BIOLOGY ENDORSEMENT
(The teaching of general science in grades 7 and 8 is included in the endorsement.)

The goals of science education are to enable students to demonstrate an understanding of science as an inquiry process; develop scientific knowledge by applying concepts of science; understand how science, technology and society influence one another; and use this knowledge in decision making. Becoming a science teacher is a lifelong undertaking that is initiated in college course work, refined in field experiences, and enhanced during professional practice. All prospective science teachers will complete studies leading to an understanding of inquiry-based instruction, the science content core and at least one of the endorsement areas: biology, chemistry, physics, or earth science. The course work and related field and laboratory experiences will provide the prospective teacher the knowledge and skills to accomplish the following:

I. INQUIRY-BASED INSTRUCTION
   A. Demonstrate processes of science such as posing questions, observing, investigating phenomena, interpreting findings, communicating results, and making judgments based on the evidence.
   B. Teach key science concepts in depth.
   C. Relate the major concepts of the various science disciplines to each other and show how these disciplines are interconnected.
   D. Relate the concepts of science to contemporary, historical, technological, ethical, environmental, and other societal issues.
   E. Design and conduct inquiry-based, open-ended investigations—both laboratory and field based—in a learning environment that maintains an appropriate level of safety.
   F. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers to collect, analyze, and display data.

II. SCIENCE CONTENT CORE
   A. Understand the unifying concepts of science such as scale and model, form and function, organization, interactions, change and conservation, and be able to apply them to science teaching.
   B. Understand the major concepts and principles of life and environmental science.
   C. Understand the major concepts and principles of chemistry.
   D. Understand the major concepts and principles of physics.
   E. Understand the major concepts and principles of earth/space science.

The above knowledge and skills relate to the teaching of science in general as well as to teaching science in grades 7 and 8. The following knowledge and skills relate to specific endorsement in biology.

III. BIOLOGY ENDORSEMENT
   A. Define organic evolution and describe the scientific theory of natural selection and other leading concepts such as gradual versus rapid rates, mechanisms of change and evidence (including anatomical, biochemical, embryological, and fossil) used to support the theory of organic evolution.
   B. Recognize taxonomic divisions of organisms and identify examples of each within the biological community.
   C. Identify characteristics of vertebrates and invertebrates and behaviors of such organisms.
   D. Identify characteristics of non-vascular and vascular plants and understand their physiology.
   E. Understand Mendelian and modern genetics.
   F. Describe the various biotic and abiotic relationships in an ecosystem.
   G. Understand the methods of population study, factors which regulate populations, and the consequences of radical changes in population numbers in an ecosystem.
   H. Explain the organization and chemical composition of life including the structure of the atom, molecules, elements, mixtures, inorganic and organic compounds, bonding patterns, enzymes, and acids and bases.
   I. Understand the structure and function of the human body.
   J. Operate laboratory instrumentation, including the compound and dissecting microscopes.
   K. Apply mathematics, including statistics and precalculus, to investigations in biology and the analysis of data.
   L. Understand cellular organelles including the structure of DNA and the internal biochemical processes associated with their interaction within an organism, including photosynthesis and cellular respiration.

A program that covers the above competencies normally includes at least the following courses:

- Zoology
- Botany
- Physiology
- Genetics
- Ecology
- Microbiology
- Cell Biology/Biochemistry
- Evolution
Biology Audit for Licensure (continued)

___ Organic Chemistry
___ Biology & Science, Technology, Society

And, to meet knowledge and skills for the teaching of science in grades 7 and 8:

___ General Chemistry
___ General Physics
___ Geology
___ History of Science

COMMENTS:

DEFICIENCIES:

ADVISOR APPROVAL:

Date

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The goals of science education are to enable the student to demonstrate an understanding of science as an inquiry process; develop scientific knowledge by applying concepts of science; understand how science, technology and society influence one another; and use this knowledge in decision making. Becoming a science teacher is a long undertaking that is initiated in college course work, refined in field experiences, and enhanced during professional practice. All prospective science teachers will complete studies leading to an understanding of inquiry-based instruction, the science content core and at least one of the endorsement areas: biology, chemistry, physics, or earth science. The course work and related field and laboratory experiences will provide the prospective teacher the knowledge and skills to accomplish the following:

I. INQUIRY-BASED INSTRUCTION
   A. Demonstrate processes of science such as posing questions, observing, investigating phenomena, interpreting findings, communicating results, and making judgments based on the evidence.
   B. Teach key science concepts in depth.
   C. Relate the major concepts of the various science disciplines to each other and show how these disciplines are interconnected.
   D. Relate the concepts of science to contemporary, historical, technological, ethical, environmental, and other societal issues.
   E. Design and conduct inquiry-based, open-ended investigations—both laboratory and field based—in a learning environment that maintains an appropriate level of safety.
   F. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers to collect, analyze, and display data.

II. SCIENCE CONTENT CORE
   A. Understand the unifying concepts of science such as scale and model, form and function, organization, interactions, change and conservation, and be able to apply them to science teaching.
   B. Understand the major concepts and principles of life and environmental science.
   C. Understand the major concepts and principles of chemistry.
   D. Understand the major concepts and principles of physics.
   E. Understand the major concepts and principles of earth/space science.

The above knowledge and skills relate to the teaching of science in general as well as to teaching science in grades 7 and 8. The following knowledge and skills relate to specific endorsement in chemistry.

III. CHEMISTRY ENDORSEMENT
   A. Explain atomic structure, the development of atomic theory, and modern quantum theory.
   B. Explain the modern periodic law, and use of the periodic table of the elements in predicting the formula of a compound.
   C. Understand about nuclear chemistry, radioactive decay, and nuclear energy.
   D. Describe the differences between covalent and ionic bonding and the different properties of compounds formed by each.
   E. Explain how the percentage composition of a compound can be determined from the compound’s formula.
   F. Define and illustrate the fundamental measuring unit of a chemical quantity, the mole, for both the quantity of an element and the quantity of a compound.
   G. Identify and explain the differences among the following types of reactions and to balance representative equations of each: simple replacement, double replacement, decomposition, combination, and oxidation-reduction.
   H. Explain the chemistry of selected elements in depth.
   I. Explain solutions and the quantitative calculations of concentrations.
   J. Explain the chemistry of acids and bases.
   K. Explain the chemistry of water and of the atmosphere and pollution problems associated with each.
   L. Understand the processing of chemical raw materials from the earth, air, and sea, and their importance to our economy.
   M. Relate knowledge of electrochemistry, batteries, fuel cells, and corrosion.
   N. Explain organic chemistry and organic chemicals of major importance.
   O. Understand the chemistry of living systems.
   P. Explain elementary thermodynamics.
   Q. Understand chemical equilibrium and kinetics.
   R. Apply mathematics, including calculus, to investigations in chemistry and the analysis of data.

A program that covers the above competencies normally includes at least the following courses:

- General Chemistry
- Organic Chemistry
- Inorganic Chemistry
- Analytical Chemistry
- Physical Chemistry
- Biochemistry
- Chemistry & Science, Technology, Society
And, to meet knowledge and skills for the teaching of science in grades 7 and 8:

- General Biology
- General Physics
- Geology
- History of Science

COMMENTS:

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PHYSICS ENDORSEMENT
(The teaching of general science in grades 7 and 8 is included in the endorsement.)

The goals of science education are to enable student to demonstrate an understanding of science as an inquiry process; develop scientific knowledge by applying concepts of science; understand how science, technology and society influence one another; and use this knowledge in decision making. Becoming a science teacher is a life long undertaking that is initiated in college course work, refined in field experiences, and enhanced during professional practice. All prospective science teachers will complete studies leading to an understanding of inquiry-based instruction, the science content core and at least one of the endorsement areas: biology, chemistry, physics, or earth science. The course work and related field and laboratory experiences will provide the prospective teacher the knowledge and skills to accomplish the following:

I. INQUIRY-BASED INSTRUCTION
   A. Demonstrate processes of science such as posing questions, observing, investigating phenomena, interpreting findings, communicating results, and making judgments based on the evidence.
   B. Teach key science concepts in depth.
   C. Relate the major concepts of the various science disciplines to each other and show how these disciplines are interconnected.
   D. Relate the concepts of science to contemporary, historical, technological, ethical, environmental, and other societal issues.
   E. Design and conduct inquiry-based, open-ended investigations—both laboratory and field based—in a learning environment that maintains an appropriate level of safety.
   F. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers to collect, analyze, and display data.

II. SCIENCE CONTENT CORE
   A. Understand the unifying concepts of science such as scale and model, form and function, organization, interactions, change and conservation, and be able to apply them to science teaching.
   B. Understand the major concepts and principles of life and environmental science.
   C. Understand the major concepts and principles of chemistry.
   D. Understand the major concepts and principles of physics.
   E. Understand the major concepts and principles of earth/space science.

The above knowledge and skills relate to the teaching of science in general as well as to teaching science in grades 7 and 8. The following knowledge and skills relate to specific endorsement in chemistry.

III. PHYSICS ENDORSEMENT
   A. Explain vectors and use of vector analysis.
   B. Explain and be able to apply the conservation principles for energy and for linear and angular momentum.
   C. Relate the physical properties of the states of matter, as well as mass, volume, density, and inertia.
   D. Explain elementary thermodynamics.
   E. Explain wave phenomena and their interactions as experienced in sound waves, interference, resonance, intensity, quality, and the Doppler effect.
   F. Describe the electromagnetic spectrum and the properties of electromagnetic waves to include reflection, refraction, interference, dispersion, and polarization.
   G. Describe the nature of light, explain the relationship of radio waves, ultraviolet, visible, and infrared light.
   H. Explain the principles of geometric optics.
   I. Explain magnetism and electricity, as well as electromagnetic induction as applied to generators, motors, and transformers.
   J. Explain atomic structure, the development of atomic theory, and modern quantum theory.
   K. Explain nuclear energy, basic principles of particle accelerators, and detection instruments.
   L. Understand calculations of mechanical advantage and friction as related to simple and compound machines.
   M. Apply the laws of motion as they relate to gravity, speed, acceleration, and velocity.
   N. Explain work, power, energy, and the measurement of each.
   O. Describe applications of solid state physics in modern technology.
   P. Apply mathematics, including statistics, calculus, and introductory and differential equations to investigations in physics and the analysis of data.

A program that covers the above competencies normally includes at least the following courses:

- General Physics
- Classical Mechanics
- Electricity/Magnetism
- Heat/Thermodynamics
- Waves/Optics
- Atomic & Nuclear
- Radiation/Radioactivity
- Relativity

Physics Audit for Licensure (continued)
Quantum Mechanics

Physics & Science, Technology, Society

Calculus-Differential Equations

And, to meet knowledge and skills for the teaching of science in grades 7 and 8:

General Chemistry

General Biology

Geology

History of Science

COMMENTS:

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Earth Science Audit for Licensure (continued)

Earth Science & Science, Technology, Society

Meteorology

Physical Geology

I. INQUIRY-BASED INSTRUCTION
A. Demonstrate processes of science such as posing questions, observing, investigating phenomena, interpreting findings, communicating results, and making judgments based on the evidence.
B. Teach key science concepts in depth.
C. Relate the major concepts of the various science disciplines to each other and show how these disciplines are interconnected.
D. Relate the concepts of science to contemporary, historical, technological, ethical, environmental, and other societal issues.
E. Design and conduct inquiry-based, open-ended investigations—both laboratory and field based—in a learning environment that maintains an appropriate level of safety.
F. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers to collect, analyze, and display data.

II. SCIENCE CONTENT CORE
A. Understand the unifying concepts of science such as scale and model, form and function, organization, interactions, change and conservation, and be able to apply them to science teaching.
B. Understand the major concepts and principles of life and environmental science.
C. Understand the major concepts and principles of chemistry.
D. Understand the major concepts and principles of physics.
E. Understand the major concepts and principles of earth/space science.

The above knowledge and skills relate to the teaching of science in general as well as to teaching science in grades 7 and 8. The following knowledge and skills relate to specific endorsement in biology.

III. EARTH SCIENCE ENDORSEMENT
A. Describe the Earth as a system that includes other interactive systems including hydrosphere, lithosphere, biosphere, cryosphere, atmosphere, and space.
B. Explain the Earth’s environment as a closed system in terms of the hydrologic cycle, the geochemical cycle, the rock cycle, and the tectonic cycle.
C. Explain methods for determining relative and absolute time in the context of Earth history; understand the geologic time scale.
D. Explain the relevance of paleontology in the reconstruction of ancient environments throughout the course of Earth history; understand the role of organisms in the evolution of the planet Earth; and understand the concept of species extinction.
E. Explain the leading hypotheses and theories of the origin and evolution of the major components of the Universe, including such concepts as galaxy, planet, satellite, and solar system.
F. Understand the structure, composition, and dynamics of galactic matter including stars, planets, and satellites.
G. Understand the schemes used to classify minerals and rocks; identify common minerals and rocks using physical and chemical properties; and explain the origin and natural history of igneous, metamorphic, and sedimentary rocks.
H. Explain the theory of plate tectonics and understand endogenic geologic processes related to plate tectonics, including volcanoes, earthquakes, and metamorphism.
I. Explain the exogenic geologic processes responsible for the diverse landforms on the Earth’s surface, including the continents and the sea floor.
J. Explain what constitutes geologic hazards, how humans may protect themselves, and the role of geology in waste disposal.
K. Understand mineral, rock, and energy resources—how and where they form, how they are evaluated, and how they are extracted.
L. Apply mathematics, including statistics and precalculus, to investigations in the earth/space sciences and the analysis of data.

A program that covers the above competencies normally includes study in Earth Science and specialization in one of the Earth Sciences (astronomy, geology, meteorology, or oceanography) to include coursework in the following:

Physical Geology

Historical Geology

Meteorology

Astronomy

Oceanography

Earth Science & Science, Technology, Society

Earth Science Audit for Licensure (continued)
And, to meet knowledge and skills for the teaching of science in grades 7 and 8:

- General Chemistry
- General Physics
- General Biology
- History of Science

COMMENTS:

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