PLACE®

STUDY GUIDE

05 Science

Program for Licensing Assessments for Colorado Educators®

CO-SG-FLD005-02

Readers should be advised that this study guide, including many of the excerpts used herein, is protected by federal copyright law.

TABLE OF CONTENTS

TEST FIELD 05: SCIENCE

PART 1: GENERAL INFORMATION ABOUT THE PLACE® AND TEST PREPARATION

Part 1 of this study guide is contained in a separate PDF file. Click the link below to view or print this section:

General Information About the PLACE and Test Preparation

PART 2: FIELD-SPECIFIC INFORMATION

TEST FIELD 05: SCIENCE

INTRODUCTION

This section includes a list of the test objectives, immediately followed by a set of practice multiple-choice questions. For test areas that include a performance assessment (Basic Skills, all languages other than English, Special Education Specialist: Visually Impaired), one or more practice performance assignments (as applicable) will also be included.

TEST OBJECTIVES. As noted earlier, the test objectives are broad, conceptual statements that reflect the knowledge, skills, and understanding an entry-level educator needs to teach effectively in a Colorado classroom. The list of test objectives represents the **only** source of information about what a specific test will cover.

PRACTICE MULTIPLE-CHOICE QUESTIONS. The practice multiple-choice questions included in this section are designed to give you an introduction to the nature of the questions included on the PLACE test. The practice questions represent the various types of multiple-choice questions you may expect to see on an actual test; however, they are **not** designed to provide diagnostic information to help you identify specific areas of individual strengths and weaknesses or to predict your performance on the test as a whole.

When you answer the practice multiple-choice questions, you may wish to use the answer key to check your answers. To help you identify how the test objectives are measured, the objective statement to which each multiple-choice question corresponds is listed in the answer key. When you are finished with the practice questions, you may wish to go back and review the entire list of test objectives and descriptive statements for your test area.

CALCULATORS. For the Science (05) test, you will be provided with one of the following models of scientific calculators at the test administration. The models distributed are subject to change; directions for use will not be provided at the test site. You may not use your own calculator or calculator manual for this test.

- Texas Instruments TI-30X
- Texas Instruments TI-30X Solar
- Texas Instruments TI-30Xa
- Texas Instruments TI-30Xs
- Texas Instruments TI-30XIIs

TEST FIELD 05: SCIENCE

Scientific Inquiry and Connections
Physical Science
Life Science
Earth and Space Science

SCIENTIFIC INQUIRY AND CONNECTIONS

Understand the principles and processes of scientific inquiry and conducting scientific investigations.

Includes recognizing questions and hypotheses that can be investigated according to the criteria and methods of science; characteristics of various types of scientific investigations (e.g., controlled experiments, field observations, historical studies); principles and procedures of designing and conducting scientific investigations (e.g., manipulating one variable at a time); the appropriateness of a given investigative design for testing a particular hypothesis; and sources of error or uncertainty in an investigation.

Understand procedures for gathering, recording, organizing, interpreting, analyzing, and communicating scientific data and information.

Includes appropriate methods, tools, technologies, and measurement units for gathering, recording, and processing data; methods and criteria for organizing and communicating data (e.g., tables, graphs, models); analyzing data to construct and revise scientific hypotheses and models; and identifying and evaluating various sources of scientific information (e.g., handbooks, professional journals, popular press, on-line resources).

Understand appropriate safety practices and the selection and proper use of materials, equipment, and technologies in scientific investigations.

Includes evaluating equipment, materials, procedures, and setting for potential safety hazards; selecting appropriate materials, equipment, and technologies for specified purposes; and identifying and locating sources of information about safety, the proper handling of scientific materials, state and federal regulations, legal issues, and guidelines pertaining to scientific materials and specimens.

Understand the nature of scientific knowledge and common connections among scientific disciplines.

Includes the purpose of science; the dynamic nature of scientific knowledge, including ways in which scientific knowledge is developed and modified; the importance of empirical standards, verifiable evidence, logical reasoning, rational thought, and openness to new ideas in science; the roles of communication, critique, and consensus in promoting scientific progress; and common scientific themes (e.g., change, systems, models, equilibrium) and how they help to unify scientific theories and facts regarding natural phenomena.

Understand the interrelationships among science, technology, and society.

Includes concepts and methods that are common to science and technology; the different roles of science and technology with respect to society; the interdependence of science and technology; the influence of social and cultural factors on advances in science and technology; the effects of significant scientific and technological advances on humans; ethical issues related to science and technology; benefits, limitations, costs, and consequences associated with given technologies (e.g., biotechnology, space technology); and scientific and technological aspects of contemporary issues (e.g., resource availability, environmental quality, personal health).

PHYSICAL SCIENCE

Understand the structure and properties of matter.

Includes models of atomic structure; classification and characteristics of atoms, elements, molecules, compounds, and mixtures; the use of models to explain observed properties of matter; organization of the periodic table and its relationship to the structure and properties of matter; physical and chemical properties of matter; and the use of chemical symbols and formulas to represent the composition and structure of matter.

Understand principles and concepts related to energy.

Includes forms of energy (e.g., heat, light, mechanical, sound) and their characteristics; the basic principles and concepts of the laws of thermodynamics (e.g., conservation of energy, entropy); quantities used to measure energy in its various forms (e.g., temperature, electrical charge, voltage, amplitude); and qualitative and quantitative relationships associated with energy transfer or transformation (e.g., kinetic energy, potential energy).

Understand interactions of energy and matter.

Includes the relationship between energy and matter and ways in which they interact (e.g., light absorbed or reflected by a substance); the use of conceptual models (e.g., the kinetic molecular model) to describe and explain the behavior of solids, liquids, and gases and the interactions of energy and matter; the interrelationships among temperature, pressure, and volume in a closed system; and characteristics of the electromagnetic spectrum.

Understand physical and chemical changes in matter.

Includes types and characteristics of physical and chemical changes; applying the concept of conservation of matter; factors that cause physical and chemical changes in matter; characteristics of the various states of matter and energy changes associated with changes in state; types and characteristics of chemical bonds; the relationship between chemical bonds and the properties of matter; factors that affect rates of chemical reactions (e.g., temperature, concentration); and the use of symbolic equations to represent chemical changes and reactions.

Understand forces and motions.

Includes basic principles of mechanics; types and characteristics of forces (e.g., gravitational, frictional); the effects of forces on particles and objects; qualitative and quantitative descriptions of moving objects and of the physical interactions in a system (e.g., force, velocity, acceleration, power); and types and characteristics of simple machines.

Understand electricity, magnets, and electromagnetism.

Includes characteristics of static electricity and electric fields; characteristics and interpretation of simple electrical circuits; characteristics of magnets and magnetic fields; and principles and applications of electromagnetism.

LIFE SCIENCE

Understand the characteristics of living things and the diversity of life.

Includes characteristics that distinguish organisms from nonliving things; basic requirements of life; principles of cell theory; methods of classifying organisms; and similarities and differences among organisms from various taxonomic groups.

Understand matter and energy in living systems.

Includes sources of energy for various types of organisms; forms of energy in living systems; principles related to the transformation and transfer of energy in living systems; the importance to organisms of a constant input of energy and other materials (e.g., water, oxygen, nutrients); the fundamental processes of photosynthesis and cellular respiration; ways in which organisms use energy and matter; and the cycling of matter (e.g., carbon cycle, nitrogen cycle) and the movement of energy through an ecosystem.

Understand the structure, organization, and basic life functions of organisms.

Includes structures and functions of various types of cells and cellular organelles; levels of organization (i.e., cells, tissues, organs, systems) in organisms; basic physiological functions (e.g., excretion, digestion, respiration, reproduction) in various organisms; the relationship between structure and function in organisms; homeostatic and metabolic processes; and structures and functions of human body systems and characteristics of diseases and disorders that may affect these systems.

Understand interactions of organisms with one another and with their environment.

Includes characteristics of populations, communities, ecosystems, and biomes and how they are related; interactions of abiotic and biotic components of ecosystems; interrelationships among organisms in ecosystems (e.g., predator-prey, parasite-host); the ecological concepts of niche and carrying capacity; strategies used by organisms to obtain their basic needs (e.g., food, water, space); features of food chains and food webs; the process of ecological succession; ways in which ecosystems respond to change; and the significance of biodiversity and factors that affect biodiversity.

Understand how organisms change over time in terms of genetics and biological evolution.

Includes the structures and functions of DNA, genes, and chromosomes; basic concepts and principles of inheritance (e.g., dominance, independent assortment); the processes of mitosis and meiosis and their relationship to genetic principles; the transmission of traits from one generation to the next; sources of variation in populations (e.g., mutations, environmental factors); the roles of variation, natural selection, and reproductive isolation in speciation; and evidence for changes in organisms over time and evolutionary relationships among organisms.

EARTH AND SPACE SCIENCE

Understand the composition and structure of Earth, its history, and the natural processes that shape Earth.

Includes the composition and structure of Earth's interior; properties of rocks, minerals, and soils and their formation; the rock cycle; theories and evidence about Earth's geologic history; the theory of plate tectonics and supporting evidence; major features of Earth's surface (e.g., mountains, oceans, plateaus, deep-sea trenches) and the processes that create and shape them (e.g., earthquakes, erosion, volcanic activity); and the causes and effects of natural events (e.g., earthquakes, landslides, floods).

Understand the characteristics of the atmosphere and weather processes.

Includes the basic composition, properties, and structure of the atmosphere; the patterns and effects of energy transfer in the atmosphere (e.g., air circulation, cloud formation, precipitation); characteristics of large-scale and local weather systems; factors that influence weather and climate; methods and equipment for observing, measuring, and recording weather conditions; the analysis of weather data to make predictions; and the causes and effects of severe weather events (e.g., tornadoes, blizzards, thunderstorms).

Understand the characteristics of the hydrosphere and the movement of water in the environment.

Includes properties and behaviors of water; the water cycle; major categories of water on Earth (e.g., oceans, glaciers, rivers, ground water); patterns and processes of water circulation through the environment; interactions among the hydrosphere, atmosphere, lithosphere, and biosphere; the composition and physical characteristics of oceans (e.g., salinity, currents, waves); and the interrelationships between the circulation of oceans and weather and climate.

Understand the structure and components of the solar system and universe and the interactions of objects in the universe.

Includes major components of the solar system (e.g., sun, planets, asteroids) and their characteristics; the effects of gravitation on the motions of objects in the solar system and universe; movements and interactions of the sun, Earth, and moon and the effects of these movements and interactions (e.g., seasons, eclipses, tides); characteristics of stars and the life cycle of stars; theories regarding the origin and evolution of the solar system and universe; methods and technology used to explore space; and societal benefits of technological advances associated with space exploration.

Understand Earth's natural resources and principles and concepts related to environmental science.

Includes characteristics and sources of Earth's natural resources; the importance and uses of natural resources; costs, benefits, and consequences of various uses of Earth's natural resources; effects of human activities on the environment (e.g., habitat destruction, pollution); interrelationships among humans, the environment, and other organisms; and advantages and disadvantages of various strategies for dealing with environmental problems.

PRACTICE QUESTIONS: SCIENCE

Calculators for the Science Test (Test Field 05)

Calculators **will be provided** for this test. Scientific calculators (model Texas Instruments TI-30X) will be provided for examinees taking the Science test. Directions will **not** be provided at the site and the model distributed is subject to change. You may not bring your own calculator for the Science test.

1. Use the information below to answer the question that follows.

   In an experiment designed to test the effects of solutes on temperature, a scientist labels four beakers A, B, C, and D and adds 50 mL of distilled water at room temperature to each. The scientist then adds 5 g of table sugar to beaker B, 10 g to beaker C, and 15 g to beaker D. No sugar is added to beaker A. The scientist measures the temperature of the contents of each beaker. After heating each beaker for the same amount of time on a hot plate at the same setting, the scientist measures the temperature again. The change in temperature is recorded.

   Beaker A is included in this investigation for which of the following reasons?

   A. to determine the expected average temperature of beakers B, C, and D to compare to the average of the actual observed results

   B. as a trial run to confirm the proper functioning of the apparatus and calibration of the thermometer

   C. to be certain that the specified amount of heating time will not be enough to bring the water to the boiling point

   D. as a control to establish the standard against which to compare the temperature changes in the other beakers

2. When preparing to heat a liquid in a beaker or flask on a hot plate, the most important safety precaution would be to:

   A. check the glassware for cracks or chips that could lead to breakage upon heating.

   B. check the thermostat of the hot plate to ensure it is properly calibrated.

   C. preheat the hot plate to the final operating temperature before placing the beaker or flask on it.

   D. place boiling chips in the container with the liquid to prevent boiling over.

3. According to the kinetic theory of gases, decreasing the volume of an ideal gas, while keeping the mass and the temperature of the gas constant, increases its pressure by increasing the:

   A. average speed of the molecules in the gas.

   B. average momentum of the molecules in the gas.

   C. rate of molecular collisions with the walls of the container.

   D. intermolecular forces between the molecules in the gas.

4. Zinc and sulfur combine to produce zinc sulfide according to the equation below.

   $Zn + S \rightarrow ZnS$

   If 10.0 g of zinc are combined with 6.00 g of sulfur, which reactant is the limiting reagent, and how many moles of the other reactant are in excess?

   A. Zn is the limiting reagent, with 0.034 mole of S in excess.

   B. Zn is the limiting reagent, with 0.153 mole of S in excess.

   C. S is the limiting reagent, with 0.034 mole of Zn in excess.

   D. S is the limiting reagent, with 0.153 mole of Zn in excess.

5. A child is riding a bike along a flat road at a speed of 6 m/s. The combined mass of the child and the bike is 25 kg. The child applies the brakes and comes to a complete stop in 3 seconds. What is the average braking force on the bike?

   A. 1.4 N

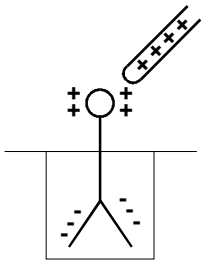
   B. 50 N

   C. 100 N

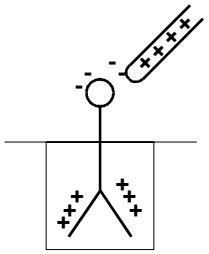
   D. 450 N

6. A positively charged plastic rod is brought near the ball of an electroscope but does not touch it. Which of the following diagrams correctly represents the charge distribution on the electroscope in this situation?

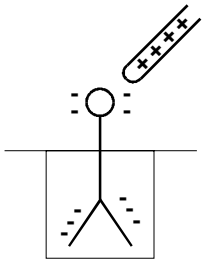
   A.



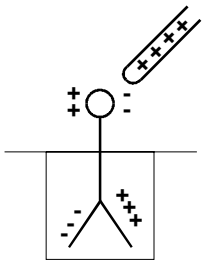
   B.



   C.



   D.



7. Use the information in the table below to answer the question that follows.

Cell	Cell Wall	Nucleus	Chlorophyll
1	yes	yes	yes
2	yes	no	no
3	no	yes	no
4	yes	no	yes

Based on the list of cell characteristics shown in the table above, which cell is most likely from the kingdom Animalia?

A. Cell 1

B. Cell 2

C. Cell 3

D. Cell 4

8. In the process of photosynthesis, radiant energy is used to:

A. convert simple sugars into complex carbohydrates such as cellulose.

B. split polysaccharides into three-carbon molecules.

C. convert atmospheric carbon dioxide into carbohydrate molecules.

D. split oxygen molecules and combine the resulting atoms with hydrogen.

9. The evolution of the seed in plants and the evolution of the amniote egg in animals were both critical in allowing organisms to:

   A. make the haploid and diploid stages of the life cycle independent of one another.

   B. colonize a greater diversity of land habitats by making their life cycles independent of water.

   C. have larger and more complex body structures.

   D. develop greater genetic variation through recombination.

10. Scientists hypothesize that Earth's magnetic field is generated by:

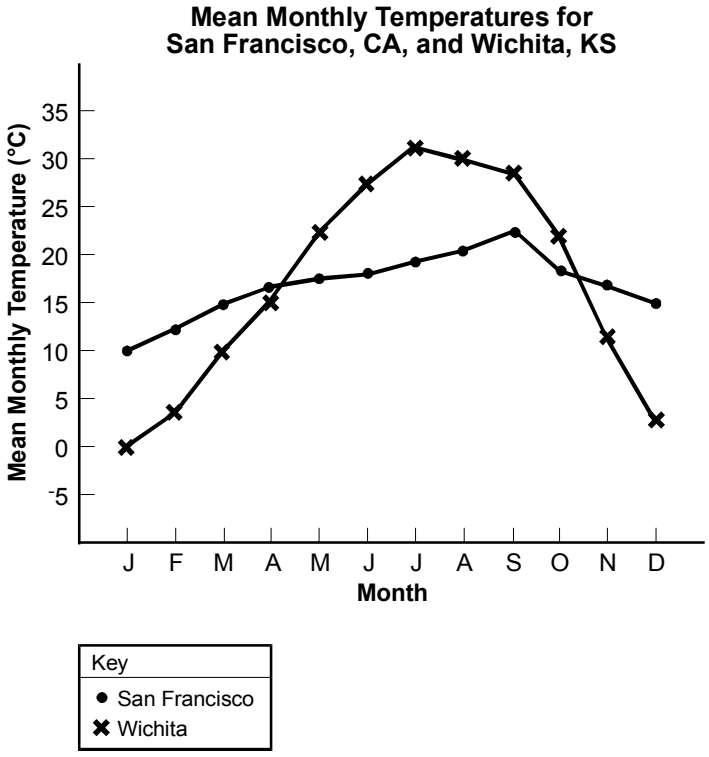
   A. attractive forces between large deposits of magnetite in the polar regions.

   B. movements of molten material in the outer layer of Earth's core.

   C. charged particles of the solar wind striking Earth's atmosphere.

   D. tidal movements of Earth's oceans in their basins.

11. Use the graph below to answer the question that follows.



Which of the following best explains the difference in the annual range of mean monthly temperatures between San Francisco and Wichita?

A. Large bodies of water heat and cool more slowly than land, which moderates seasonal temperature changes in marine climates.

B. Reflectivity of land surfaces is greater than that of water, which leads to more extreme fluctuations in radiational heating and cooling in continental climates.

C. High evaporation rates from ocean water lead to increased cloud cover, which moderates both solar heating and radiational heat loss in marine climates.

D. Variation in relief of land surfaces leads to uneven heating, which produces more frequent and severe winds in continental climates.

12. Which of the following statements would be true if Earth's axis was perpendicular to its orbital plane rather than tilted?

    A. On any particular day, a location on the equator would receive the same amount of solar radiation as a location at either pole.

    B. Each pole would have six months of continuous daylight and six months of continuous darkness each year.

    C. At any place on Earth, each day would have about 12 hours of daylight and 12 hours of darkness throughout the year.

    D. Seasonal differences at locations in the high latitudes would be more pronounced.

ANSWER KEY: SCIENCE

Question Number	Correct Response	Objective
1.	**D**	Understand the principles and processes of scientific inquiry and conducting scientific investigations.
2.	**A**	Understand appropriate safety practices and the selection and proper use of materials, equipment, and technologies in scientific investigations.
3.	**C**	Understand interactions of energy and matter.
4.	**A**	Understand physical and chemical changes in matter.
5.	**B**	Understand forces and motions.
6.	**B**	Understand electricity, magnets, and electromagnetism.
7.	**C**	Understand the characteristics of living things and the diversity of life.
8.	**C**	Understand matter and energy in living systems.
9.	**B**	Understand the structure, organization, and basic life functions of organisms.
10.	**B**	Understand the composition and structure of Earth, its history, and the natural processes that shape Earth.
11.	**A**	Understand the characteristics of the atmosphere and weather processes.
12.	**C**	Understand the structure and components of the solar system and universe and the interactions of objects in the universe.