# Secondary Physics 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 science classroom and is required to teach High School (9-12) General Physics Courses and the high school astronomy elective course. This endorsement is required as a prerequisite to earn Secondary Physics 2 which is required for Advanced Physics (AP, CE, and IB) courses.

## Endorsement Prerequisites

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

- 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. Motion, Stability, and Energy Content Knowledge 1
2. Motion, Stability, and Energy Content Knowledge 2
3. Motion, Stability, and Energy Laboratory Content Knowledge
4. Waves and Their Applications in Technology 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 4 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: Motion, Stability, and Energy Content Knowledge 1 (P1.1 and P1.2)

*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 Physics I
  - Lab course is not required but recommended
  - This course can be the same General Physics 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 Physics, Physics Education, Physical Science Education, or a Physics Variation (e.g., Astrophysics, Theoretical Physics, Nuclear Physics)
- 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)

- Physics Praxis (5266) with score of 140 or higher
- Other equivalent state or national exams that meet competencies and approved by USBE

### Requirement Area 2: Motion, Stability, and Energy Content Knowledge 2 (P1.1 and P1.2)

*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 Physics II
    - Lab course is not required but recommended
    - This course must indicate that it is a level-2 physics course and not simply a different level-1 physics 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: Motion, Stability, and Energy Laboratory Content Knowledge (P1.1 and P1.2)

*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 Physics 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: Waves and Their Applications in Technology (P1.3)

*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 Physics (e.g., Modern Physics, Electricity and Magnetism, Waves, Acoustics, and Sound)
    - 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. **Physics 1 Core Ideas** – The Utah Secondary Physics 1 qualifies teachers to teach the core High School (9-12) General Physics course focused specifically in the High School Physics (Physical Science) disciplinary core ideas:

P1.1 Motion and Stability
P1.2 Energy
P1.3 Waves and Their Applications in Technology

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

## Requirement Area 1 - Motion, Stability, and Energy Content Knowledge 1 (Options)

## Requirement Area 2 - Motion, Stability, and Energy Content Knowledge 2 (Options)

## Requirement Area 3 - Motion, Stability, and Energy Laboratory Content Knowledge (Options)

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

**Requirement Area P1.1: Motion and Stability**

Area P1.1.A: Forces and Motion

- P1.1.A.a Newton's second law accurately predicts changes in the motion of macroscopic objects, but it requires revision for subatomic scales or for speeds close to the speed of light.
- P1.1.A.b Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved.

Area P1.1.B: Types of Interactions

- P1.1.B.a Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
- P1.1.B.b Forces at a distance are explained by fields permeating space that can transfer energy through space.
- P1.1.B.c Magnets or changing electric fields cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
- P1.1.B.d The strong and weak nuclear interactions are important inside atomic nuclei.

Area P1.1.C: Stability and Instability in Physical Systems

- P1.1.C.a Systems often change in predictable ways; understanding the forces that drive the transformations and cycles within a system, as well as the forces imposed on the system from the outside, helps predict its behavior under a variety of conditions.
- P1.1.C.b When a system has a great number of component pieces, one may not be able to predict much about its precise future.

**Requirement Area P1.2: Energy**

Area P1.2.A: Definitions of Energy

- P1.2.A.a Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- P1.2.A.b At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- P1.2.A.c "Mechanical energy" generally refers to some combination of motion and stored energy in an operating machine.
- P1.2.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.

- P1.2.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).
- P1.2.A.f This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Area P1.2.B: Conservation of Energy and Energy Transfer

- P1.2.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.
- P1.2.B.b Mathematical expressions allow the concept of conservation of energy to be used to predict and describe system behavior.
- P1.2.B.c Uncontrolled systems always evolve toward more stable states

Area P1.2.C: Relationships Between Energy and Forces

- P1.2.C.a Force fields (gravitational, electric, and magnetic) contain energy and can transmit energy across space from one object to another.
- P1.2.C.b When two objects interacting through a force field change relative position, the energy stored in the force field is changed.

## Requirement Area 4 - Heredity: Inheritance and Variation of Traits Content Knowledge (Options)

**Requirement Area P1.3: Waves and Their Applications in Technology**

Area P1.3.A: Wave Properties

- P1.3.A.a The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.
- P1.3.A.b The reflection, refraction, and transmission of waves at an interface between two media can be modeled on the basis of these properties.
- P1.3.A.c Combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information.
- P1.3.A.d Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.
- P1.3.A.e Resonance is a phenomenon in which waves add up in phase in a structure, growing in amplitude due to energy input near the natural vibration frequency.
- P1.3.A.f Structures have particular frequencies at which they resonate. This phenomenon (e.g., waves in a stretched string, vibrating air in a pipe) is used in speech and in the design of all musical instruments.

Area P1.3.B: Electromagnetic Radiation

- P1.3.B.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.)
- P1.3.B.b Because a wave is not much disturbed by objects that are small compared with its

wavelength, visible light cannot be used to see such objects as individual atoms.
- P1.3.B.c All electromagnetic radiation travels through a vacuum at the same speed, called the speed of light. Its speed in any other given medium depends on its wavelength and the properties of that medium.
- P1.3.B.d When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).
- P1.3.B.e Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
- P1.3.B.f Photovoltaic materials emit electrons when they absorb light of a high enough frequency.

Area P1.3.C: Information Technologies and Instrumentation
- P1.3.C.a Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.
- P1.3.C.b Knowledge of quantum physics enabled the development of semiconductors, computer chips, and lasers, all of which are now essential components of modern imaging, communications, and information technologies.