

Massachusetts Tests for Educator Licensure™

FIELD 10: GENERAL SCIENCE TEST OBJECTIVES

Subarea

	Multiple-Choice	Range of Objectives	Approximate Test Weighting
I.	History, Philosophy, and Methodology of Science	01–04	16%
II.	Chemistry	05–08	16%
III.	Physics	09–12	16%
IV.	Biology	13–16	16%
V.	Earth and Space Science	17–20	<u>16%</u>
			80%
	Open-Response		
VI.	Integration of Knowledge and Understanding	21	20%

Copyright © 2002 by National Evaluation Systems, Inc. (NES®)

"Massachusetts Tests for Educator Licensure" and "MTEL" are trademarks of the Massachusetts Department of Education and National Evaluation Systems, Inc. (NES®).

"NES®" and its logo are registered trademarks of National Evaluation Systems, Inc.™

This document may not be reproduced for commercial use but may be copied for educational purposes.

**Massachusetts Tests for Educator Licensure™
Test Objectives
Field 10: General Science**

SUBAREAS:

HISTORY, PHILOSOPHY, AND METHODOLOGY OF SCIENCE
CHEMISTRY
PHYSICS
BIOLOGY
EARTH AND SPACE SCIENCE
INTEGRATION OF KNOWLEDGE AND UNDERSTANDING

HISTORY, PHILOSOPHY, AND METHODOLOGY OF SCIENCE [16%]

0001 Understand the nature of scientific thought and inquiry and the historical development of major scientific ideas.

For example: the reliance of scientific investigation on empirical data; the use of verifiable evidence, reasoning, and logical arguments; the importance of avoiding bias; the evaluation of scientific claims and arguments; science and technology in the ancient world (e.g., China, Greece); the foundations for modern science in the seventeenth and eighteenth centuries; the development of modern science in the nineteenth and twentieth centuries; key figures, discoveries, and theories (e.g., the Copernican revolution, Darwin's theory of evolution); and social, religious, and economic conditions that supported or inhibited the development of science and technology.

0002 Understand principles and procedures of research and experimental design.

For example: the formulation of testable hypotheses; the use of carefully planned research to solve problems; procedures and considerations, including validity and reliability, in setting up and conducting scientific investigations; the use of sampling techniques; and hypothesis testing using control and experimental groups.

Field 10: General Science Test Objectives

0003 Understand procedures for gathering, organizing, interpreting, evaluating, and communicating scientific information.

For example: the systematic observation of phenomena; strategies, tools, and technologies for gathering, measuring, recording, and processing data; advantages and disadvantages of various measurement methods and devices; solving problems involving measurement; the use of various formats (e.g., graphs, flowcharts, tables, step-by-step directions, maps, reports) for organizing, communicating, and interpreting information; the use of data for making predictions and drawing conclusions; and developing models and statistical methods for interpreting and reporting data.

0004 Understand the safe and proper use of tools, equipment, and materials (including chemicals and living organisms) related to classroom and other science investigations.

For example: practices and requirements related to the safe use and storage of tools and equipment; the use and proper disposal of materials; procedures for preventing accidents in the science laboratory; procedures for dealing with accidents and injuries in the science laboratory; and proper practices and requirements related to the use and care of living organisms.

CHEMISTRY [16%]

0005 Understand the structure and nature of matter.

For example: the atomic and molecular structure of matter; the structure of the atom; the use of models of atomic structure to explain chemical behavior; the relationship between atomic structure and the organization of the periodic table; the difference between mixtures and pure substances; and chemical symbols, formulas, and equations.

0006 Understand the nature of physical changes in matter.

For example: states of matter and their characteristics; properties of common materials; physical properties and changes; changes of state and related changes in energy; the concept of mass; the principle of conservation of matter; and types and properties of mixtures and solutions.

0007 Understand the nature of chemical changes in matter.

For example: the description of chemical changes in terms of properties and composition of reactants and products; the use of the principle of conservation of matter to analyze chemical reactions; types of chemical bonds, their characteristics, and their effects on the characteristics of matter; and factors that affect rates of reaction.

Field 10: General Science Test Objectives

0008 Understand the kinetic molecular model of matter.

For example: use of the kinetic molecular theory to explain the states of matter; interrelationships among pressure, temperature, and volume in gaseous systems; and the relationship between temperature and kinetic energy.

PHYSICS [16%]

0009 Understand the concepts of force, motion, work, and power.

For example: Newton's laws of motion; the relationship between mass and inertia; the difference between mass and weight; the vector nature of force, displacement, velocity, and acceleration; characteristics of force, work, and power; the motion of an object in terms of speed, velocity, acceleration, inertia, and momentum; distance-versus-time graphs; and the types and characteristics of simple machines.

0010 Understand the concept of energy and the forms that energy can take.

For example: the concept of conservation of energy; forms of energy (e.g., mechanical, light, thermal, electrical, nuclear); the classification of energy as kinetic or potential; the relationship between kinetic and potential energy; processes of energy transfer and conversion; elastic and inelastic collisions; and the concepts of entropy and thermodynamics.

0011 Understand characteristics of waves and the behavior of sound and light waves.

For example: transverse and longitudinal waves; characteristics (e.g., amplitude, wavelength, frequency) of waves and oscillations; the relationship of wave characteristics to wave speed and wave energy; the relationship between wave characteristics and properties of sound (e.g., loudness, pitch) and light (e.g., color, intensity); wave interactions; the properties and behavior of sound and light waves in various media; phenomena related to light and the behavior of light in various situations (e.g., refraction, diffraction, dispersion); and characteristics and properties of the electromagnetic spectrum.

0012 Understand principles of electricity, magnetism, and electromagnetism.

For example: the properties and formation of static electricity; characteristics of electron flow and electric current; characteristics and components (e.g., batteries, resistors) of simple electric circuits; the interpretation of electric circuit diagrams; characteristics of magnets and magnetic fields; and the principles of electromagnetism.

Field 10: General Science Test Objectives

BIOLOGY [16%]

0013 Understand the characteristics and life processes of living organisms.

For example: differences between living organisms and nonliving things; basic cell structures and their functions; comparisons between animal cells and plant cells; growth of multicellular organisms by cell growth and reproduction; processes of photosynthesis and cellular respiration; homeostatic and metabolic processes; levels of biological organization (i.e., molecules, cells, tissues, organs, and systems); and structures and functions of major systems in plants and animals and interactions between the systems.

0014 Understand principles related to the inheritance of characteristics.

For example: how characteristics are passed on from generation to generation, including mutations and the influence of environmental factors on the inheritance of characteristics; and the structures and functions of DNA, genes, and chromosomes.

0015 Understand principles and theories related to biological evolution.

For example: theories and processes associated with the origin and evolution of life and scientific evidence for these theories and processes; methods used to investigate evolution; the roles of genetic and phenotypic variation, environmental factors, and natural selection in speciation; and the connection between evolutionary relationships and taxonomy.

0016 Understand characteristics of populations, communities, ecosystems, and biomes.

For example: biotic and abiotic factors that affect populations, communities, ecosystems, and biomes; strategies used by organisms to obtain basic requirements for life (e.g., food, shelter, oxygen, water); interrelationships among organisms, including humans, in ecosystems; energy transfers in food webs and food chains; the process of ecological succession; responses of ecosystems to change; and factors regulating population sizes within ecosystems.

**Field 10: General Science
Test Objectives**

EARTH AND SPACE SCIENCE [16%]

0017 Understand geologic history and processes related to the changing earth.

For example: theories of the origin and history of the earth; methods of determining the relative and absolute ages of inorganic and organic materials; the structure and composition of the earth and its layers; types and characteristics of minerals, rocks, and soils; the processes of mineral formation; processes that are involved in the formation and destruction of igneous, sedimentary, and metamorphic rock; the theory of plate tectonics and supporting evidence; processes of structural change of the earth's crust; the effects of various agents (e.g., glaciers, water, wind) on the earth's surface; important topographical features of the earth and their characteristics; types and characteristics of maps and map projections commonly used in science; and the effects of catastrophic phenomena (e.g., earthquakes, collisions with asteroids) on the earth and its inhabitants.

0018 Understand characteristics and properties of the hydrosphere.

For example: properties of water; characteristics of oceans, surface water, and ground water; and use of the water cycle to explain the movement and renewal of ground water and of water in oceans, glaciers, rivers, lakes, and watersheds.

0019 Understand the earth's atmosphere, weather, and climate.

For example: the structure and characteristics of the atmosphere; factors that contribute to the uneven heating of the earth's surface; the effects on weather of the uneven heating of the earth's surface; mechanisms of energy transfer in the atmosphere; air pressure and the movement of air in the atmosphere; cloud formation and precipitation; equipment and techniques used to monitor the weather; the interpretation of meteorological information; and techniques used to predict the weather and climatic change.

0020 Understand components of the solar system and universe and their interactions.

For example: the planets and their characteristics; interactions and movements of the earth, moon, and sun (e.g., seasons, moon phases, tides, eclipses); characteristics of stars and other objects in the solar system and universe; and theories of the origin and evolution of the universe.

**Field 10: General Science
Test Objectives**

INTEGRATION OF KNOWLEDGE AND UNDERSTANDING [20%]

In addition to answering multiple-choice items, candidates will prepare written responses to questions addressing content from the preceding objectives, which are summarized in the objective and descriptive statement below.

0021 Prepare an organized, developed analysis on a topic related to one or more of the following: history, philosophy, and methodology of science; chemistry; physics; biology; and earth and space science.

For example: the structure and nature of matter; chemical and physical changes in matter; the concepts of energy, force, and motion; characteristics and behavior of waves, sound, and light; characteristics and life processes of living organisms; principles and theories related to the inheritance of characteristics and biological evolution; the structure and composition of the earth and processes of structural change in the earth's crust; characteristics and properties of the hydrosphere and atmosphere; components of the solar system and universe and their interactions; and the nature of scientific thought and inquiry.