCTC-assigned domain code from the Multiple Subjects content specifications.

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California Subject Examinations for Teachers (CSET®)

Multiple Subjects Subtest II: Science; Mathematics

CONTENT SPECIFICATIONS IN SCIENCE

Part I: Content Domains for Subject Matter Understanding and Skill in Science

0001 Physical Science (SMR Domain 1)

- 1.1 Structure and Properties of Matter.** Candidates for Multiple Subject Teaching Credentials understand the physical properties of solids, liquids, and gases, such as color, mass, density, hardness, and electrical and thermal conductivity. They know that matter can undergo physical changes (e.g., changes in state such as the evaporation and freezing of water) and chemical changes (i.e., atoms in reactants rearrange to form products with new physical and chemical properties). They know that matter consists of atoms and molecules in various arrangements, and can give the location and motions of the parts of an atom (protons, neutrons, and electrons). They can describe the constituents of molecules and compounds, naming common elements (e.g., hydrogen, oxygen, and iron), and explain how elements are organized on the Periodic Table on the basis of their atomic and chemical properties. They can describe characteristics of solutions (such as acidic, basic, and neutral solutions) and they know examples with different pH levels such as soft drinks, liquid detergents, and water. They know that mixtures may often be separated based on physical or chemical properties.
- 1.2 Principles of Motion and Energy.** Candidates for Multiple Subject Teaching Credentials describe an object's motion based on position, displacement, speed, velocity, and acceleration. They know that forces (pushes and pulls), such as gravity, magnetism, and friction act on objects and may change their motion if these forces are not in balance. They know that "like" electrical charges or magnetic poles produce repulsive forces and "unlike" charges or poles produce attractive forces. They describe simple machines in which small forces are exerted over long distances to accomplish difficult tasks (e.g., using levers or pulleys to move or lift heavy objects). Candidates identify forms of energy including solar, chemical, electrical, magnetic, nuclear, sound, light, and electromagnetic. They know that total energy in a system is conserved but may be changed from one form to another, as in an electrical motor or generator. They understand the difference between heat, (thermal energy) and temperature, and understand temperature measurement systems. Candidates know how heat may be transferred by conduction, convection, and radiation (e.g., involving a stove, the Earth's mantle, or the sun). They describe sources of light including the sun, light bulbs, or excited atoms (e.g.,

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neon in neon lights) and interactions of light with matter (e.g., vision and photosynthesis). They know and can apply the optical properties of waves, especially light and sound, including reflection (e.g., by a mirror) or refraction (e.g., bending light through a prism). They explain conservation of energy resources in terms of renewable and non-renewable natural resources and their use in society.

0002 Life Science (SMR Domain 2)

2.1 Structure of Living Organisms and Their Function (Physiology and Cell Biology).

Candidates for Multiple Subject Teaching Credentials describe levels of organization and related functions in plants and animals, including, organ systems (e.g., the digestive system), organs, tissues (e.g., ovules in plants, heart chambers in humans), cells, and subcellular organelles (e.g., nucleus, chloroplast, mitochondrion). They know structures and related functions of systems in plants and animals, such as reproductive, respiratory, circulatory, and digestive. They understand principles of chemistry underlying the functioning of biological systems (e.g., carbon's central role in living organisms, water and salt, DNA, and the energetics of photosynthesis).

2.2 Living and Nonliving Components in Environments (Ecology).

Candidates for Multiple Subject Teaching Credentials know the characteristics of many living organisms (e.g., growth, reproduction, and stimulus response). They understand the basic needs of all living organisms (e.g., food, water, and space), and can distinguish between environmental adaptations and accommodations. They describe the relationship between the number and types of organisms an ecosystem can support and relationships among members of a species and across species. They illustrate the flow of energy and matter through an ecosystem from sunlight to food chains and food webs (including primary producers, consumers, and decomposers). They identify the resources available in an ecosystem, and describe the environmental factors that support the ecosystem, such as temperature, water, and soil composition.

2.3 Life Cycle, Reproduction, and Evolution (Genetics and Evolution).

Candidates for Multiple Subject Teaching Credentials diagram life cycles of familiar organisms (e.g., butterfly, frog, mouse). They explain the factors that affect the growth and development of plants, such as light, gravity, and stress. They distinguish between sexual and asexual reproduction, and understand the process of cell division (mitosis), the types of cells and their functions, and the replication of plants and animals. They distinguish between environmental and genetic sources of variation, and understand the principles of natural and artificial selection. They know how evidence from the fossil record, comparative anatomy, and DNA sequences can be used to support the theory that life gradually evolved on earth over billions of years. They understand the basis of Darwin's theory, that species evolved by a process of natural selection.

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0003 Earth and Space Science (SMR Domain 3)

- 3.1 The Solar System and the Universe (Astronomy).** Candidates for Multiple Subject Teaching Credentials identify and describe the planets, their motion, and that of other planetary bodies (e.g., comets and asteroids) around the sun. They explain time zones in terms of longitude and the rotation of the earth, and understand the reasons for changes in the observed position of the sun and moon in the sky during the course of the day and from season to season. They name and describe bodies in the universe including the sun, stars, and galaxies.
- 3.2 The Structure and Composition of the Earth (Geology).** Candidates for Multiple Subject Teaching Credentials describe the formation and observable physical characteristics of minerals (e.g., quartz, calcite, hornblende, mica, and common ore minerals) and different types of rocks (e.g., sedimentary, igneous, and metamorphic). They identify characteristics of landforms, such as mountains, rivers, deserts, and oceans. They explain chemical and physical weathering, erosion, deposition, and other rock forming and soil changing processes and the formation and properties of different types of soils and rocks. They describe layers of the earth (crust, lithosphere, mantle, and core) and plate tectonics, including its convective source. They explain how mountains are created and why volcanoes and earthquakes occur, and describe their mechanisms and effects. They know the commonly cited evidence supporting the theory of plate tectonics. They identify factors influencing the location and intensity of earthquakes. They describe the effects of plate tectonic motion over time on climate, geography, and distribution of organisms, as well as more general changes on the earth over geologic time as evidenced in landforms and the rock and fossil records, including plant and animal extinction.
- 3.3 The Earth's Atmosphere (Meteorology).** Candidates for Multiple Subject Teaching Credentials explain the influence and role of the sun and oceans in weather and climate and the role of the water cycle. They describe causes and effects of air movements and ocean currents (based on convection of air and water) on daily and seasonal weather and on climate.
- 3.4 The Earth's Water (Oceanography).** Candidates for Multiple Subject Teaching Credentials compare the characteristics of bodies of water, such as rivers, lakes, oceans, and estuaries. They describe tides and explain the mechanisms causing and modifying them, such as the gravitational attraction of the moon, sun, and coastal topography.

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**Part II: Subject Matter Skills and Abilities
Applicable to the Content Domains in Science**

Candidates for Multiple Subject Teaching Credentials know how to plan and conduct a scientific investigation to test a hypothesis. They apply principles of experimental design, including formulation of testable questions and hypotheses, and evaluation of the accuracy and reproducibility of data. They distinguish between dependent and independent variables and controlled parameters, and between linear and nonlinear relationships on a graph of data. They use scientific vocabulary appropriately (e.g., observation, organization, experimentation, inference, prediction, evidence, opinion, hypothesis, theory, and law). They can select and use a variety of scientific tools (e.g., microscopes) and know how to record length, mass, and volume measurements using the metric system. They interpret results of experiments and interpret events by sequence and time (e.g., relative age of rocks, phases of the moon) from evidence of natural phenomena. They can communicate the steps in an investigation, record data, and interpret and analyze numerical and non-numerical results using charts, maps, tables, models, graphs, and labeled diagrams. They make appropriate use of print and electronic resources, including the World Wide Web, in preparing for an investigative activity. Candidates communicate the steps and results of a scientific investigation in both verbal and written formats.

CONTENT SPECIFICATIONS IN MATHEMATICS

**Part I: Content Domains for
Subject Matter Understanding and Skill in
Mathematics**

0004 Number Sense (SMR Domain 1)

- 1.1 Numbers, Relationships Among Numbers, and Number Systems.** Candidates for Multiple Subject Teaching Credentials understand base ten place value, number theory concepts (e.g., greatest common factor), and the structure of the whole, integer, rational, and real number systems. They order integers, mixed numbers, rational numbers (including fractions, decimals, and percents) and real numbers. They represent numbers in exponential and scientific notation. They describe the relationships between the algorithms for addition, subtraction, multiplication, and division. They understand properties of number systems and their relationship to the algorithms, [e.g., 1 is the multiplicative identity; $27 + 34 = 2 \times 10 + 7 + 3 \times 10 + 4 = (2 + 3) \times 10 + (7 + 4)$]. Candidates perform operations with positive, negative, and fractional exponents, as they apply to whole numbers and fractions.

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- 1.2 Computational Tools, Procedures, and Strategies.** Candidates demonstrate fluency in standard algorithms for computation and evaluate the correctness of nonstandard algorithms. They demonstrate an understanding of the order of operations. They round numbers, estimate the results of calculations, and place numbers accurately on a number line. They demonstrate the ability to use technology, such as calculators or software, for complex calculations.

0005 Algebra and Functions (SMR Domain 2)

- 2.1 Patterns and Functional Relationships.** Candidates represent patterns, including relations and functions, through tables, graphs, verbal rules, or symbolic rules. They use proportional reasoning such as ratios, equivalent fractions, and similar triangles, to solve numerical, algebraic, and geometric problems.
- 2.2 Linear and Quadratic Equations and Inequalities.** Candidates are able to find equivalent expressions for equalities and inequalities, explain the meaning of symbolic expressions (e.g., relating an expression to a situation and vice versa), find the solutions, and represent them on graphs. They recognize and create equivalent algebraic expressions (e.g., $2(a+3) = 2a + 6$), and represent geometric problems algebraically (e.g., the area of a triangle). Candidates have a basic understanding of linear equations and their properties (e.g., slope, perpendicularity); the multiplication, division, and factoring of polynomials; and graphing and solving quadratic equations through factoring and completing the square. They interpret graphs of linear and quadratic equations and inequalities, including solutions to systems of equations.

0006 Measurement and Geometry (SMR Domain 3)

- 3.1 Two- and Three-dimensional Geometric Objects.** Candidates for Multiple Subject Teaching Credentials understand characteristics of common two- and three-dimensional figures, such as triangles (e.g., isosceles and right triangles), quadrilaterals, and spheres. They are able to draw conclusions based on the congruence, similarity, or lack thereof, of two figures. They identify different forms of symmetry, translations, rotations, and reflections. They understand the Pythagorean theorem and its converse. They are able to work with properties of parallel lines.
- 3.2 Representational Systems, Including Concrete Models, Drawings, and Coordinate Geometry.** Candidates use concrete representations, such as manipulatives, drawings, and coordinate geometry to represent geometric objects. They construct basic geometric figures using a compass and straightedge, and represent three-dimensional objects through two-dimensional drawings. They combine and dissect two- and three-dimensional figures into familiar shapes, such as dissecting a parallelogram and rearranging the pieces to form a rectangle of equal area.

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3.3 Techniques, Tools, and Formulas for Determining Measurements. Candidates estimate and measure time, length, angles, perimeter, area, surface area, volume, weight/mass, and temperature through appropriate units and scales. They identify relationships between different measures within the metric or customary systems of measurements and estimate an equivalent measurement across the two systems. They calculate perimeters and areas of two-dimensional objects and surface areas and volumes of three-dimensional objects. They relate proportional reasoning to the construction of scale drawings or models. They use measures such as miles per hour to analyze and solve problems.

0007 Statistics, Data Analysis, and Probability (SMR Domain 4)

4.1 Collection, Organization, and Representation of Data. Candidates represent a collection of data through graphs, tables, or charts. They understand the mean, median, mode, and range of a collection of data. They have a basic understanding of the design of surveys, such as the role of a random sample.

4.2 Inferences, Predictions, and Arguments Based on Data. Candidates interpret a graph, table, or chart representing a data set. They draw conclusions about a population from a random sample, and identify potential sources and effects of bias.

4.3 Basic Notions of Chance and Probability. Candidates can define the concept of probability in terms of a sample space of equally likely outcomes. They use their understanding of complementary, mutually exclusive, dependent, and independent events to calculate probabilities of simple events. They can express probabilities in a variety of ways, including ratios, proportions, decimals, and percents.

**Part II: Subject Matter Skills and Abilities
Applicable to the Content Domains in Mathematics**

Candidates for Multiple Subject Teaching Credentials identify and prioritize relevant and missing information in mathematical problems. They analyze complex problems to identify similar simple problems that might suggest solution strategies. They represent a problem in alternate ways, such as words, symbols, concrete models, and diagrams, to gain greater insight. They consider examples and patterns as means to formulating a conjecture.

Candidates apply logical reasoning and techniques from arithmetic, algebra, geometry, and probability/statistics to solve mathematical problems. They analyze problems to identify alternative solution strategies. They evaluate the truth of mathematical statements (i.e., whether a given statement is always, sometimes, or never true). They apply different solution strategies (e.g., estimation) to check the reasonableness of a solution. They demonstrate that a solution is correct.

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Candidates explain their mathematical reasoning through a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and concrete models. They use appropriate mathematical notation with clear and accurate language. They explain how to derive a result based on previously developed ideas, and explain how a result is related to other ideas.