Secondary Chemistry 1 Endorsement Specs

Purpose

This endorsement, when attached to a current Secondary Education License, verifies that the individual has the skills and knowledge necessary to teach students in a secondary physical chemistry science classroom and is required to teach High School (9-12) General Chemistry Courses. This endorsement is required as a prerequisite to earn Secondary Chemistry 2 which is required for Advanced Chemistry (AP, CE, and IB) courses.

Endorsement Prerequisites

To be eligible for this endorsement, candidates must meet the following prerequisites:

- Have a Secondary Education License
- Have the Secondary Science Core Endorsement

Endorsement Requirement Areas

The Science Core Endorsement has the following 4 requirement areas:

1. Matter and Its Interactions & Energy Content Knowledge 1
2. Matter and Its Interactions & Energy Content Knowledge 2
3. Matter and Its Interactions & Energy Laboratory Content Knowledge
4. Integration with Life and Earth Science Content Knowledge

Endorsement Type

A professional endorsement will be awarded when all of the requirement areas have been met. An associate endorsement will be awarded if the applicant holds a professional Science Core endorsement **OR** has completed at least 2 of the 5 requirement areas.

Requirement Area Options

The different options available to complete each of the requirement areas are described below. Quick links to the requirement area competencies are linked in parentheses.

Requirement Area 1: Matter and Its Interactions & Energy Content Knowledge 1 (C1.1 and C1.2)

Complete one of the following options to show evidence of competency in this Requirement Area

University Courses

- Any 3+ credit university course (passed with a grade of C or higher) in General Chemistry I
    - Lab course is not required but recommended
    - This course can be the same General Chemistry used to meet course requirements for the Science Core (6-8) Endorsement (if applicable).

College Major or Minor (Meets Requirement Areas 1-4 for this endorsement)

- College Major or Minor in Chemistry, Chemistry Education, Physical Science Education, or a Chemistry Variation (e.g., Biochemistry, Geochemistry, Physical Chemistry)
- Other College Majors or Minors may be approved for this endorsement with approval of USBE Science Specialist based on a transcript review

Praxis Exam (Meets Requirement Areas 1-4 for this endorsement)

- Chemistry Praxis (5246) with score of 140 or higher
- Other equivalent state or national exams that meet competencies and approved by USBE

Requirement Area 2: Matter and Its Interactions & Energy Content Knowledge 2 (C1.1 and C1.2)

Complete one of the following options to show evidence of competency in this Requirement Area

University Courses

- Any 3+ credit university course (passed with a grade of C or higher) in General Chemistry II
    - Lab course is not required but recommended
    - This course must indicate that it is a level-2 chemistry course and not simply a different level-1 chemistry course.

College Major or Minor (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Praxis Exam (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Requirement Area 3: Matter and Its Interactions & Energy Laboratory Content Knowledge (C1.1 and C1.2)

Complete one of the following options to show evidence of competency in this Requirement Area

University Courses

- Any 1+ credit university course (passed with a grade of C or higher) in a Chemistry Laboratory Experience
    - A course used for Requirements 2, 3, or 5 that is worth 4+ credits will meet this requirement.

College Major or Minor (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Praxis Exam (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Requirement Area 4: Integration with Life and Earth Science Content Knowledge (C1.3)

Complete one of the following options to show evidence of competency in this Requirement Area

University Courses

- Any 3+ credit university course (passed with a grade of C or higher) in Advanced/Applied Chemistry (e.g., Organic Chemistry, Biochemistry, Geochemistry, Physical Chemistry)
    - Lab course is not required but recommended

College Major or Minor (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Praxis Exam (Meets Requirement Areas 1-4 for this endorsement)

- As described in Requirement Area 1 description

Requirement Area Competencies

The Secondary Chemistry 1 competencies are organized into 1 section:

1. **Chemistry 1 Core Ideas** – The Utah Secondary Chemistry 1 qualifies teachers to teach the core

High School (9-12) General Chemistry course focused specifically in the High School Chemistry (Physical Science) disciplinary core ideas:
C1.1 Matter and Its Interactions
C1.2 Energy
C1.3 Integration with Life and Earth Science

Each of the requirement area competencies are described below. Quick links to each requirement area options are provided in the parentheses.

Requirement Area 1 - Matter and Its Interactions & Energy Content Knowledge 1 (Options)
Requirement Area 2 - Matter and Its Interactions & Energy Content Knowledge 2 (Options)
Requirement Area 3 - Matter and Its Interactions & Energy Laboratory Content Knowledge (Options)

Note: Requirement Areas 1, 2, and 3 all have the same competencies.

Requirement Area C1.1: Matter and Its Interactions

Area C1.1.A: Structure and Properties of Matter

- C1.1.A.a Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- C1.1.A.b The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns.
- C1.1.A.c The repeating patterns of this table reflect patterns of outer electron states.
- C1.1.A.d The structure and interactions of matter at the bulk scale are determined by electrical forces within/between atoms
- C1.1.A.e Stable forms of matter are those in which the electric and magnetic field energy is minimized.
- C1.1.A.f A stable molecule has less energy, by an amount known as the binding energy, than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart

Area C1.1.B: Chemical Reactions

- C1.1.B.a Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in total binding energy (i.e., the sum of all bond energies in the set of molecules) that are matched by changes in kinetic energy.
- C1.1.B.b In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
- C1.1.B.c The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
- C1.1.B.d Chemical processes and properties of materials underlie many important biological and geophysical phenomena.

Area C1.1.C: Nuclear Processes

- C1.1.C.a The total number of neutrons plus protons does not change in any nuclear process.
- C1.1.C.b Spontaneous radioactive decays follow a characteristic exponential decay law.
- C1.1.C.c Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials from the isotope ratios present

Requirement Area C1.2: Energy

Area C1.2.A: Definitions of Energy

- C1.2.A.a Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- C1.2.A.b At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- C1.2.A.c Mechanical energy generally refers to some combination of motion and stored energy in an operating machine.
- C1.2.A.d Chemical energy generally is used to mean the energy that can be released or stored in chemical processes, and "electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. Historically, different units and names were used for the energy present in these different phenomena, and it took some time before the relationships between them were recognized.
- C1.2.A.e These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields (which mediate interactions between particles).
- C1.2.A.f This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Area C1.2.B: Conservation of Energy and Energy Transfer

- C1.2.B.a Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems

Area C1.2.C: Electromagnetic Radiation

- C1.2.C.a Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. Quantum theory relates the two models. (Boundary: Quantum theory is not explained further at this grade level.)
- C1.2.C.b Atoms of each element emit and absorb characteristic frequencies of light, and nuclear transitions have distinctive gamma ray wavelengths. These characteristics allow identification of the presence of an element, even in microscopic quantities.

Requirement Area 4 - Integration with Life and Earth Science Content Knowledge (Options)

Requirement Area C1.3: Integration with Life and Earth Science

Area C1.3.A Competencies: Connections with Life Science

- C1.3.A.a Carbon-based chemistry. This includes the unique reactivity of groupings of atoms, interactions of nucleophiles and electrophiles, electron flow in organic reactions, and the 3-dimensional structure of carbon-based molecules.
- C1.3.A.b Biomolecules. This includes structure, properties, and reactivity of proteins, nucleic acids, lipids, and carbohydrates.
- C1.3.A.c Processing of carbon-based molecules by living organisms. This includes metabolism, toxicity, absorption, and excretion.

Area C1.3.B Competencies: Connections with Earth Science

- C1.3.B.a Processing of molecules by the environment and universe. This includes greenhouse gases, biogeochemical cycles, and energy flow.

- C1.3.B.b Human impact on the environment. This includes pollution (e.g., plastics, heavy metals, and other toxins), ocean acidification, environmental protection, green technologies, and societal energy resources.