Kansas Educator Preparation Program Standards for Physics Educators 6-12

****"Learner(s) is defined as children including those with disabilities or exceptionalities, who are gifted, and students who represent diversity based on ethnicity, race, socioeconomic status, gender, language, religion, and geographic origin.**

Standard 1: Content Pedagogy: Effective science teachers understand how students learn and develop science concepts and practices. They incorporate disciplinary core ideas, scientific and engineering practices, and crosscutting concepts into instruction.

Function 1: The teacher plans multiple lessons using a variety of inquiry approaches incorporating science and engineering practices.

Content Knowledge	Professional Skills
1.1.1 CK The teacher knows how to locate resources, design and conduct inquiry-based open-ended science investigations, interpret findings, communicate results, and make judgments based on evidence.	1.1.2 PS The teacher supports student learning through appropriate curricular and instructional experiences linked to the standards
	1.1.3 PS The teacher is able to develop lessons for students that demonstrate knowledge of the practices of science and engineering by questioning, defining problems, modeling, investigating, and analyzing evidence in order to construct explanations and alternative explanations.
	1.1.4 PS The teacher is able to develop lessons in which students collect and interpret data, develop and communicate concepts, and understand scientific processes, relationships and natural patterns from empirical experiences. Applications of science-specific technology are included in the lessons when appropriate.

Function 2: The teacher demonstrates knowledge and understanding of how diverse students learn science.

Content Knowledge	Professional Skills
1.2.1 CK The teacher knows learning is influenced by cultural and environmental differences of the student and family.	1.2.4 PS The teacher gains and values information about the family's culture and environment and uses it to understand individual development and learning.
1.2.2 CK The teacher understands developmentally and chronologically age-appropriate needs and practices of students.	1.2.5 PS The teacher promotes developmentally and chronologically age-appropriate educational experiences to meet the learning abilities, strengths, needs, and preferences of students.
1.2.3 CK The teacher understands diverse learning styles.	

Function 3: The teacher designs instruction and assessment strategies that confront and address naïve concepts/preconceptions.

Content Knowledge	Professional Skills
1.3.1 CK The teacher knows learning is influenced by cultural and environmental differences of the student and family.	1.3.3 PS The teacher uses appropriate formal and informal evaluation/assessment instruments to identify learning needs of students.
1.3.2 CK The teacher understands formative and summative assessment and how they are used.	1.3.4 PS The teacher is able to identify common student misconceptions and naïve understandings and design and implement appropriate instruction to address these.

Standard 2: Learning Environments: Teachers work with students and others to create and manage environments that support learning.	
Function 1: The teacher supports individual and group learning.	
Content Knowledge	**Professional Skills**
2.1.1 CK The teacher understands the importance of rigor, respect, and responsibility for the learning environment.	2.1.3 PS The teacher sets and articulates appropriate goals that are consistent with knowledge of how students learn science.
2.1.2 CK The teacher understands how teacher feedback influences student learning.	2.1.4 PS The teacher sets goals that are aligned with state and other professional standards.
	2.1.5 PS The teacher manages the environment to make learning experiences appropriately challenging.
Function 2: The teacher encourages positive social interaction.	
Content Knowledge	**Professional Skill**
2.2.1 CK The teacher understands how learner diversity can affect communication and knows how to communicate effectively in differing environments.	2.2.3a PS The teacher plans fair and equitable assessment strategies to analyze student learning and to evaluate if the learning goals are met. 2.2.3b PS The teacher promotes celebration of learning by providing positive reinforcement and encouraging learners to present work demonstrating their learning and interacting with community members about their work. 2.2.3c PS The teacher communicates verbally and nonverbally, with families, communities, colleagues, and other professionals, in ways that demonstrate respect for and responsiveness to the cultural backgrounds and differing perspectives learners bring to the learning environment. 2.2.3d PS The teacher knows how to help learners work productively and cooperatively with each other to achieve learning goals.
2.2.2 CK The teacher understands how learning occurs, how learners construct knowledge, acquire skills, and develop disciplined thinking processes and knows how to use instructional strategies that promote student learning.	2.2.4a PS The teacher develops plans that reflect the nature and social context of science and inquiry. 2.2.4b PS The teacher creates developmentally appropriate instruction that takes into account individual learners' strengths, interests, and needs and that enables each learner to advance and accelerate his/her learning.
Function 3: The teacher promotes active engagement in learning and self-motivation.	
Content Knowledge	**Professional Skill**
2.3.1 CK The teacher understands the relationships between motivation, engagement, and self-efficacy, and knows how to design learning experiences using strategies that build learner self-direction and ownership of learning.	2.3.3a PS The teacher shows the ability to use a variety of strategies that demonstrate the candidates' knowledge and understanding of how to select the appropriate teaching and learning activities, including laboratory or field settings and applicable instruments and technology. 2.3.3b PS The teacher incorporates differentiated instruction strategies to engage students with diverse learning needs.

	2.3.3c PS The teacher incorporates tools of language development into planning and instruction, including strategies for making content accessible to English language learners and for evaluating and supporting their development of English proficiency.
2.3.2 CK The teacher creates learning environments where students have an opportunity to actively engage in the practices of science and engineering.	2.3.4a PS The teacher will develop lesson plans that include active inquiry lessons where students are collecting, analyzing and interpreting data. 2.3.4b PS The teacher will develop lesson plans that allow students to engage in developing and using models, constructing explanations and designing solutions, engaging in argument from evidence, and evaluating and communicating information.

Standard 3: Safety: Effective teachers of science demonstrate and implement safety procedures, material safety practices, and the ethical treatment and use of living organisms (appropriate to their area of licensure).	
Function 1: The teacher implements safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials.	
Content Knowledge	**Professional Skill**
3.1.1 CK The teacher understands safety considerations affecting the purchase, storage, maintenance, and disposal of materials such as minimizing quantities in ordering, tracking usage of materials and production of waste, and keeping current on inventory of materials.	3.1.3 PS The teacher understands, applies, and promotes the maintenance of a safe environment in accordance with the recommendations of the National Science Teachers Association.
3.1.2 CK The teacher understands proper techniques and precautions for controlling access to materials in the student laboratory including appropriate dispensing, supervision of materials, and handling of waste.	3.1.4 PS The teacher maintains an orderly environment, uses safe and appropriate storage of materials and equipment, and minimizing clutter so as to reduce the potential for accidents.
Function 2: The teacher designs and models activities to implement emergency procedures. The teacher understands the maintenance of safety equipment and follows policies and procedures that comply with established state and/or national guidelines. The teacher ensures safe science activities appropriate for the abilities of all students.	
Content Knowledge	**Professional Skill**
3.2.1 CK The teacher understands appropriate emergency procedures and maintenance of safety equipment, policies and procedures that comply with established state and/or national guidelines.	3.2.3 PS The teacher designs and implements activities that demonstrate emergency procedures and the proper use of safety equipment in accordance with the recommendations of the National Science Teachers Association.
3.2.2 CK The teacher understands how students' developmental levels affect safety in classroom, laboratory and field environments, and considers this in designing activities to maintain a safe environment.	3.2.4 PS The teacher enforces safe science practices in activities appropriate to the abilities of all students.
Function 3: The teacher designs and implements activities that demonstrate ethical decision-making with respect to the treatment of living organisms in and out of the classroom. The teacher emphasizes safe, humane, and ethical treatment of animals and complies with the legal restrictions on the collection, keeping, use, and treatment of living organisms.	
Content Knowledge	**Professional Skill**
3.3.1 CK The teacher understands the principles of ethical decision-making with respect to the treatment of living organisms in and out of the classroom.	3.3.4 PS The teacher designs and implements activities that demonstrate ethical decision-making with respect to the treatment of living organisms in and out of the classroom.

3.3.2 CK The teacher knows the legal restrictions on the collection, keeping, use, and treatment of living organisms.	3.3.5 PS The teacher complies with the legal restrictions on the collection, keeping, and use of living organisms.
3.3.3 CK The teacher is aware of hazards from exposure to allergens, toxins, and pathogens in the classroom, laboratory, or field environment.	

Standard 4: Impact on Student Learning: Science teachers provide evidence that students' understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts have increased in sophistication as a result of instruction. Candidates provide evidence representative of the entire population they teach.	
Function 1: Teachers collect, organize, analyze, and reflect on diagnostic, formative and summative evidence of student learning.	
Content Knowledge	**Professional Skills**
4.1.1 CK The teacher understands the various methodologies to assess and analyze student learning, and address misconceptions.	4.1.2 PS The teachers utilize knowledge of appropriate developmental levels within the classroom environment.
	4.1.3 PS The teacher reflects on formative and summative assessments, and adjusts instruction appropriately.
Function 2: The teacher provides data to show that students are able to distinguish science from nonscience, understand the evolution and practice of science as a human endeavor, and critically analyze the quality of evidence supporting scientific claims.	
Content Knowledge	**Professional Skills**
4.2.1 CK The teacher understands the distinction between science and nonscience, and can distinguish between the two.	4.2.4 PS The teacher demonstrates that students are able to understand the distinction between science and nonscience, and can distinguish between the two.
4.2.2 CK The teacher understands the history, development and practice of science as a human endeavor.	4.2.5 PS The teacher demonstrates that students are able to understand the history, development and practice of science as a human endeavor.
4.2.3 CK The teacher critically analyzes the quality of evidence supporting scientific claims.	4.2.6 PS The teacher demonstrates that students are able to critically analyze the quality of evidence supporting scientific claims.

Standard 5: Professional Knowledge and Skills: Effective science teachers are aware of and engage in professional development opportunities to continually improve their knowledge and understanding of science content and pedagogy. They conduct themselves as part of the science education community.	
Function 1: Teachers engage in professional development opportunities in their content field such as talks, symposiums, research opportunities, projects within their community, and/or social media.	
Content Knowledge	**Professional Skills**
5.1.1 CK The teacher demonstrates an awareness of professional organizations in science/education, and professional development available from these organizations.	5.1.2 PS Teachers engage in professional development opportunities such as conferences, research opportunities, projects within their community, and/or social media.

Standard 6: Engineering, Technology, and the Applications of Science: The teacher demonstrates an understanding of concepts and practices of engineering, technology, and the applications of science in developing instruction for students.	
Function 1: The teacher incorporates engineering design in instruction to solve problems. Engineering design includes the iterative processes of defining problems, developing solutions, and optimizing solutions.	
Content Knowledge	**Professional Skills**
6.1.1 CK The teacher can define and delimit engineering problems with precision, and specify the goals intended to be reached.	6.1.4 PS The teacher develops and implements lessons in which students use engineering design principles (define the problem, develop solutions, and optimize solutions) in applications appropriate to their content area.
6.1.2 CK The teacher can develop possible solutions for a defined problem.	
6.1.3 CK The teacher can systematically evaluate alternative solutions to engineering problems, analyzing data from tests of different solutions, and combining the best ideas into an improved solution.	
Function 2: The teacher makes authentic connections among engineering, technology, science, and society.	
6.2.1 CK The teacher understands the interdependence of science, engineering, and technology.	6.2.3 PS The teacher incorporates into instruction examples of the interdependence of science, engineering, and technology. Examples include: 1) advances in scientific understanding in genetics can be translated into medical treatments, and 2) new technology such as advanced telescopes and probes provide new understandings of outer space.
6.2.2 CK The teacher understands the influences of engineering, technology, and science to the broader society and environment.	6.2.4 PS The teacher incorporates into instruction examples of the influences of engineering, technology, and science to the broader society and environment. Examples include: 1) how measurement technologies have changed civilizations throughout history, and 2) how the use of natural resources has impacted the natural world.

Standard 7: Motion, Forces, Energy, & Heat: The physics teacher demonstrates a solid grasp of the classical mechanics of particles and fluids and thermal physics.	
Function 1: The teacher of physics understands and can apply the classical mechanics of particles and fluids.	
Content Knowledge	**Professional Skills**
7.1.1 CK The teacher understands Translational Kinematics in one and two dimensions.	7.1.5a PS The teacher will have a working knowledge of vector algebra and be able to utilize both polar and rectangular (component) notation. 7.1.5b PS The teacher will understand and utilize the concepts of displacement, velocity, and acceleration. 7.1.5c PS The teacher will be able to derive and employ the three major kinematic equations. 7.1.5d PS The teacher will be able to read a kinematic graph, interpret it in terms of slope and area under the curve, and produce a written/verbal description of the motion depicted.

7.1.2a CK The teacher understands Dynamics. 7.1.2b CK The teacher understands Newton's Laws. 7.1.2c CK The teacher understands Conservation of Momentum. 7.1.2d CK The teacher understands Universal Gravitation. 7.1.2e CK The teacher understands Conservation of Energy.	7.1.6a PS The teacher will know Newton's three laws of motion and use them to explain a number of natural events. 7.1.6b PS The teacher will be able to apply Newton's 2nd law to a variety of one and two-dimensional static and dynamic situations, including those involving several forces, weight, friction, and tension. 7.1.6c PS The teacher will be able to state and apply the law of conservation of momentum (as per Newton's 3rd law) to a variety of one and two-dimensional situations involving both open and isolated systems. 7.1.6d PS The teacher will understand and be able to apply Kepler's laws of planetary motion in simple situations. 7.1.6e PS The teacher will be able to state Newton's law of gravitation, express it mathematically, and apply it to a variety of simple near earth and orbital situations. 7.1.6f PS The teacher will understand the concept of work, in the scientific sense, and be able to calculate the work involved in a variety of simple situations. 7.1.6g PS The teacher will relate work to energy using the work-energy theorem and apply it to a variety of simple mechanical situations. 7.1.6h PS The teacher will understand the nature of potential energy, kinetic energy, and internal energy, be able to derive the formulas for translational kinetic energy and gravitational potential energy and apply them to simple cases. 7.1.6i PS The teacher will be able to state the law of conservation of energy, express it mathematically ($\Delta E=Q+w$), and apply it to a variety of simple situations. 7.1.6j PS The teacher will understand and be able to apply the principles underlying the operation of simple machines.
7.1.3a CK The teacher understands Periodic Motion. 7.1.3b CK The teacher understands Rotational Motion. 7.1.3c CK The teacher understands Simple Harmonic Motion.	7.1.7a PS The teacher will understand the concepts of centripetal acceleration and centripetal force, be able to derive formulas for calculating them and apply them to simple cases such as objects moving in uniform circular motion and vehicles rounding highway curves. 7.1.7b PS The teacher will understand and be able to apply the concepts of angular displacement, angular velocity, and angular acceleration in simple cases.

	7.1.7c PS The teacher will be able to derive the three major kinematic equations for rotational motion and apply them in simple situations. 7.1.7d PS The teacher will understand the concepts of torque and rotational inertia and be able to calculate them for simple cases. 7.1.7e PS The teacher will understand and be able to apply Newton's 2nd law for rotation in simple situations. 7.1.7f PS The teacher will be able to derive the formula for rotational kinetic energy and apply it in simple situations. 7.1.7g PS The teacher will understand the law of conservation of angular momentum and be able to apply it to simple cases. 7.1.7h PS The teacher will understand the nature of pseudoforces, such as centrifugal force and the Coriolis force, and explain why an observer traveling in a rotating coordinate system needs to invent them. 7.1.7i PS The teacher will know what simple harmonic motion (SHM) is and be able to identify common cases of objects in approximate SHM. 7.1.7j PS The teacher will understand what is meant by the frequency, period, and amplitude of an oscillator moving in SHM (an SHO) and measure these characteristics for real world SHO's. 7.1.7k PS The teacher will understand Hooke's law of elasticity and be able to apply it to simple situations, including the derivation of a formula for calculating the elastic potential energy of a stretched or compressed spring. 7.1.7l PS The teacher will be able to apply the law of conservation of energy to SHO's. 7.1.7m PS The teacher will be able to use a reference circle to develop formulas for calculating the speed and period for a SHO and apply them to a simple pendulum. 7.1.7n PS The teacher will be able to use a reference circle to justify the graphs and equations for the displacement, velocity, and acceleration of a SHO. 7.1.7o PS The teacher will be able to differentiate between natural and forced vibrations and between free and damped vibrations in real world systems.

	7.1.7p PS The teacher will grasp the concept of resonance on a qualitative level and recognize real world examples.
7.1.4a CK The teacher understands Fluid Mechanics. 7.1.4b CK The teacher understands Fluid Statics. 7.1.4c CK The teacher understands Fluid Dynamics. 7.1.4d CK The teacher understands Wave Motion. 7.1.4e CK The teacher understands Acoustics.	7.1.8a PS The teacher will understand what a fluid is, both macroscopically and microscopically, and be able to recognize common real world fluids. 7.1.8b PS The teacher will understand the concepts of density and specific gravity and be able to apply them to situations involving fluids. 7.1.8c PS The teacher will understand the meaning of pressure and the role of pressure in fluid systems, and be able to operate instruments used to measure pressure in real world situations. 7.1.8d PS The teacher will understand Pascal's principle, Archimedes' principle, and Boyle's law and be able to apply them to simple situations. 7.1.8e PS The teacher will understand and be able to apply the continuity equation and Bernoulli's principle to simple situations. 7.1.8f PS The teacher will understand the principles of sedimentation, Drag, surface tension, and fluid flow in tubes and channels, and apply them in simple situations. 7.1.8g PS The teacher will know what a wave is, be able to describe it in terms of its frequency, period, wavelength, and amplitude, and realize that a wave is the only way to transfer energy without it being carried by a particle. 7.1.8h PS The teacher will know and be able to utilize the fundamental wave formula ($v=f\lambda$). 7.1.8i PS The teacher will differentiate between transverse and longitudinal waves. 7.1.8j PS The teacher will be able to demonstrate the characteristic behaviors of waves; reflection, refraction, interference, diffraction, and polarization (transverse waves only). 7.1.8k PS The teacher will be able to calculate the energy content, power, and intensity of a simple wave at a given point and its amplitude and intensity at a remote point. 7.1.8l PS The teacher will be able to apply the law of reflection and derive and utilize Snell's law of refraction. 7.1.8m PS The teacher will be able to differentiate between constructive and destructive interference using the law of superposition.

	7.1.8n PS The teacher will be able to demonstrate the nature and anatomy of a standing wave, natural vibrating frequencies, and resonance. 7.1.8o PS The teacher will understand the nature and characteristics of sound and be able to compare and contrast quality sound and noise on a technical level. 7.1.8p PS The teacher will understand how the intensity of sound is measured and expressed and be able to apply that knowledge to simple situations. 7.1.8q PS The teacher will understand how sound is produced with emphasis on vibrating strings, membranes, air columns, and woodwind and brass musical instruments. 7.1.8r PS The teacher will understand the Doppler effect, both qualitatively and quantitatively, and be able to apply it to simple situations. 7.1.8s PS The teacher will demonstrate a qualitative knowledge of the nature of shock waves and sonic booms and technologies based upon sound such as ultrasound and medical imaging.
Function 2: The teacher of physics understands and can apply the basic principles of thermal physics.	
Content Knowledge	**Professional Skills**
7.2.1 CK The teacher understands the Laws of Thermodynamics.	7.2.4a PS The teacher will understand that heat is a specific form of energy transfer and compare and contrast it with other forms of energy transfer. 7.2.4b PS The teacher will understand the 1st law of thermodynamics and be able to apply it to simple cases. 7.2.4c PS The teacher will be able to render a statement of and understand the need for the 2nd law of thermo-dynamics. 7.2.4d PS The teacher will understand the basic principles upon which heat engines and refrigerators operate and apply these principles to real world machines. 7.2.4e PS The teacher will be familiar with the property of entropy, on both a phenomenological and statistical level, and be able to apply it to simple cases.
7.2.2 CK The teacher understands Temperature and the Kinetic Theory of Matter.	7.2.5a PS The teacher will be familiar with and be able to utilize the phenomenological definition of temperature. 7.2.5b PS The teacher will be able to develop the mathematical relationships governing thermal expansion and be able to apply them to simple cases involving linear and volume expansion.

	7.2.5c PS The teacher will understand Charles', Gay Lussac's, and the ideal gas laws and be able to apply them to simple situations. 7.2.5d PS The teacher will be able to use Charles' and Gay Lussac's laws to demonstrate the existence of an absolute zero temperature and construct the Kelvin and Rankine temperature scales accordingly. 7.2.5e PS The teacher will utilize the postulates of the kinetic theory of gases to develop the ideal gas law. 7.2.5f PS The teacher will understand that a group of molecules exhibits a range of kinetic energy values at any given temperature, that this range is statistically described by the Maxwell-Boltzmann distribution, and relate their absolute temperature to their average kinetic energy.
7.2.3 CK The teacher understands Heat Exchange and Transfer.	7.2.6a PS The teacher will demonstrate that the gain or loss of heat on the part of a system results in a temperature change and/or change(s) in state. 7.2.6b PS The teacher will understand the nature of heat capacities and latent heats and be able to use them to carry out simple heat exchange calculations, such as those related to calorimeter measurements. 7.2.6c PS The teacher will understand the nature of heat transfer by conduction and be able to calculate the rate of heat transfer through a material using its thermal conductivity. 7.2.6d PS The teacher will understand the nature of heat transfer by convection and differentiate between natural and forced convection. 7.2.6e PS The teacher will understand the nature of heat transfer by radiation and be able to calculate the rate of heat transfer from an object at a specific absolute temperature and the net rate at which it exchanges heat with its surroundings at a different absolute temperature using its emissivity and the Stefan-Boltzmann constant.

Standard 8: Electricity and Magnetism: The physics teacher demonstrates a solid grasp of electricity and magnetism.	
Function 1: The teacher of physics understands and can apply knowledge of Fields.	
Content Knowledge	**Professional Skills**
8.1.1 CK The teacher understands Electric Charge.	8.1.6 PS The teacher should understand that there are two signs of charge, and that charge is conserved.
8.1.2 CK The teacher understands Electric Forces.	8.1.7a PS The teacher should be able to find the force on a point charge due to several other point charges using Coulomb's law.

	8.1.7b PS The teacher should know the force on a charge in an electric field
8.1.3 CK The teacher understands Electric Fields.	8.1.8a PS The teacher should be able to find the electric field at a point in space due to several point charges by adding the electric fields from the point charges at the point in space. 8.1.8b PS The teacher should be able to use find the electric field at a point in space due to simple charge distributions by summing up the electric field at the point in space from each element of the charge distribution. 8.1.8c PS The teacher should be able to use Gauss law to find the electric field due to a cylindrically symmetric charge distribution, due to a spherically symmetric charge distribution, and due to a plane of charge. 8.1.8d PS The teacher should understand the relation between electric field and electric potential, and given a simple electric field, should be able to find the electric potential difference between two points in space. 8.1.8e PS The teacher should understand the relation between electric field, electric potential, and the potential energy of a charge in an electric field. 8.1.8f PS The teacher should understand how a changing magnetic field induces an electric field (Faraday's law). In particular, given a changing magnetic field through a loop, the teacher should be able to find the induced electric field around the loop.
8.1.4 CK The teacher understands Magnetic Fields.	8.1.9a PS The teacher should understand that magnetic field lines form loops, and that there are no magnetic monopoles. 8.1.9b PS The teacher should understand the direction and magnitude of the force on a moving charge in a static magnetic field. 8.1.9c PS The teacher should be able to calculate the force on a current carrying wire in a static magnetic field. The teacher should be able to use Ampere's law to calculate the magnetic field due to a current carrying wire, in a current carrying solenoid, and in a toroid. 8.1.9d PS The teacher should be able to calculate the force between parallel current-carrying wires. 8.1.9e PS The teacher should understand how a changing magnetic flux through a loop induces an EMF around the loop (Faraday's law).
8.1.5 CK The teacher understands EM Radiation.	8.1.10a PS The teacher should understand that a changing electric field induces a magnetic field.

	8.1.10b PS The teacher should have a qualitative understanding of how a changing magnetic field inducing an electric field, and changing electric field inducing a magnetic field can give rise to an electromagnetic wave. 8.1.10c PS The teacher should understand that the EM wave in a vacuum travels with the speed of light. 8.1.10d PS The teacher should understand the concepts of polarization of an EM wave, wavelength, wavenumber, frequency and angular frequency of the wave. 8.1.10e PS The teacher should understand the terminology involved with discussing the EM spectrum (that radio waves have longer wavelength than infrared, etc.).
Function 2: The teacher of physics understands and can apply knowledge of Circuits.	
Content Knowledge	**Professional Skills**
8.2.1 CK The teacher understands Ohm's Law.	8.2.3a PS The teacher should be able to use Ohm's law to find the voltage drop across a resistor given a current. 8.2.3b PS The teacher should understand the relation between charge on a capacitor plate and the voltage drop across a capacitor. 8.2.3c PS The teacher should understand batteries, and an ideal EMF.
8.2.2 CK The teacher understands Kirchoff's laws.	8.2.4a PS The teacher should understand that in any circuit, the sum of voltage drops around a circuit loop is zero, and that the sum of currents going in to any junction in the circuit is zero. 8.2.4b PS The teacher should understand how resistors add in parallel and in series. 8.2.4c PS The teacher should understand how capacitors add in parallel and in series. 8.2.4d PS The teacher should be able to find energy stored in a capacitor or and inductor. 8.2.4e PS The teacher should understand how inductors add in parallel and in series. 8.2.4f PS The teacher should be able to use Kirchoff's laws to find the current through a resistor, or voltage drop across a resistor in a circuit involving loops with resistors in parallel and in series and an EMF. 8.2.4g PS The teacher should understand the time behavior of charging and discharging RC circuits.

	8.2.4h PS The teacher should understand the relation between the changing current in an inductor and the voltage drop across an inductor. 8.2.4i PS The teacher should understand the behavior of LR circuits. 8.2.4j PS Given simple AC circuits, the teacher should be able to calculate the phase and amplitude of the voltage across a particular element. 8.2.4k PS The teacher should understand how transformers work, and how they change the voltage amplitude in an AC circuit according to the number of windings on the primary and secondary coils.
Function 3: The teacher of physics understands and can apply knowledge of Geometric Optics, Waves, and Polarization.	
Content Knowledge	**Professional Skills**
8.3.1 CK The teacher understands Geometric Optics.	8.3.4a PS The teacher should understand the concept of rays. 8.3.4b PS The teacher should understand the index of refraction. 8.3.4c PS The teacher should understand angles of incidence, angles of refraction and angles of reflection. 8.3.4d PS The teacher should be able to find the angle of refraction using Snell's law knowing index of refraction. 8.3.4e PS The teacher should be able to draw ray diagram for thin lenses, and draw principle rays to find an image given an object. 8.3.4f PS The teacher should be able to use the lens maker equation to find image distance given a focal length of the lens. 8.3.4g PS The teacher should be able to draw the ray diagram for spherical mirrors. 8.3.4h PS The teacher should be able to use geometrical optics to understand optical instruments, particularly the eye.
8.3.2 CK The teacher understands Waves.	8.3.5a PS The teacher should understand how Huygen's principle gives interference and diffraction phenomenon. 8.3.5b PS The teacher should be able to find intereference maxima and minima for double slit interference. 8.3.5c PS The teacher should be able to find diffraction minima for single slit interference.

	8.3.5d PS The teacher should be able to find interference maxima for a diffraction grating.
8.3.3 CK The teacher understands Polarization.	8.3.6a PS The teacher should understand the polarization and intensity of light passing through multiple polarizers. 8.3.6b PS The teacher should qualitatively understand polarization by reflection, and Brewster's angle

Standard 9: Curricular Content Knowledge in Modern Physics: The teacher of physics demonstrates understanding of basic concepts and applications of 20th century discoveries in the fundamental views of space, time, and the wave nature of matter, collectively termed Modern Physics.	
Function 1: The teacher of physics knows the historical development, interpretation, major effects, and recent applications of the principles of relativity as specified in the Special and General Theories.	
Content Knowledge	**Professional Skills**
9.1.1 CK The teacher applies transformation equations correctly for different inertial frames of reference and interprets what these transformations mean to observers in each frame.	9.1.3a PS The teacher can show how the two postulates of Special Relativity led to the Lorentz transformation equations. 9.1.3b PS The teacher calculates time dilation and length contraction for different inertial frames of reference, contrasts them with Galilean transformations, and can specify conditions leading to the so-called twin paradox. 9.1.3c PS The teacher describes conditions for wavelength shifts in light due to high relative speeds and calculates these shifts for specific inertial frames of reference. 9.1.3d PS The teacher correctly adds relativistic speeds for different frames of reference. 9.1.3e PS The teacher calculates mass/energy equivalences for various energetic processes, such as nuclear fission, fusion reactions, or stellar explosions.
9.1.2 CK The teacher qualitatively explains how gravitational forces arise from curvature of space and time in the presence of mass, and how this creates observed effects in non-inertial frames of reference.	9.1.5a PS The teacher describes the equivalence between gravity and acceleration in non-inertial frames. 9.1.5b PS The teacher describes how either gravity or acceleration can produce various non-inertial effects, including red/blue shifts in light, time dilation, length contraction, bending of light, and precession of Mercury's orbit. 9.1.5c PS The teacher qualitatively explains the circumstances that require relativistic corrections to clocks on satellites used for GPS.
Function 2: The teacher of physics knows the historical development, interpretation, key concepts, major effects, and further applications of the principles of quantum mechanics.	
Content Knowledge	**Professional Skills**

9.2.1 CK The teacher quantitatively explains how analysis of blackbody radiation and the photoelectric effect led to the concept of quantization of dynamical variables and the Bohr model of the hydrogen atom.	9.2.5a PS The teacher explains how the introduction of Planck's constant into Rayleigh's derivation of the distribution of wavelengths, solved the problem at short wavelengths but implied the restriction of light to wave packets. 9.2.5b PS The teacher calculates key parameters of the Planck distribution of wavelengths for a black body as a function of absolute temperature, including Stephen's Law for total radiated power and Wien's Displacement Law for the peak of the distribution. 9.2.5c PS The teacher calculates wavelengths for the spectrum of hydrogen using Bohr's energy levels and reduced mass to reproduce the Rydberg formula. 9.2.5d PS The teacher calculates de Broglie wavelengths for combinations of mass and speed to demonstrate that Bohr's quantization of momentum was equivalent to integer multiples of wavelength. 9.2.5e PS Using appropriate wave functions, the teacher calculates probability densities and energy levels for bound states in simple one dimensional potentials. 9.2.5f PS The teacher normalizes basic wave functions.
9.2.2 CK The teacher applies the Schroedinger Equation to simple systems in one dimension.	9.2.6a PS Using appropriate wave functions, the teacher calculates transmission and reflection coefficients for simple one dimensional potential barriers. 9.2.6b PS The teacher calculates probability densities, energy levels, and transitions for the Simple Harmonic Oscillator problem and applies these to molecular vibrations.
9.2.3 CK The teacher applies the time independent Schroedinger Equation to the hydrogen atom.	9.2.7a PS The teacher explains how separation of variables is used to split the general solution for the Coulomb potential into three parts, each with a quantum number: a radial function that indexes the energy level, an angular momentum function, and a magnetic moment. 9.2.7b PS The teacher uses normalized hydrogen functions to calculate probability densities, expectation values, and transition probabilities for the electric dipole. 9.2.7c PS The teacher uses the concepts of intrinsic spin, anti-symmetric waves functions, and Pauli Exclusion to explain anomalous Zeeman splitting in hydrogen spectra.
9.2.4 CK The teacher generalizes the quantum model of hydrogen to multi-particle systems, including larger atoms, molecules, and nuclei.	9.2.8a PS Based on the structure of hydrogen states, the Pauli Exclusion Principle, and spin-orbit interactions, the teacher explains key properties and ordering of elements in the Periodic Table.

	9.2.8b PS Based on key differences in properties between particles with integer and half-integer spins, the teacher calculates appropriate energy distributions, either Fermi-Dirac, Bose-Einstein, or Maxwell-Boltzmann, for systems of identical particles in thermal equilibrium and lists examples of systems where each type of distribution is appropriate. 9.2.8c PS The teacher explains properties of ionic, covalent, and metallic molecular bonds. 9.2.8d PS The teacher describes key phenomena resulting from the energy level structure in nuclei, including radioactive decay modes and calculations based on the concept of half-life; ionizing emissions and detector technology; nuclear reactions, induced activity, and the probabilistic concept of reaction cross section; fission, fusion, where they occur naturally, and their modern applications.

Standard 10: General Science, Engineering, & Technology: The physics teacher demonstrates an understanding of the cross curricular ties between physics, life science, earth science, engineering, and technology	
Function 1: The teacher of physics demonstrates an understanding of life science and how it applies to the physics content area.	
Content Knowledge	**Professional Skills**
10.1.1 CK The teacher is qualitatively able to apply the laws of conservation to energy flow through earth systems.	10.1.4a PS The teacher will be able to utilize the concept of conservation of energy and how it applies to organisms in their environments. 10.1.4b PS The teacher will be able to utilize the concept of conservation of energy and how it applies to ecosystems.
10.1.2 CK The teacher applies Newton's Laws to the field of biology through the use of biomechanics.	10.1.5a PS The teacher will be able to utilize concepts from Newtonian physics to explain the mechanics involved in biological systems. 10.1.5b PS The teacher will apply knowledge of mechanics principles to devices found within the life sciences.
10.1.3 CK The teacher applies the unifying principles of biology to the field of physics.	10.1.6a PS The teacher will demonstrate an understanding of how evolution is dependent upon physical constraints and must obey natural laws including conservation of energy and thermodynamics. 10.1.6b PS The teacher demonstrates understanding of basic genetics including DNA and RNA and how it can be used to alter genetics such as in crops. 10.1.6c PS The teacher demonstrates an understanding of the process of DNA replication and how this allows cells to reproduce.
Function 2: The teacher of physics understands and applies physics to the field of earth science and astronomy.	
Content Knowledge	**Professional Skills**

10.2.1 CK The teacher explains how principles of dynamics relate to earth system science.	10.2.3a PS The teacher will demonstrate understanding of the Earth's energy budget and relate this to conservation of energy. 10.2.3b PS The teacher will demonstrate how earth systems interact and apply this knowledge to situations involving interaction between the geosphere, biosphere, atmosphere, and hydrosphere. 10.2.3c PS The teacher will be able to demonstrate understanding of the atmospheric energy budget in terms of conservation of energy in a system. 10.2.3d PS The teacher will apply the basic concepts of fluid dynamics to atmospheric dynamics. 10.2.3e PS The teacher will be able to apply knowledge of fluid dynamics and conservation of energy within earth systems to explain ocean systems. 10.2.3f PS The teacher will demonstrate understanding of climate control factors and how this relates to ocean systems. 10.2.3g PS The teacher will apply law of motion to Earth dynamics and relate this in several ways through plate tectonics.
10.2.2 CK The teacher is able to qualitatively and quantitatively relate the field of physics to the world of astronomy.	10.2.4a PS The teacher will demonstrate an understanding of the different types of galaxies by comparing and contrasting. 10.2.4b PS The teacher will demonstrate understanding of star formation and solar evolution using the H-R diagram. 10.2.4c PS The teacher will apply the knowledge of the natural laws at work in the Milky Way to the other galaxies in our universe. 10.2.4d PS The teacher will apply knowledge of the universal forces to the galaxies in our universe. 10.2.4e PS The teacher is able to demonstrate understanding that dark matter in our universe is causing the rate of expansion of the universe to accelerate and may continue to expand forever. 10.2.4f PS The teacher is able to demonstrate an understanding of the evolution of technology in astronomy and its relationship to the formation of our current models of the solar system and universe.

	10.2.4g PS The teacher will describe how objects create distortions in space time and that the force of gravity is the motion of an object on distorted space time and how this relates to the big bang theory and the structure of the universe. 10.2.4h PS The teacher demonstrates an understanding of the use of observational and theoretical astrophysics to explain the physical properties, interactions and behavior of physics in the universe.
Function 3: The teacher of physics understands and can apply the principles of physics to engineering and technology.	
Content Knowledge	**Professional Skills**
10.3.1 CK Application of waves for information is applied to the field of physics and wave motion.	10.3.4a PS The teacher is able to demonstrate an understanding and show how to build an antenna for the use of coding and decoding information sent through waves. 10.3.4b PS The teacher is able to describe wave modulation through both frequency and amplitude changes and the benefits to encoding information using each method. 10.3.4c PS The teacher is able to explain the electromagnetic spectrum and the uses for each wave in society. 10.3.4d PS The teacher will demonstrate understanding of the use of signaling using electromagnetic waves. 10.3.4e PS The teacher is able to explain the use of fiber optics to transfer information using a coherent light source.
10.3.2 CK The teacher applies information on digital circuits to programming.	10.3.5a PS The teacher will demonstrate understanding of digital circuits through programming. 10.3.5b PS The teacher will demonstrate understanding of digital circuits by building circuits including an op-amp.
10.3.3 CK The teacher is able to explain how technology and engineering connect through all fields of physics and related sciences.	10.3.6a PS The teacher demonstrates and understanding of the use of technology in society and how it has influenced changes in the field of science. 10.3.6b PS The teacher applies the principles of physics to engineering design problems.