Physics II Science Standards

Science and Engineering Process Standards (SEPS)

The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Physics II Science Standards

Literacy in Science/Technical Subjects: Grades 11-12 (11-12 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and
	GRADES 11-12
	11-12.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 11-CCR independently and proficiently by the end of grade 12.
	11-12.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING) Extract and construct meaning from science and technical texts using a variety of comprehension skills
	GRADES 11-12
	11-12.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	11-12.LST.2.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
	11-12.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 11-12
	11-12.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	11-12.LST.3.2: Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
	11-12.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 11-12
	11-12.LST.4.1: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., *quantitative data, video, multimedia*) in order to address a question or solve a problem.
	11-12.LST.4.2: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
	11-12.LST.4.3: Synthesize information from a range of sources (e.g., *texts, experiments, simulations*) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

WRITING GENRES	LST.5: WRITING GENRES (WRITING) Write for different purposes and to specific audiences or people
	GRADES 11-12
	11-12.LST.5.1: Write arguments focused on discipline-specific content.
	11-12.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	LST.6: THE WRITING PROCESS (WRITING) Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others
	GRADES 11-12
	11-12.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	11-12.LST.6.2: Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

<table>
<tr><td rowspan="5">THE RESEARCH PROCESS</td><td>LST.7: THE RESEARCH PROCESS (WRITING)
Build knowledge about the research process and the topic under study by conducting short or more sustained research</td></tr>
<tr><td>GRADES 11-12</td></tr>
<tr><td>11-12.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</td></tr>
<tr><td>11-12.LST.7.2: Gather relevant information from multiple types of authoritative sources, using advanced searches effectively; annotate sources; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (e.g., APA or CSE).</td></tr>
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</table>

Physics II Science Standards

Content Standards

For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Physics II	
Standard 1: Energy and Momentum in Two Dimensions	**PII.1.1** For a system consisting of a single object with a net external force applied, qualitatively and quantitatively predict changes in its linear momentum using the impulse-momentum theorem and in its translational kinetic energy using the work-energy theorem.
	PII.1.2 For a system consisting of a two objects with no net external forces applied, qualitatively and quantitatively analyze a two dimensional interaction (i.e. collision or separation) to show that the total linear momentum of the system remains constant.
	PII.1.3 For a system consisting of two objects moving in two dimensions with no net external forces applied, apply the principles of conservation of linear momentum and of mechanical energy to quantitatively predict changes in the linear momentum, velocity, and kinetic energy after the interaction between the two objects.
	PII.1.4 Classify interactions between two objects moving in two dimensions as elastic, inelastic, and completely inelastic.

Standard 2: Temperature and Thermal Energy Transfer	**PII.2.1** Develop graphical and mathematical representations that describe the relationship among the temperature, thermal energy, and thermal energy transfer (i.e. heat) in the kinetic molecular theory and apply those representations to qualitatively and quantitatively describe how changing the temperature of a substance affects the motion of the molecules.
	PII.2.2 Describe the process of the transfer of thermal energy (i.e. heat) that occurs during the heating cycle of a substance from solid to gas and relate the changes in molecular motion to temperature changes that are observed.
	PII.2.3 Cite evidence from everyday life to describe the transfer of thermal energy by conduction, convection, and radiation.
	PII.2.4 Develop graphical and mathematical representations that describe the relationship among the volume, temperature, and number of molecules of an ideal gas in a closed system and the pressure exerted by the system and apply those representations to qualitatively and quantitatively describe how changing any of those variables affects the others.

	PII.2.5 Describe the slope of the graphical representation of pressure vs. the product of: the number of particles, temperature of the gas, and inverse of the volume of the gas in terms of the ideal gas constant.
	PII.2.6 Using PV graphs, qualitatively and quantitatively determine how changes in the pressure, volume, or temperature of an ideal gas allow the gas to do work and classify the work as either done on or done by the gas.

Standard 3: Fluids	**PII.3.1** For a static, incompressible fluid, develop and apply graphical and mathematical representations that describe the relationship between the density and the pressure exerted at various positions in the fluid, and apply those representations to qualitatively and quantitatively describe how changing the depth or density affects the pressure.
	PII.3.2 Qualitatively and quantitatively determine how the density of fluid or volume of fluid displaced is related to the force due to buoyancy acting on either a floating or submerged object as described by Archimedes' principle of buoyancy.
	PII.3.3 Develop and apply the principle of constant volume flow rate to determine the relationship between cross-sectional area of a pipe and the velocity of an incompressible fluid flowing through a pipe.
	PII.3.4 Develop and apply Bernoulli's principle and continuity equations to predict changes in the speed and pressure of a moving incompressible fluid.
	PII.3.5 Describe how a change in the pressure of as static fluid in an enclosed container is transmitted equally in all directions (Pascal's Principle) and apply Pascal's Principle to determine the mechanical advantage of a hydraulic system.

Standard 4: Electricity	**PII.4.1** Describe the methods of charging an object (i.e. contact, induction, and polarization) and apply the principle of conservation of charge to determine the charges on each object after charge is transferred between two objects by contact.
	PII.4.2 For a single isolated charge, develop and apply graphical and mathematical representations that describe the relationship between the amount of charge, the distance from the charge and the strength of the electric field created by the charge and apply those representations to qualitatively and quantitatively describe how changing either the amount of charge or distance from the charge affects the strength of the electric field.
	PII.4.3 Using Coulomb's law, pictorially and mathematically describe the force on a stationary charge due to other stationary charges. Understand that these forces are equal and opposite as described by Newton's third law and compare and contrast the strength of this force to the force due to gravity.

	PII.4.4 For a single isolated charge, develop graphical and mathematical representations that describe the relationship between the amount of charge, the distance from the charge and the electric potential created by the charge and apply those representations to qualitatively and quantitatively describe how changing either the amount of charge or distance from the charge affects the electric potential.
	PII.4.5 Map electric fields and equipotential lines, showing the electric field lines are perpendicular to the equipotential lines, and draw conclusions about the motion of a charged particle either between or along equipotential lines due the electric field.
	PII.4.6 Distinguish between electric potential energy and electric potential (i.e. voltage).
	PII.4.7 Apply conservation of energy to determine changes in the electric potential energy, translational kinetic energy, and speed of a single charged object (i.e. a point particle) placed in a uniform electric field.

Standard 5: Simple and Complex Circuits	**PII.5.1** Relate the idea of electric potential energy to electric potential (i.e. voltage) in the context of electric circuits.
	PII.5.2 Develop graphical and mathematical representations that describe the relationship between the between the amount of current passing through an ohmic device and the amount of voltage (i.e. EMF) applied across the device according to Ohm's Law. Apply those representations to qualitatively and quantitatively describe how changing the current affects the voltage and vice versa for an ohmic device of known resistance.
	PII.5.3 Describe the slope of the graphical representation of current vs. voltage or voltage vs. current in terms of the resistance of the device.
	PII.5.4 Define and describe a device as ohmic or non-ohmic based on the relationship between the current passing through the device and the voltage across the device based on the shape of the curve of a current vs. voltage or voltage vs. current graphical representation.
	PII.5.5 Explain and analyze simple arrangements of electrical components in series and parallel DC circuits in terms of current, resistance, voltage and power. Use Ohm's and Kirchhoff's laws to analyze DC circuits.

Standard 6: Magnetism	
	PII.6.1 Describe the magnetic properties of ferromagnetic, paramagnetic, and diamagnetic materials on a macroscopic scale and atomic scale.
	PII.6.2 Develop and apply a mathematical representation that describes the relationship between the magnetic field created by a long straight wire carrying an electric current, the magnitude of the current, and the distance to the wire.
	PII.6.3 Describe the motion of a charged or uncharged particle through a uniform magnetic field.
	PII.6.4 Determine the magnitude of the magnetic force acting on a charged particle moving through a uniform magnetic field and apply the right hand rule to determine the direction of either the magnetic force or the magnetic field.
	PII.6.5 Describe the practical uses of magnetism in motors, electronic devices, mass spectroscopy, MRIs, and other applications.

Standard 7: Electromagnetic Induction	
	PII.7.1 Given the magnitude and direction of a uniform magnetic field, calculate the flux through a specified area in terms of the field magnitude and the size and orientation of the area with respect to the field.
	PII.7.2 Develop graphical and mathematical representations that describe the relationship between the rate of change of magnetic flux and the amount of voltage induced in a simple loop circuit according to Faraday's Law of Induction and apply those representations to qualitatively and quantitatively describe how changing the voltage across the device affects the current through the device.
	PII.7.3 Apply Ohm's Law, Faraday's Law, and Lenz's Law to determine the amount and direction of current induced by a changing magnetic flux in a loop of wire or simple loop circuit.

Physics II Science Standards

Standard 8: Geometric Optics	**PII.8.1** Develop graphical, mathematical, and pictorial representations (e.g. ray diagrams) that describe the relationships between the focal length, the image distance and the object distance for planar, converging, and diverging mirrors and apply those representations to qualitatively and quantitatively describe how changing the object distance affects the image distance.
	PII.8.2 Develop graphical, mathematical, and pictorial representations (e.g. ray diagrams) that describe the relationship between the angles of incidence and refraction of monochromatic light passed between two different media and apply those representations to qualitatively and quantitatively describe how changing the angle of incidence affects the angle of refraction.
	PII.8.3 Develop graphical, mathematical, and pictorial representations (e.g. ray diagrams) that describe the relationships between the focal length, the image distance, and the object distance for both converging and diverging lenses and apply those representations to qualitatively and quantitatively describe how changing the object distance affects the image distance.
	PII.8.4 Describe an image as real or virtual for both a curved mirror and lens system based on the position of the image relative to the optical device.

Standard 9: Particle and Wave Nature of Light	**PII.9.1** Develop the relationship among frequency, wavelength, and energy for electromagnetic waves across the entire spectrum.
	PII.9.2 Explain how electromagnetic waves interact with matter both as particles (i.e. photons) and as waves and be able to apply the most appropriate model to any particular scenario.
	PII.9.3 Develop graphical and mathematical representations that describe the relationship between the frequency of a photon and the kinetic energy of an electron emitted through the photoelectric effect and apply those representations to qualitatively and quantitatively describe how changing the frequency or intensity of light affect the current produced in the photoelectric effect.
	PII.9.4 Describe the slope of the graphical representation of the kinetic energy of a photoelectron vs. frequency in terms of Planck’s constant.
	PII.9.5 Develop graphical and mathematical representations that describe the relationship between the wavelength of monochromatic light, spacing between slits, distance to screen, and interference pattern produced for a double-slit scenario and apply those representations to qualitatively and quantitatively describe how changing any of the independent variables affects the position of the bright fringes.

	PII.9.6 Develop graphical and mathematical representations that describe the relationship between the angle between two polarizing filters and the intensity of light passed through the filters from an unpolarized light source and apply those representations to qualitatively and quantitatively describe how changing the angle between polarizing filters affects the intensity of light passing through both filters.

Standard 10: Modern Physics	**PII.10.1** Describe the Standard Model and explain the composition and decay of subatomic particles using the Standard Model and Feynman diagrams.
	PII.10.2 Explain the stability of the nucleus considering the electromagnetic repulsion in the nucleus and how forces govern binding energy and radioactive decay for different elements.
	PII.10.3 Qualitatively compare and contrast how particle interactions, fission, and fusion can convert matter into energy and energy into matter, and calculate the relative amounts of matter and energy in such processes.
	PII.10.4 Apply the conservation of mass, conservation of charge, and conservation of linear momentum principles to describe the results of a radioactive particle undergoing either alpha or beta decay.
	PII.10.5 Know and describe how a particle accelerator functions and how current high energy particle physics experiments are being used to develop the Standard Model.

Physics I Science Standards

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	11-12.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards
For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Physics I	
Standard 1: Constant Velocity	**PI.1.1** Develop graphical, mathematical, and pictorial representations (e.g. a motion map) that describe the relationship between the clock reading (time) and position of an object moving at a uniform rate and apply those representations to qualitatively and quantitatively describe the motion of an object.
	PI.1.2 Describe the slope of the graphical representation of position vs. clock reading (time) in terms of the velocity of the object.
	PI.1.3 Rank the velocities of objects in a system based on the slope of a position vs. clock reading (time) graphical representation. Recognize that the magnitude of the slope representing a negative velocity can be greater than the magnitude of the slope representing a positive velocity.

	PI.1.4 Describe the differences between the terms "distance," "displacement," "speed," "velocity," "average speed," and "average velocity" and be able to calculate any of those values given an object moving at a single constant velocity or with different constant velocities over a given time interval.

Standard 2: Constant Acceleration	**PI.2.1** Develop graphical, mathematical, and pictorial representations (e.g. a motion map) that describe the relationship between the clock reading (time) and velocity of an object moving at a uniformly changing rate and apply those representations to qualitatively and quantitatively describe the motion of an object.
	PI.2.2 Describe the slope of the graphical representation of velocity vs. clock reading (time) in terms of the acceleration of the object.
	PI.2.3 Rank the accelerations of objects in a system based on the slope of a velocity vs. clock reading (time) graphical representation. Recognize that the magnitude of the slope representing a negative acceleration can be greater than the magnitude of the slope representing a positive acceleration.
	PI.2.4 Given a graphical representation of the position, velocity, or acceleration vs. clock reading (time), be able to identify or sketch the shape of the other two graphs.
	PI.2.5 Qualitatively and quantitatively apply the models of constant velocity and constant acceleration to determine the position or velocity of an object moving in free fall near the surface of the Earth.

Standards 3: Forces	**PI.3.1** Understand Newton's first law of motion and describe the motion of an object in the absence of a net external force according to Newton's first law.
	PI.3.2 Develop graphical and mathematical representations that describe the relationship among the inertial mass of an object, the total force applied, and the acceleration of an object in one dimension where one or more forces is applied to the object and apply those representations to qualitatively and quantitatively describe how a net external force changes the motion of an object.
	PI.3.3 Construct force diagrams using appropriately labeled vectors with magnitude, direction, and units to qualitatively and quantitatively analyze a scenario and make claims (i.e. develop arguments, justify assertions) about forces exerted on an object by other objects for different types of forces or components of forces.
	PI.3.4 Understand Newton's third law of motion and describe the interaction of two objects using Newton's third law and the representation of action-reaction pairs of forces.

	PI.3.5 Develop graphical and mathematical representations that describe the relationship between the gravitational mass of an object and the force due to gravity and apply those representations to qualitatively and quantitatively describe how changing the gravitational mass will affect the force due to gravity acting on the object.
	PI.3.6 Describe the slope of the force due to gravity vs. gravitational mass graphical representation in terms of gravitational field.
	PI.3.7 Explain that the equivalence of the inertial and gravitational masses leads to the observation that acceleration in free fall is independent of an object's mass.

Standard 4: Energy	**PI.4.1** Evaluate the translational kinetic, gravitational potential, and elastic potential energies in simple situations using the mathematical definitions of these quantities and mathematically relate the initial and final values of the translational kinetic, gravitational potential, and elastic potential energies in the absence of a net external force.
	PI.4.2 Identify the forms of energy present in a scenario and recognize that the potential energy associated with a system of objects and is not stored in the object itself.
	PI.4.3 Conceptually define "work" as the process of transferring of energy into or out of a system when an object is moved under the application of an external force and operationally define "work" as the area under a force vs. change in position curve.
	PI.4.4 For a force exerted in one or two dimensions, mathematically determine the amount of work done on a system by an unbalanced force over a change in position in one dimension.
	PI.4.5 Understand and apply the principle of conservation of energy to determine the total mechanical energy stored in a closed system and mathematically show that the total mechanical energy of the system remains constant as long as no dissipative (i.e. non-conservative) forces are present.
	PI.4.6 Develop and apply pictorial, mathematical or graphical representations to qualitatively and quantitatively predict changes in the mechanical energy (e.g. translational kinetic, gravitational, or elastic potential) of a system due to changes in position or speed of objects or non-conservative interactions within the system.

Physics I Science Standards

Standard	
Standard 5: Linear Momentum In One Dimension	**PI.5.1** For an object moving at constant rate, define linear momentum as the product of an object's mass and its velocity and be able to quantitatively determine the linear momentum of a single object.
	PI.5.2 Operationally define "impulse" as the area under a force vs. change in clock reading (time) curve and be able to determine the change in linear momentum of a system acted on by an external force. Predict the change in linear momentum of an object from the average force exerted on the object and time interval during which the force is exerted.
	PI.5.3 Demonstrate that when two objects interact through a collision or separation that both the force experienced by each object and change in linear momentum of each object are equal and opposite, and as the mass of an object increases, the change in velocity of that object decreases.
	PI.5.4 Determine the individual and total linear momentum for a two-body system before and after an interaction (e.g. collision or separation) between the two objects and show that the total linear momentum of the system remains constant when no external force is applied consistent with Newton's third law.
	PI.5.5 Classify an interaction (e.g. collision or separation) between two objects as elastic or inelastic based on the change in linear kinetic energy of the system.
	PI.5.6 Mathematically determine the center of mass of a system consisting of two or more masses. Given a system with no external forces applied, show that the linear momentum of the center of mass remains constant during any interaction between the masses.

Standard	
Standard 6: Simple Harmonic Oscillating Systems	**PI.6.1** Develop graphical and mathematical representations that describe the relationship between the amount of stretch of a spring and the restoring force and apply those representations to qualitatively and quantitatively describe how changing the stretch or compression will affect the restoring force and vice versa, specifically for an ideal spring.
	PI.6.2 Describe the slope of the graphical representation of restoring force vs. change in length of an elastic material in terms of the elastic constant of the material, specifically for an ideal spring.
	PI.6.3 Develop graphical and mathematical representations which describe the relationship between the mass, elastic constant, and period of a simple horizontal mass-spring system and apply those representations to qualitatively and quantitatively describe how changing the mass or elastic constant will affect the period of the system for an ideal spring.

	PI.6.4 Develop graphical and mathematical representations which describe the relationship between the strength of gravity, length of string, and period of a simple mass-string (i.e. pendulum) system apply the those representations to qualitatively and quantitatively describe how changing the length of string or strength of gravity will affect the period of the system in the limit of small amplitudes.
	PI.6.5 Explain the limit in which the amplitude does not affect the period of a simple mass-spring (i.e. permanent deformation) or mass-string (i.e. pendulum, small angles) harmonic oscillating system.

Standard 7: Mechanical Waves and Sound	**PI.7.1** Differentiate between transverse and longitudinal modes of oscillation for a mechanical wave traveling in one dimension.
	PI.7.2 Understand that a mechanical wave requires a medium to transfer energy, unlike an electromagnetic wave, and that only the energy is transferred by the mechanical wave, not the mass of the medium.
	PI.7.3 Develop graphical and mathematical representations that describe the relationship between the frequency of a mechanical wave and the wavelength of the wave and apply those representations to qualitatively and quantitatively describe how changing the frequency of a mechanical wave affects the wavelength and vice versa.
	PI.7.4 Describe the slope of the graphical representation of wavelength vs. the inverse of the frequency in terms of the speed of the mechanical wave.
	PI.7.5 Apply the mechanical wave model to sound waves and qualitatively and quantitatively determine how the relative motion of a source and observer affects the frequency of a wave as described by the Doppler Effect.
	PI.7.6 Qualitatively and quantitatively apply the principle of superposition to describe the interaction of two mechanical waves or pulses.
	PI.7.7 Qualitatively describe the phenomena of both resonance frequencies and beat frequencies that arise from the interference of sound waves of slightly different frequency and define the beat frequency as the difference between the frequencies of two individual sound wave sources.

Standard 8: Simple Circuit Analysis	
	PI.8.1 Develop graphical, mathematical, and pictorial representations that describe the relationship between length, cross-sectional area, and resistivity of an ohmic device and apply those representations to qualitatively and quantitatively describe how changing the composition, size, or shape of the device affect the resistance.
	PI.8.2 Describe the slope of the graphical representation of resistance vs. the ratio of length to cross-sectional area in terms of the resistivity of the material.
	PI.8.3 Develop graphical and mathematical representations that describe the relationship between the amount of current passing through an ohmic device and the amount of voltage (i.e. EMF) applied across the device according to Ohm's Law and apply those representations to qualitatively and quantitatively describe how changing the current affects the voltage and vice versa.
	PI.8.4 Describe the slope of the graphical representation of current vs. voltage or voltage vs. current in terms of the resistance of the device.
	PI.8.5 Qualitatively and quantitatively describe how changing the voltage or resistance of a simple series (i.e. loop) circuit affects the voltage, current, and power measurements of individual resistive devices and for the entire circuit.
	PI.8.6 Qualitatively and quantitatively describe how changing the voltage or resistance of a simple parallel (i.e. ladder) circuit affects the voltage, current, and power measurements of individual resistive devices and for the entire circuit.
	PI.8.7 Apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($\sum \Delta V = 0$) in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches.
	PI.8.8 Apply conservation of electric charge (i.e. Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed.
	PI.8.9 Use a description or schematic diagram of an electrical circuit to calculate unknown values of current, voltage, or resistance in various components or branches of the circuit according to Ohm's Law, Kirchhoff's junction rule, and Kirchhoff's loop rule.

Integrated Chemistry & Physics Science Standards

Science and Engineering Process Standards (SEPS)

The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 9-10 (9-10 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences**
	GRADES 9-10
	9-10.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 9-10 independently and proficiently by the end of grade 10.
	9-10.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 9-10
	9-10.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
	9-10.LST.2.2: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate, objective summary of the text.
	9-10.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 9-10
	9-10.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
	9-10.LST.3.2: Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
	9-10.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 9-10
	9-10.LST.4.1: Translate quantitative or technical information expressed in words in a text into visual form (e.g., *a table or chart*) and translate information expressed visually or mathematically (e.g., *in an equation*) into words.
	9-10.LST.4.2: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
	9-10.LST.4.3: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

WRITING GENRES	LST.5: WRITING GENRES (WRITING) Write for different purposes and to specific audiences or people
	GRADES 9-10
	9-10.LST.5.1: Write arguments focused on discipline-specific content.
	9-10.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	LST.6: THE WRITING PROCESS (WRITING) Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others
	GRADES 9-10
	9-10.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	9-10.LST.6.2: Use technology to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 9-10
	9-10.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	9-10.LST.7.2: Gather relevant information from multiple authoritative sources, using advanced searches effectively; annotate sources; assess the usefulness of each source in answering the research question; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	9-10.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards
For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Integrated Chemistry and Physics	
Standards 1: Constant Velocity	**ICP.1.1** Develop graphical, mathematical, and pictorial representations (such as a motion map) that describe the relationship between the clock reading (time) and position of an object moving at a constant velocity and apply those representations to qualitatively and quantitatively describe the motion of an object.
	ICP.1.2 Describe the slope of the graphical representation of position vs. clock reading (time) in terms of the velocity of the object moving in one dimension.
	ICP.1.3 Distinguish between the terms “distance” and “displacement,” and determine the value of either given a graphical or mathematical representation of position vs. clock reading (time).
	ICP.1.4 Distinguish between the terms “speed,” “velocity,” “average speed,” and “average velocity” and determine the value of any of these measurements given either a graphical or mathematical representation.

Standard 2: Uniform Acceleration	**ICP.2.1** Develop graphical, mathematical, and pictorial representations (such as a motion map) that describe the relationship between the clock reading (time) and velocity of an object moving at a constant acceleration and apply those representations to qualitatively and quantitatively describe the motion of an object in terms of its change in position or velocity.
	ICP.2.2 Describe the differences between average velocity and instantaneous velocity and be able to determine either quantity given a graph of position vs clock reading (time).
	ICP.2.3 For an object thrown vertically, qualitatively describe or quantitatively determine the velocity and acceleration at various positions during its motion.

Standard 3: Newton's Laws of Motion (One Dimension)	**ICP.3.1** Develop pictorial and graphical representations which show that a single external applied force changes the velocity of an object, and that when no force acts, the velocity of an object remains constant.
	ICP.3.2 Construct force diagrams and combine forces to determine the equivalent single net force acting on the object when more than one force is acting on the object.
	ICP.3.3 Distinguish between forces acting on a body and forces exerted by the body. Categorize forces as contact forces, friction, or action at a distance (field) forces.
	ICP.3.4 Develop pictorial and graphical representations which show that a non-zero net force on an object results in an acceleration of the object and that the acceleration of an object of constant mass is proportional to the total force acting on it, and inversely proportional to its mass for a constant applied total force.
	ICP.3.5 Qualitatively describe and quantitatively determine the magnitude and direction of forces from observing the motion of an object of known mass.
	ICP.3.6 Qualitatively describe and quantitatively determine the acceleration of an object of known mass from observing the forces acting on that object.
	ICP.3.7 Develop pictorial and graphical representations which show that when two objects interact, the forces occur in pairs according to Newton's third law and that the change in motion of each object is dependent on the mass of each object.

Standard 4: Energy	**ICP.4.1** Define energy as a quantity that can be represented as being within a system that is distinct from the remainder of the universe and is measured in Joules.
	ICP.4.2 Identify forms of energy present in a system (kinetic, gravitational, elastic, etc.), and pictorially represent the distribution of energies, such as using pie or bar charts.
	ICP.4.3 Understand and explain that the total energy in a closed system is conserved.
	ICP.4.4 Qualitatively and quantitatively analyze various scenarios to describe how energy may be transferred into or out of a system by doing work through an external force or adding or removing heat.

Standard 5: Particle Theory of Matter	**ICP.5.1** Develop pictorial representations which show that matter is made of particles.
	ICP.5.2 Describe the assumptions used to develop the kinetic theory of gasses.
	ICP.5.3 At the particle level, describe the relationship between temperature and the average kinetic energy of particles in the system and describe how a thermometer measures the temperature of a system.
	ICP.5.4 Distinguish "temperature" from "thermal energy," compare and contrast the Fahrenheit, Celsius, and Kelvin temperature scales, and convert temperatures between them.
	ICP.5.5 Evaluate graphical or pictorial representations that describe the relationship among the volume, temperature, and number of molecules and the pressure exerted by the system to qualitatively and quantitatively describe how changing any of those variables affects the others.
	ICP.5.6 Describe and demonstrate how the kinetic theory can be extended to describe the properties of liquids and solids by introducing attractive forces between the particles.
	ICP.5.7 Analyze a heating / cooling curve to describe how adding or removing thermal energy from a system changes the temperature or state of an object and be able to identify the melting and freezing temperatures of the system.
	ICP.5.8 Collect and use experimental data to determine the number of items in a sample without actually counting them and qualitatively relate this to Avogadro's hypothesis.

Standard 6: Describing Substances	**ICP.6.1** Distinguish between elements, mixtures, and compounds based on their composition and bonds and be able to construct or sketch particle models to represent them.
	ICP.6.2 Develop graphical and mathematical representations to show that mixtures can be made in any proportion and separated based on the properties of the components of the mixture and apply those representations to quantitatively determine the ratio of components.
	ICP.6.3 Cite the evidence that supports the idea that some pure substances are combined of elements in a definite ratio, as for example seen in electrolysis of water.
	ICP.6.4 Given the periodic table, determine the atomic mass, atomic number, and charges for any element.
	ICP.6.5 Given a periodic table, understand and describe the significance of column location for the elements by calculation of molar ratios of known compounds.
	ICP.6.6 Develop graphical and mathematical representations that describe the relationship between volume and mass of an object, describe the slope in terms of the object's density, and apply those representations to qualitatively and quantitatively determine the mass or volume of any object.
	ICP.6.7 Describe how both density and molecular structure are applicable in distinguishing the properties of gases from those of liquids and solids.

Standard 7: Representing Chemical Change	**ICP.7.1** Pictorially or mathematically represent chemical changes using particle diagrams and chemical equations.
	ICP.7.2 Demonstrate the Law of Conservation of Matter in terms of atoms and mass of substances by balancing equations.
	ICP.7.3 Differentiate the basic types of reactions, for example: synthesis, decomposition, combustion, single replacement, and double replacement.
	ICP.7.4 Using balanced equations and stoichiometric calculations, demonstrate the principle of Conservation of Matter in terms of atoms and mass.

Standard 8: Electricity and Magnetism	**ICP.8.1** Describe electrical current in terms of the motion of electrons within a device and relate the rate of motion of the electrons to the amount of current measured.
	ICP.8.2 Describe the relationship among voltage, current, and resistance for an electrical system consisting of a single voltage source and a single device.
	ICP.8.3 Describe on a macroscopic scale how any distribution of magnetic materials (e.g. iron filings, ferrofluid, etc.) aligns with the magnetic field created by a simple magnet.

Standard 9: Waves	**ICP.9.1** Develop qualitative particle models of mechanical waves and explain the relationship of the particles and their interactions in transverse and longitudinal waves, as well as, how waves appear in nature as in water waves and tsunamis, ground waves in earth quakes, and sound waves.
	ICP.9.2 Develop and apply a simple mathematical model regarding the relationship among frequency, wavelength, and speed of waves in a medium as well.
	ICP.9.3 Qualitatively describe the reflection and transmission of a mechanical wave at either a fixed or free boundary or interface.
	ICP.9.4 Describe how interacting waves produce different phenomena than singular waves in a medium (e.g. periodic changes in volume of sound or resonance).
	ICP.9.5 Describe and provide examples of how modern technologies use mechanical or electromagnetic waves and their interactions to transmit information.

Standard 10: Nuclear Energy	**ICP.10.1** Describe and compare/contrast the atomic models suggested by Rutherford and Bohr.
	ICP.10.2 Describe the model of the atomic nucleus and explain how the nucleus stays together in spite of the repulsion between protons.
	ICP.10.3 Develop and apply simple qualitative models or sketches of the atomic nucleus that illustrate nuclear structures before and after undergoing fusion, fission, or radioactive decay.
	ICP.10.4 Distinguish between fusion, fission, and radioactivity and qualitatively compare the amount of energy released in these processes.
	ICP.10.5 Explain the potential applications and possible consequences as the result of nuclear processes such as the generation of energy at nuclear power plants, including the potential damage that radioactivity can cause to biological tissues.

Environmental Science Standards

Science and Engineering Process Standards (SEPS)
The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 11-12 (11-12 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and**
	GRADES 11-12
	11-12.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 11-CCR independently and proficiently by the end of grade 12.
	11-12.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 11-12
	11-12.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	11-12.LST.2.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
	11-12.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 11-12
	11-12.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	11-12.LST.3.2: Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
	11-12.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 11-12
	11-12.LST.4.1: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., *quantitative data, video, multimedia*) in order to address a question or solve a problem.
	11-12.LST.4.2: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
	11-12.LST.4.3: Synthesize information from a range of sources (e.g., *texts, experiments, simulations*) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

WRITING GENRES	LST.5: WRITING GENRES (WRITING) Write for different purposes and to specific audiences or people
	GRADES 11-12
	11-12.LST.5.1: Write arguments focused on discipline-specific content.
	11-12.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	LST.6: THE WRITING PROCESS (WRITING) Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others
	GRADES 11-12
	11-12.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	11-12.LST.6.2: Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 11-12
	11-12.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	11-12.LST.7.2: Gather relevant information from multiple types of authoritative sources, using advanced searches effectively; annotate sources; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (e.g., *APA or CSE*).
	11-12.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards
For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Environmental Science	
Standard 1: Environmental Systems	**Env.1.1** Understand and explain that ecosystems have cyclic fluctuations, such as seasonal changes or changes in population, as a result of migration, birth, and mortality.
	Env.1.2 Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.
	Env.1.3 Recognize and describe the difference between systems in equilibrium and systems in disequilibrium. Describe how steady state is achieved through negative and positive feedback loops.

	Env.1.4 Diagram the cycling of carbon, nitrogen, phosphorus, and water and describe the human impacts on each.
	Env.1.5 Identify and measure biological, chemical, and physical (abiotic and biotic) factors within an ecosystem.
	Env.1.6 Describe the difference between weather and climate. Locate, identify, and describe the major Earth biomes. Explain how biomes are determined by climate (temperature and precipitation patterns) that support specific kinds of plants.
	Env.1.7 Identify tools and technologies used to adapt and alter environments and natural resources in order to meet human physical and cultural needs.
	Env.1.8 Explain the factors that influence weather and climate, the action of gravitational forces, and the rotation of the Earth.
	Env.1.9 Describe how weather can be influenced by global climatic patterns, such as El Niño and La Niña.

Standard 2: Flow of Matter and Energy	**Env.2.1** Describe how matter cycles through sources and sinks and how energy is transferred. Explain how matter and energy move between and within components of an environmental system.
	Env.2.2 Identify the different forms of energy and understand that energy may be converted from one form to another, but cannot be created or destroyed.
	Env.2.3 Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, nutrients and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms.
	Env.2.4 Recognize and describe the different sources of energy, including fossil fuels, nuclear, and alternative sources of energy provided by water, wind, geothermal, biomass/biofuels, and the sun.
	Env.2.5 Give examples of the various forms and uses of fossil fuels and nuclear energy in our society.
	Env.2.6 Understand and describe how layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of matter such as carbon dioxide and other air pollutants.

	Env.2.7 Differentiate between renewable and nonrenewable resources, and compare and contrast the pros and cons of using nonrenewable resources.
	Env.2.8 Cite examples of how all fuels, renewable and nonrenewable, have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the industrially developing nations. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.
	Env.2.9 Describe how decisions to slow the depletion of energy sources through efficient technologies can be made at many levels, from personal to national, and these technologies involve trade-offs of economic costs and social values.
	Env.2.10 Understand and describe how nuclear reactions release energy without the combustion products of burning fuels, but that the radioactivity of fuels and by-products poses other risks which may last for thousands of years. Understand and assess the uses of nuclear fission and fusion, including the implications for society.
	Env.2.11 Recognize and describe the role of natural resources in providing the raw materials for an industrial society.

Standard 3: Natural Disasters	**Env.3.1** Identify and describe geomorphic processes controlled by tectonics (i.e. volcanic activity, uplift, and shaping of landforms).
	Env.3.2 Identify and describe tornado formation with the use of a weather map.
	Env.3.3 Read and describe a weather map in terms of pressure systems, fronts, and changing weather patterns.
	Env.3.4 Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.

Environmental Science Standards

Standard 4: Environmental Policy	**Env.4.1** Explain environmental policies/organizations (Clean Water Act, Clean Air Act, Endangered Species Act, Species Survival Plan, Resource Conservation and Recovery Act, Department of Energy, and the World Health Organization) and identify their impact.
	Env.4.2 Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment.

Standard 5: Biodiversity	**Env.5.1** Explain how variation within a species increases the chances of survival of the species under changing environmental conditions.
	Env.5.2 Explain how the great diversity of species increases the chance that at least some living organisms will survive in the event of major global changes.
	Env.5.3 Explain genetic engineering and identify implications on the environment and society.
	Env.5.4 Describe, provide examples, and contrast GMO products, organic products, and conventional products. Describe and explain the environmental concerns associated with GMOs.
	Env.5.5 Identify the indirect and direct threats to biodiversity (e.g. habitat loss and destruction, invasion by exotic species, commercial over fishing and hunting, pollution, climate change, and bioaccumulation and biomagnification of toxins).
	Env.5.6 Identify and explain the three levels of biodiversity: genetic, species, and ecosystem.

Standard 6: Population	**Env.6.1** Demonstrate, calculate, and explain how factors such as birth rate, death rate, and migration rate determine growth rates of populations.
	Env.6.2 Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental (resource availability) factors.
	Env.6.3 Describe and give examples about how the decisions of one generation both provide and limit the range of possibilities open to the next generation.
	Env.6.4 Explain how the carrying capacity of an ecosystem may change as availability of resources changes.

Environmental Science Standards

Standard	
Standard 7: Pollution	**Env.7.1** Identify evidence, consequences, and prevention for climate change produced by anthropogenic sources.
	Env.7.2 Differentiate between natural pollution and pollution caused by humans.
	Env.7.3 Compare and contrast the effects of environmental stressors (i.e. herbicides, pesticides) on plants and animals. Give examples of secondary effects on other environmental components.
	Env.7.4 Explain what common household toxins are, what to do in an emergency, and how to properly dispose.
	Env.7.5 Identify and describe the major air pollutants and their sources and impacts on the environment and human health.
	Env.7.6 Understand and explain how the burning of fossil fuels releases energy, waste heat, and matter (air pollutants).
	Env.7.7 Describe and explain the product life cycle and waste stream and its implications to waste management. Explain the difference between reduce, reuse, and recycle.

Standard	
Standard 8: Natural and Anthropogenic Resource Cycles	**Env.8.1** Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world, and explain how natural resources influence relationships among nations.
	Env.8.2 Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.
	Env.8.3 Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter.
	Env.8.4 Describe how agricultural technology requires trade-offs between increased production and environmental harm and between efficient production and social values.
	Env.8.5 Describe and examine how water is controlled in developed and undeveloped nations.
	Env.8.6 Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources.

	Env.8.7 Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost. Also understand that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical.

Science and Engineering Process Standards (SEPS)

The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 9-10 (9-10 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences**
	GRADES 9-10
	9-10.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 9-10 independently and proficiently by the end of grade 10.
	9-10.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 9-10
	9-10.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
	9-10.LST.2.2: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate, objective summary of the text.
	9-10.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 9-10
	9-10.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
	9-10.LST.3.2: Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
	9-10.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 9-10
	9-10.LST.4.1: Translate quantitative or technical information expressed in words in a text into visual form (e.g., *a table or chart*) and translate information expressed visually or mathematically (e.g., *in an equation*) into words.
	9-10.LST.4.2: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
	9-10.LST.4.3: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

WRITING GENRES	**LST.5: WRITING GENRES (WRITING)** **Write for different purposes and to specific audiences or people**
	GRADES 9-10
	9-10.LST.5.1: Write arguments focused on discipline-specific content.
	9-10.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	**LST.6: THE WRITING PROCESS (WRITING)** **Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others**
	GRADES 9-10
	9-10.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	9-10.LST.6.2: Use technology to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 9-10
	9-10.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	9-10.LST.7.2: Gather relevant information from multiple authoritative sources, using advanced searches effectively; annotate sources; assess the usefulness of each source in answering the research question; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	9-10.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards

For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Earth and Space Science	
Standard 1: The Universe	**ES.1.1** Construct an explanation detailing how space can be studied by observing all frequencies of the electromagnetic radiation with differentiated telescopes and observational tools.
	ES.1.2 Describe the expanding universe theory, also known as the "Big Bang Theory," based on observed astronomical evidence including: The Doppler Effect, red shift, Hubble's Law, and the cosmic microwave background.
	ES.1.3 Create a diagram, flowchart, or written explanation that details the cooling of energy into protons and early elements, and early elements into superstars and galaxies. Explain the role of gravitational attraction in the formation of stars and galaxies from clouds of these early elements.

	ES.1.4 Differentiate between the life cycles of stars of different masses found on the Hertzsprung-Russell Diagram. Differentiate between low, medium (including our sun), and high mass stars by what elements can be produced, and therefore whether or not they can achieve red giant phase or go supernova.
	ES.1.5 Illustrate the hierarchical relationship and scales of stars, planetary systems including multiple-star systems, star clusters, galaxies, and galactic groups in the universe.

Standard 2: The Solar System	**ES.2.1** Construct a flowchart with diagrams and descriptions outlining the nebular theory of solar system formation. Include the formation of one or more stars, planetesimals, protoplanets, Jovian and terrestrial planets, and other objects including satellites and small bodies.
	ES.2.2 Describe the characteristics of the various kinds of objects in the solar system including planets, satellites, comets, asteroids, and protoplanets. Recognize that planets have been identified orbiting stars other than the sun, or exist outside of solar systems orbiting no sun at all. Describe the organization of our solar system including terrestrial and Jovian planets, asteroid belts, and the Oort Cloud.
	ES.2.3 Develop a model illustrating the layers and life span of the sun. Explain how nuclear fusion in the core produces elements and energy, which are both retained through convection and released to space, including Earth, through radiation. Additionally, elements heavier than iron cannot form in stars, and form only as a result of supernovae.
	ES.2.4 Use mathematical and/or computational representations to demonstrate the motions of the various kinds of objects in our solar system including planets, satellites, comets, and asteroids. Explain that Kepler's Laws determine the orbits of those objects and know that Kepler's Laws are a direct consequence of Newton's Law of Universal Gravitation together with his laws of motion.
	ES.2.5 Explain how scientific theory changes over time with the introduction of new information and observational data. Use works from ancient Greeks such as Ptolemy, and other astronomers including Copernicus, Brahe, Kepler, and Galileo to demonstrate the effect of observational data and scientific discussion on our understanding of the mechanics and motion of our solar system.

Standard 3: Earth Cycles and Systems	**ES.3.1** Create flowcharts that show the exchange of carbon and oxygen between the lithosphere, hydrosphere, biosphere, and atmosphere, including carbon dioxide and methane. Explain how human activities such as farming and industry, temperature change in oceans, and natural processes such as volcanic eruptions can speed or slow the cycling from reservoirs within the solid earth and oceans into the atmosphere.
	ES.3.2 Create diagrams and flowcharts that show the cycling between the lithosphere, hydrosphere, biosphere, and atmosphere for nitrogen. Complete the same for phosphorus, excluding the atmosphere. Explain how human activities can alter the amounts of both phosphorus and nitrogen between these layers.
	ES.3.3 Analyze and explain how events on one side of the world can alter temperature and precipitation around the globe. Analyze and explain the possible effects of natural and human-driven processes on our atmosphere and climate.
	ES.3.4 Evaluate the use of sustainable versus nonrenewable resources. Explain the consequences of overuse and continued increased consumption of limited resources. Analyze and evaluate the benefits of researching, designing, and developing sustainable resources for private use and industry.

Standard 4: The Atmosphere and Hydrosphere	**ES.4.1** Create a model that shows the composition, distribution, and circulation of gases in Earth's atmosphere. Show how carbon and oxygen cycles affect the composition through gas exchange with organisms, oceans, the solid earth, and industry.
	ES.4.2 Create models to demonstrate the circulation, retention, and reflection of heat in regards to the atmosphere, solid land, and bodies of water including lakes and oceans. Demonstrate the effects of cities, various terrain, cloud cover, sea ice, and open water on albedo. Examine local and global heat exchanges, including land & sea breezes, lake effects, urban heat islands, and thermohaline circulation.
	ES.4.3 Create a presentation that demonstrates the process of the water cycle on both local and global scales. Illustrate the process of water cycling both from the solid earth to the atmosphere and around the solid earth. Examine the interaction of ground water, surface water, and ocean circulation. Illustrate the effects of human activity on water systems.
	ES.4.4 Create a model to demonstrate how the Coriolis Effect influences the global circulation of the atmosphere. Explain how changes in the circulation of the atmosphere and oceans can create events such as El Niño and La Niña.
	ES.4.5 Chart and explain the changes in weather as it relates to humidity, air pressure, and temperature. Explain how these factors result in local wind patterns and cloud cover. Explain the origin, life cycle, and behavior of weather systems, especially severe weather. Create an emergency plan for severe storms, both summer and winter.

	ES.4.6 Differentiate between weather and climate. Examine long term, natural climate change and periods of glaciation as influenced by Milankovitch Cycles due to the gravity of other solar system bodies (obliquity and precession of axis and eccentricity of orbit). Explain how these are different from any short term (less than thousands of years) changes to climate.
	ES.4.7 Create diagrams or models to demonstrate the effect of the gravitational pull of the sun and moon on Earth's oceans. Explain the difference between daily (high and low) tides and monthly (spring and neap) tides. Explain how monthly tides relate to the revolution of the moon, and therefore, its phases.

Standard 5: The Solid Earth	**ES.5.1** Construct a lab to analyze minerals based on their physical and chemical properties. Explain how rocks may contain many minerals, one mineral, or no minerals, and minerals can be made of either single elements (such as gold) or compounds (such as silicates).
	ES.5.2 Create a rock cycle flowchart or diagram that demonstrates the processes involved in the formation, breakdown, and reformation of igneous, sedimentary, and metamorphic rock. Show how each type can melt and reform igneous rock, undergo the various metamorphic processes, and undergo physical and chemical weathering to form sedimentary rock.
	ES.5.3 Construct a model that demonstrates the difference between weathering, erosion, transportation of material, deposition, and new soil and sedimentary rock formation. Differentiate between types of physical and chemical weathering.
	ES.5.4 Differentiate between relative and absolute geological time. Detail how sedimentary rock can be dated based on relative-age dating and positioning, while igneous formations can be radiometrically dated. Differentiate between radiocarbon dating used for organic materials and other types of radiometric dating for inorganic rock formation.
	ES.5.5 Create a timeline detailing the processes that have occurred in Indiana to create mostly sedimentary bedrock. Explain how changing sea levels, climate, and glaciation have shaped Indiana geology.
	ES.5.6 Create models or diagrams to show how plate movement and sea level changes have changed continental land masses over time. Include the creation and destruction of inland seas, sedimentary rock formations including evaporites and biochemical formations, and the shaping and destruction of surface features.

Standard 6: Earth Processes	
	ES.6.1 Construct a diagram or model that identifies and describes the physical and chemical properties of the crust, mantle, outer core, and inner core of Earth.
	ES.6.2 Explain how Earth's fluid outer core creates the magnetosphere and how this helps protect both humans and technology (such as satellites) from solar winds.
	ES.6.3 Construct a diagram and explanation showing the convection of Earth's mantle and its impact on the movements of tectonic plates. Explain how the decay of radioactive isotopes and residual energy from Earth's original formation provide the heat to fuel this convective process, which, along with ridge push and slab pull, drive the movements of tectonic plates.
	ES.6.4 Create a timeline to show the development of modern tectonic plate theory. Identify and explain how the evidence from the theory of continental drift, seafloor spreading, and paleomagnetism built upon each other to support tectonic plate theory.
	ES.6.5 Create models that demonstrate different types of orogeny resulting from plate tectonics. Show how the interactions between oceanic and continental plates create different geological features (such as volcanic island arcs or high altitude plateaus) depending on what types of plates are involved in the motions along different plate boundaries.
	ES.6.6 Create models and differentiate between shield, composite, and cinder cone volcanoes. Explain how volcanoes form, how the chemical composition of lava affects the type of volcanoes formed, and how the location (such as hot spots or along continental or oceanic margins) can affect the types of magma present.
	ES.6.7 Use models, diagrams, and captions to explain how tectonic motion creates earthquakes and tsunamis. Using resources such as indianamap.org, analyze how close the school is to known faults and liquefaction potential. Differentiate between intraplate fault zones such as the Wabash Valley Fault System and the more commonly discussed faults along tectonic margins.
	ES.6.8 Create an action plan detailing what to do in an emergency if an earthquake occurred near the school or home. Detail what should be kept in an earthquake preparation kit, how to prepare homes for earthquake safety, and what actions should be taken during and after an earthquake to ensure personal safety.

Science and Engineering Process Standards (SEPS)

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Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 9-10 (9-10 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and**
	GRADES 11-12
	11-12.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 11-CCR independently and proficiently by the end of grade 12.
	11-12.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 11-12
	11-12.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	11-12.LST.2.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
	11-12.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 11-12
	11-12.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	11-12.LST.3.2: Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
	11-12.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 11-12
	11-12.LST.4.1: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., *quantitative data, video, multimedia*) in order to address a question or solve a problem.
	11-12.LST.4.2: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
	11-12.LST.4.3: Synthesize information from a range of sources (e.g., *texts, experiments, simulations*) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

WRITING GENRES	LST.5: WRITING GENRES (WRITING) Write for different purposes and to specific audiences or people
	GRADES 11-12
	11-12.LST.5.1: Write arguments focused on discipline-specific content.
	11-12.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	LST.6: THE WRITING PROCESS (WRITING) Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others
	GRADES 11-12
	11-12.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	11-12.LST.6.2: Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 11-12
	11-12.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	11-12.LST.7.2: Gather relevant information from multiple types of authoritative sources, using advanced searches effectively; annotate sources; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (e.g., *APA or CSE*).
	11-12.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards

For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Chemistry Standards	
Standard 1: Properties and States of Matter	**C.1.1** Differentiate between pure substances and mixtures based on physical and chemical properties.
	C.1.2 Use chemical properties, extensive, and intensive physical properties to identify substances.
	C.1.3 Recognize observable macroscopic indicators of chemical changes.
	C.1.4 Describe physical and chemical changes at the particle level.
	C.1.5 Describe the characteristics of solids, liquids, and gases and changes in state at the macroscopic and microscopic levels.

	C.1.6 Demonstrate an understanding of the law of conservation of mass through the use of particle diagrams and mathematical models.
	C.1.7 Perform calculations involving density and distinguish among materials based on densities.

Standard 2: Atomic Structure and the Periodic Table	**C.2.1** Using available experimental data, explain how and why models of atomic structure have changed over time.
	C.2.2 Determine the number of protons, neutrons, and electrons in isotopes and calculate the average atomic mass from isotopic abundance data.
	C.2.3 Write the full and noble gas electron configuration of an element, determine its valence electrons, and relate this to its position on the periodic table.
	C.2.4 Use the periodic table as a model to predict the relative properties of elements based on the pattern of valence electrons and periodic trends.
	C.2.5 Compare and contrast nuclear reactions with chemical reactions.
	C.2.6 Describe nuclear changes in matter, including fission, fusion, transmutations, and decays.
	C.2.7 Perform half-life calculations when given the appropriate information about the isotope.

Standard 3: Bonding and Molecular Structure	**C.3.1** Investigate the observable characteristics of elements, ionic, and covalent compounds.
	C.3.2 Compare and contrast how ionic and covalent compounds form.
	C.3.3 Draw structural formulas for simple molecules and determine their molecular shape.
	C.3.4 Write chemical formulas for ionic compounds and covalent compounds given their names and vice versa.
	C.3.5 Use laboratory observations and data to compare and contrast ionic, covalent, network, metallic, polar, and non-polar substances with respect to constituent particles, strength of bonds, melting, and boiling points and conductivity; provide examples of each type.

	C.3.6 Use structural formulas of hydrocarbons to illustrate carbon's ability to form single and multiple bonds within a molecule.

Standard 4: Reactions and Stoichiometry	**C.4.1** Describe, classify, and give examples of various kinds of reactions: synthesis (i.e., combination), decomposition, single displacement, double displacement, acid/base, and combustion.
	C.4.2 Predict products of simple reactions as listed in C.4.1.
	C.4.3 Balance chemical equations and use the law of conservation of mass to explain why this must be true.
	C.4.4 Apply the mole concept to determine the mass, moles, number of particles, or volume of a gas at STP, in any given sample, for an element or compound.
	C.4.5 Use a balanced chemical equation to calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion.
	C.4.6 Perform calculations to determine the composition of a compound or mixture when given the necessary information.
	C.4.7 Apply lab data to determine the empirical and molecular formula of a compound.

Standard 5: Behavior of Gases	**C.5.1** Use the kinetic molecular theory with the combined and ideal gas laws to explain changes in volume, pressure, moles, and temperature of a gas.
	C.5.2 Apply the ideal gas equation ($PV = nRT$) to calculate the change in one variable when another variable is changed and the others are held constant.
	C.5.3 Use lab data and a balanced chemical equation to calculate volume of a gas at STP and non STP conditions, assuming that the reaction goes to completion and the ideal gas law holds.

Standard 6: Thermochemistry	**C.6.1** Explain that atoms and molecules are in constant motion and that this motion increases as thermal energy increases.
	C.6.2 Distinguish between the concepts of temperature and heat flow in macroscopic and microscopic terms.
	C.6.3 Classify chemical reactions and phase changes as exothermic or endothermic based on enthalpy values. Use a graphical representation to illustrate the energy changes involved.
	C.6.4 Perform calculations involving heat flow, temperature changes, and phase changes by using known values of specific heat, phase change constants, or both.

Standard 7: Solutions	**C.7.1** Describe the composition and properties of solutions.
	C.7.2 Explain how temperature, pressure, and polarity of the solvent affect the solubility of a solute.
	C.7.3 Describe the concentration of solutes in a solution in terms of molarity. Perform calculations using molarity, mass, and volume. Prepare a sample of given molarity provided a known solute.

Standard 8: Acids and Bases	**C.8.1** Classify solutions as acids or bases and describe their characteristic properties.
	C.8.2 Compare and contrast the strength of acids and bases in solutions.
	C.8.3 Given the hydronium ion and/or the hydroxide ion concentration, calculate the pH and/or the pOH of a solution. Explain the meanings of these values.

Biology Science Standards

Science and Engineering Process Standards (SEPS)

The Science and Engineering Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Science and Engineering Process Standards from the Content Standards is intentional; the separation of the standards explicitly shows that what students are doing while learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.

SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 9-10 (9-10 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences**
	GRADES 9-10
	9-10.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 9-10 independently and proficiently by the end of grade 10.
	9-10.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 9-10
	9-10.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
	9-10.LST.2.2: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate, objective summary of the text.
	9-10.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 9-10
	9-10.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
	9-10.LST.3.2: Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
	9-10.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 9-10
	9-10.LST.4.1: Translate quantitative or technical information expressed in words in a text into visual form (e.g., *a table or chart*) and translate information expressed visually or mathematically (e.g., *in an equation*) into words.
	9-10.LST.4.2: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
	9-10.LST.4.3: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

WRITING GENRES	LST.5: WRITING GENRES (WRITING) Write for different purposes and to specific audiences or people
	GRADES 9-10
	9-10.LST.5.1: Write arguments focused on discipline-specific content.
	9-10.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	LST.6: THE WRITING PROCESS (WRITING) Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others
	GRADES 9-10
	9-10.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	9-10.LST.6.2: Use technology to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 9-10
	9-10.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	9-10.LST.7.2: Gather relevant information from multiple authoritative sources, using advanced searches effectively; annotate sources; assess the usefulness of each source in answering the research question; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	9-10.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards

For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are indicators which serve as the more detailed expectations within each of the content areas.

Indiana Biology Standards	
Standard 1: Cellular Structure and Function	**B.1.1** Compare and contrast the shape and function of the essential biological macromolecules (i.e. carbohydrates, lipids, proteins, and nucleic acids), as well as, how chemical elements (i.e. carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) can combine to form these biomolecules.
	B.1.2 Analyze how the shape of a molecule determines its role in the many different types of cellular processes (e.g., metabolism, homeostasis, growth and development, and heredity) and understand that the majority of these processes involve proteins that act as enzymes.
	B.1.3 Develop and use models that illustrate how a cell membrane regulates the uptake of materials essential for growth and survival while removing or preventing harmful waste materials from accumulating through the processes of active and passive transport.

	B.1.4 Develop and use models to illustrate how specialized structures within cells (i.e. nuclei, ribosomes, Golgi, endoplasmic reticulum) interact to produce, modify, and transport proteins.
	B.1.5 Develop and use a model to illustrate the hierarchical organization of interacting systems (cell, tissue, organ, organ system) that provide specific functions within multicellular organisms.

Standard 2: Matter Cycles and Energy Transfer	**B.2.1** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
	B.2.2 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
	B.2.3 Use mathematical and/or computational representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
	B.2.4 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Standard 3: Interdependence	**B.3.1** Use mathematical and/or computational representation to explain why the carrying capacity ecosystems can support is limited by the available energy, water, oxygen, and minerals and by the ability of ecosystems to recycle the remains of dead organisms.
	B.3.2 Design, evaluate, and refine a model which shows how human activities and natural phenomena can change the flow of matter and energy in an ecosystem and how those changes impact the environment and biodiversity of populations in ecosystems of different scales, as well as, how these human impacts can be reduced.
	B.3.3 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, and identify the impact of changing conditions or introducing non-native species into that ecosystem.

Biology Science Standards

Standard 4: Inheritance and Variation in Traits	**B.4.1** Develop and revise a model that clarifies the relationship between DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
	B.4.2 Construct an explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
	B.4.3 Construct a model to explain that the unique shape and function of each protein is determined by the sequence of its amino acids, and thus is determined by the sequence of the DNA that codes for this protein.
	B.4.4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
	B.4.5 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and (3) mutations caused by environmental factors.
	B.4.6 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Standard 5: Evolution	**B.5.1** Evaluate anatomical and molecular evidence to provide an explanation of how organisms are classified and named based on their evolutionary relationships into taxonomic categories.
	B.5.2 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence including both anatomical and molecular evidence.
	B.5.3 Apply concepts of statistics and probability to support a claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
	B.5.4 Evaluate evidence to explain the role of natural selection as an evolutionary mechanism that leads to the adaptation of species, and to support claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and/or (3) the extinction of other species.
	B.5.5 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

	B.5.6 Analyze and interpret data for patterns in the fossil record and molecular data that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Science and Engineering Process Standards (SEPS)

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SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"
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SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Literacy in Science/Technical Subjects: Grades 11-12 (11-12 LST)

The Indiana Academic Standards for Content Area Literacy (Science/Technical Subjects) indicate ways in which educators incorporate literacy skills into science at the 6-12 grade levels.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and**
	GRADES 11-12
	11-12.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 11-CCR independently and proficiently by the end of grade 12.
	11-12.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 11-12
	11-12.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	11-12.LST.2.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
	11-12.LST.2.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 11-12
	11-12.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	11-12.LST.3.2: Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
	11-12.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 11-12
	11-12.LST.4.1: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., *quantitative data, video, multimedia*) in order to address a question or solve a problem.
	11-12.LST.4.2: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
	11-12.LST.4.3: Synthesize information from a range of sources (e.g., *texts, experiments, simulations*) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

WRITING GENRES	**LST.5: WRITING GENRES (WRITING)** **Write for different purposes and to specific audiences or people**
	GRADES 11-12
	11-12.LST.5.1: Write arguments focused on discipline-specific content.
	11-12.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	**LST.6: THE WRITING PROCESS (WRITING)** **Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others**
	GRADES 11-12
	11-12.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach, focusing on addressing what is most significant for a specific purpose and audience; and edit to produce and strengthen writing that is clear and coherent.
	11-12.LST.6.2: Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 11-12
	11-12.LST.7.1: Conduct short as well as more sustained research assignments and tasks to answer a question (including a self-generated question), test a hypothesis, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	11-12.LST.7.2: Gather relevant information from multiple types of authoritative sources, using advanced searches effectively; annotate sources; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; synthesize and integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (e.g., *APA or CSE*).
	11-12.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Content Standards

For the high school science courses, the content standards are organized around the core ideas in each particular course. Within each core idea are standards which serve as the more detailed expectations within each of the content areas.

Indiana Science: Anatomy & Physiology Standards	
Standard 1: Levels of Organization in the Human Body: Cellular	AP.1.1 Investigate the forms of cellular transport within and across cell membranes. Explain how passive and active transport move materials through the body and into/out of cells. Describe the how simple diffusion differs from facilitated diffusion. Describe how vesicular transport moves materials within a cell.
	AP.1.2 Develop a model which describes the stages of somatic cell division (mitosis), how it contributes to maintaining homeostasis, and why cellular differentiation is vital to development.
	AP.1.3 Explore the homeostatic range to sustaining human life, the principal mechanism involved, and predict the consequences of what happens when homeostasis is not maintained.
	AP.1.4 Introduce the basic step and control mechanisms of protein synthesis.
	AP.1.5 Explore the vital ways that proteins contribute to the structure, metabolism, and defense of the body, as well as, the importance of shape to their function.

Standard 2: Levels of Organization in the Human Body: Tissue and Organs	AP.2.1 Analyze how each hierarchical level of life contributes to complexity of anatomy and physiological functions (e.g. cells, tissues, etc.). Investigate the relationships among various tissue types as well as the molecular and cellular composition of these tissues.
	AP.2.2 Investigate and be able to describe the histological structural and functional characteristics of the four basic tissue types.
	AP.2.3 Identify the body cavities, their membranes, and the organs within each cavity. Investigate the major organ systems and describe their basic functional importance.
	AP.2.4 Identify anatomical terms (including body direction, regions, planes) on a diagram, model, or through dissection.

Standard 3: Movement and Support in the Human Body: The Integumentary System	AP.3.1 Analyze the structural characteristics and functional importance of the integumentary system to maintaining homeostasis of the body.
	AP.3.2 Investigate the injuries, diseases, and causes associated with the integumentary system and evaluate the consequences.

Standard 4: Movement and Support in the Human Body: The Skeletal System	AP.4.1 Develop a model to illustrate the structure, development, growth, and function of compact and spongy bone.
	AP.4.2 Evaluate the general macroscopic characteristics of a typical long bone, then locate and identify individual bones and bone features.
	AP.4.3 Identify and describe the structure of the major types of joints and how these structural components influence functional mobility and stability.

Standard 5: Movement and Support in the Human Body: The Muscular System	AP.5.1 Compare and contrast the structural and functional similarities and differences between skeletal, cardiac, and smooth muscle.
	AP.5.2 Investigate the molecular components of skeletal muscle fiber and how they function to bring about contraction and relaxation.
	AP.5.3 Explain the molecular processes involved in the sliding filament model and biochemical mechanisms that provide energy for muscle contraction and relaxation.
	AP.5.4 Describe how a neuromuscular junction functions and investigate how motor units influence the force and velocity of muscle contraction.
	AP.5.5 Identify the major muscles on a diagram, model, or through dissection.
	AP.5.6 Distinguish between isotonic and isometric contractions of skeletal muscle. Examine muscular hypertrophy and atrophy and discuss causes of these processes.

Standard 6: Integration and Coordination in the Human Body: The Nervous System	AP.6.1 Develop a model that illustrates the structural components and functional subdivisions of the nervous system.
	AP.6.2 Describe and diagram the structures of the various types of neurons, their supporting neuroglial cells, and investigate their basic functions.
	AP.6.3 Compare and contrast the actions, origins, and pathways of nerve fibers in the parasympathetic and sympathetic divisions of the autonomic nervous system and their associated neurotransmitters.
	AP.6.4 Identify and model how action potentials are generated, the ions and channel protein involved, and the basic structural and functional aspects which allow for synaptic connection.

Standard 7: Integration and Coordination in the Human Body: Somatic and Special Senses	AP.7.1 Distinguish between somatic senses and special senses, the prominent sensory receptor types, and their functional operation.
	AP.7.2 Explore the anatomy of the eye, it's functional layers, the fovea and its function. Investigate how the eye accommodates for near and distance vision as well as how the eye adapts to changes in light.
	AP.7.3 Investigate the structural components and function of the ear, and model how equilibrium and sound are detected through the ear.

Standard 8: Integration and Coordination in the Human Body: The Endocrine System	AP.8.1 Investigate the structure and function of the endocrine system and develop models showing how changes in prominent hormone levels impact homeostasis throughout the body systems.
	AP.8.2 Discuss the structural and functional differences between an endocrine gland and an exocrine gland.
	AP.8.3 Distinguish between amino acid, peptide, and lipid based hormones and describe how they differ in bringing about changes in cellular activity.
	AP.8.4 Investigate the hormones of the hypothalamus-pituitary complex, the function of these hormones in controlling the thyroid, gonads, and adrenal cortex; and the feedback signals that control them. Evaluate how the HP complex, the sympathetic nervous system, and the adrenal medulla are influenced by stress.
	AP.8.5 Investigate the endocrine and exocrine functions of the pancreas and its involvement in digestion and blood sugar regulation.

Standard 9: Transport in the Human Body: The Blood	AP.9.1 Analyze and model the functions of blood which are fundamental to maintaining homeostasis; including hemostasis; nutrient, gas, and waste exchange; and inflammatory response.
	AP.9.2 Evaluate the composition and functions of whole blood, plasma, and the regulation and production of blood cells.
	AP.9.3 Investigate the ABO blood types, antigens and antibodies, and their significance in blood transfusion.

Standard 10: Transport in the Human Body: The Cardiovascular System	AP.10.1 Investigate the primary structures of the cardiovascular system and explore their functional importance to maintaining homeostasis.
	AP.10.2 Investigate the stages, control, and regulation of the cardiac cycle.
	AP.10.3 Compare and contrast the structural and functional difference between the different blood vessel types. Model what vasoconstriction and vasodilation are and how they impact homeostasis.
	AP.10.4 Use a diagram and/or a model to illustrate the external and internal structures and layers of the heart, the vessels entering and leaving the heart, and the one-way blood flow through the heart.
	AP.10.5 Discuss the regulation of blood pressure. Analyze the effect of abnormal blood pressure on long term health.
	AP.10.6 Investigate how the cardiovascular system and other body systems respond to changes in blood volume as well as changes in physical activity which allow the body to maintain homeostasis.

Standard 11: Transport in the Human Body: The Lymphatic System and Immune Mechanisms	AP.11.1 Identify the primary structural components of the lymphatic system and their functions. Analyze the relationship with activities of bone marrow, thymus gland, and overall importance in maintaining homeostasis.
	AP.11.2 Investigate the difference between innate and acquired immunity. Examine how cellular and non-cellular components work collectively to defend the body against foreign pathogens and how they contribute to maintaining homeostasis.

Standard 12: Absorption and Excretion in the Human Body: The Digestive System	AP.12.1 Identify and locate major and accessory organs of the digestive system and investigate their physiological functions.
	AP.12.2 Investigate the enzymes of the gastrointestinal tract and accessory organs in relation to the processing, digesting, and absorbing of the three major biomolecules.
	AP.12.3 Explain the difference between metabolic and respiratory acidosis and alkalosis.

Standard 13: Absorption and Excretion in the Human Body: The Respiratory System	AP.13.1 Identify and locate major organs of the respiratory system and discuss their functions.
	AP13.2 Investigate the anatomical structures and physiological processes involved in inspiration & expiration.
	AP.13.3 Investigate how percentages and partial pressure gradients of oxygen and carbon dioxide impact net gas exchange.
	AP.13.4 Describe how the body monitors changes in blood pH and carbon dioxide using specialized receptors and how the respiratory system adjusts in order to maintain homeostasis.

Standard 14: Absorption and Excretion in the Human Body: The Urinary System	AP.14.1 Identify and locate major organs of the urinary system and discuss their functions.
	AP.14.2 Understand the function of the kidneys in relation to homeostatic control of bodily fluids, blood pressure, and erythrocyte production.
	AP.14.3 Develop a model of the nephron which explores its structural components and the functional processes of filtration, secretion, and reabsorption, which are essential to maintaining homeostasis.
	AP.14.4 Explain the neural basis of micturition including the function of the sphincters associated with the male and female urethra.
	AP.14.5 Investigate how the kidneys respond to excess water intake and to dehydration, as well as the role of antidiuretic hormone (ADH) and sodium in the regulation of water absorption and excretion.

Standard 15: Life Cycle in the Human Body: The Reproductive System	
	AP.15.1 Identify and locate major and accessory organs of the female and male reproductive systems and discuss their functions.
	AP.15.2 Discuss the role of hormones in the reproductive system.
	AP.15.3 Create a model showing how fluctuating hormonal changes associated with the reproductive system impact both the uterine and ovarian cycles.
	AP.15.4 Describe how spermatozoa move through the female reproductive tract and describe the process of fertilization.
	AP.15.5 Investigate and develop a model of early development which traces the changes of a fertilized cell (zygote) through the blastocyst level of development and the then gastrulation process resulting in the rise of the three primary germ layers.

Eighth Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Eighth Grade Science Standards

LEARNING OUTCOMES	LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences
	GRADES 6-8
	6-8.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 6-8 independently and proficiently by the end of grade 8.
	6-8.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING) Extract and construct meaning from science and technical texts using a variety of comprehension skills
	GRADES 6-8
	6-8.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts.
	6-8.LST.2.2: Determine the central ideas or conclusions of a text; provide an accurate, objective summary of the text.
	6-8.LST.2.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

STRUCTURAL ELEMENTS AND ORGANIZATION	LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING) Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message
	GRADES 6-8
	6-8.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
	6-8.LST.3.2: Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
	6-8.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 6-8
	6-8.LST.4.1: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., *in a flowchart, diagram, model, graph, or table*).
	6-8.LST.4.2: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
	6-8.LST.4.3: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

WRITING GENRES	**LST.5: WRITING GENRES (WRITING)** **Write for different purposes and to specific audiences or people**
	GRADES 6-8
	6-8.LST.5.1: Write arguments focused on discipline-specific content.
	6-8.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	**LST.6: THE WRITING PROCESS (WRITING)** **Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others**
	GRADES 6-8
	6-8.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach; and edit to produce and strengthen writing that is clear and coherent, with some guidance and support from peers and adults.
	6-8.LST.6.2: Use technology to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 6-8
	6-8.LST.7.1: Conduct short research assignments and tasks to answer a question (including a self- generated question), or test a hypothesis, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
	6-8.LST.7.2: Gather relevant information from multiple sources, using search terms effectively; annotate sources; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	6-8.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Eighth Grade Science Standards

Physical Science (PS)
8.PS.1 Create models to represent the arrangement and charges of subatomic particles in an atom (protons, neutrons and electrons). Understand the significance that the currently 118 known chemical elements combine to form all the matter in the universe.
8.PS.2 Illustrate with diagrams (drawings) how atoms are arranged in simple molecules. Distinguish between atoms, elements, molecules, and compounds.
8.PS.3 Use basic information provided for an element (atomic mass, atomic number, symbol, and name) to determine its place on the Periodic Table. Use this information to find the number of protons, neutrons, and electrons in an atom.
8.PS.4 Identify organizational patterns (radius, atomic number, atomic mass, properties and radioactivity) on the Periodic Table.
8.PS.5 Investigate the property of density and provide evidence that properties, such as density, do not change for a pure substance.
8.PS.6 Compare and contrast physical change vs. chemical change. Analyze the properties of substances before and after substances interact to determine if a chemical reaction has occurred.
8.PS.7 Balance chemical equations to show how the total number of atoms for each element does not change in chemical reactions and as a result, mass is always conserved in a closed system. (Law of Conservation of Mass.)

Earth and Space Science (ESS)
8.ESS.1 Research global temperatures over the past century. Compare and contrast data in relation to the theory of climate change.
8.ESS.2 Create a diagram or carry out a simulation to describe how water is cycled through the earth's crust, atmosphere and oceans. Explain how the water cycle is driven by energy from the sun and the force of gravity.
8.ESS.3 Research how human consumption of finite natural resources (i.e. coal, oil, natural gas, and clean water) and human activities have had an impact on the environment (i.e. causes of air, water, soil, light, and noise pollution).

Eighth Grade Science Standards

	Life Science (LS)
	8.LS.1 Compare and contrast the transmission of genetic information in sexual and asexual reproduction. Research organisms that undergo these two types of reproduction.
	8.LS.2 Demonstrate how genetic information is transmitted from parent to offspring through chromosomes via the process of meiosis. Explain how living things grow and develop.
	8.LS.3 Create and analyze Punnett squares to calculate the probability of specific traits being passed from parents to offspring using different patterns of inheritance.
	8.LS.4 Differentiate between and provide examples of acquired and genetically inherited traits.
	8.LS.5 Explain how factors affecting natural selection (competition, genetic variations, environmental changes, and overproduction) increase or decrease a species' ability to survive and reproduce.
	8.LS.6 Create models to show how the structures of chromatin, chromosomes, chromatids, genes, alleles and deoxyribonucleic acid (DNA) molecules are related and differ.
	8.LS.7 Recognize organisms are classified into taxonomic levels according to shared characteristics. Explain how an organism's scientific name correlates to these shared characteristics.
	8.LS.8 Explore and predict the evolutionary relationships between species looking at the anatomical differences among modern organisms and fossil organisms.
	8.LS.9 Examine traits of individuals within a species that may give them an advantage or disadvantage to survive and reproduce in stable or changing environment.
	8.LS.10 Gather and synthesize information about how humans alter organisms genetically through a variety of methods.
	8.LS.11 Investigate how viruses and bacteria affect the human body.

	Engineering (E)
	6-8.E.1 Identify the criteria and constraints of a design to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
	6-8.E.2 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
	6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
	6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Seventh Grade Science Standards

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences**
	GRADES 6-8
	6-8.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 6-8 independently and proficiently by the end of grade 8.
	6-8.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 6-8
	6-8.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts.
	6-8.LST.2.2: Determine the central ideas or conclusions of a text; provide an accurate, objective summary of the text.
	6-8.LST.2.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 6-8
	6-8.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
	6-8.LST.3.2: Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
	6-8.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 6-8
	6-8.LST.4.1: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., *in a flowchart, diagram, model, graph, or table*).
	6-8.LST.4.2: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
	6-8.LST.4.3: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

WRITING GENRES	**LST.5: WRITING GENRES (WRITING)** **Write for different purposes and to specific audiences or people**
	GRADES 6-8
	6-8.LST.5.1: Write arguments focused on discipline-specific content.
	6-8.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	**LST.6: THE WRITING PROCESS (WRITING)** **Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others**
	GRADES 6-8
	6-8.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach; and edit to produce and strengthen writing that is clear and coherent, with some guidance and support from peers and adults.
	6-8.LST.6.2: Use technology to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 6-8
	6-8.LST.7.1: Conduct short research assignments and tasks to answer a question (including a self- generated question), or test a hypothesis, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
	6-8.LST.7.2: Gather relevant information from multiple sources, using search terms effectively; annotate sources; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	6-8.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Seventh Grade Science Standards

Physical Science (PS)
7.PS.1 Draw, construct models, or use animations to differentiate between atoms, elements, molecules, and compounds.
7.PS.2 Describe the properties of solids, liquids, and gases. Develop models that predict and describe changes in particle motion, density, temperature, and state of a pure substance when thermal energy is added or removed.
7.PS.3 Investigate the Law of Conservation of Mass by measuring and comparing the mass of a substance before and after a change of state.
7.PS.4 Investigate Newton's first law of motion (Law of Inertia) and how different forces (gravity, friction, push and pull) affect the velocity of an object.
7.PS.5 Investigate Newton's second law of motion to show the relationship among force, mass and acceleration.
7.PS.6 Investigate Newton's third law of motion to show the relationship between action and reaction forces.
7.PS.7 Construct a device that uses one or more of Newton's laws of motion. Explain how motion, acceleration, force, and mass are affecting the device.
7.PS.8 Investigate a process in which energy is transferred from one form to another and provide evidence that the total amount of energy does not change during the transfer when the system is closed. (Law of conservation of energy)
7.PS.9 Compare and contrast the three types of heat transfer: radiation, convection, and conduction.

Seventh Grade Science Standards

Earth and Space Science (ESS)
7.ESS.1 Identify and investigate the properties of minerals. Identify and classify a variety of rocks based on physical characteristics from their origin, and explain how they are related using the rock cycle. (i.e. Sedimentary, igneous, and metamorphic rocks)
7.ESS.2 Construct a model or scale drawing (digitally or on paper), based on evidence from rock strata and fossil records, for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history.
7.ESS.3 Using simulations or demonstrations, explain continental drift theory and how lithospheric (tectonic) plates have been and still are in constant motion resulting in the creation of landforms on the Earth's surface over time.
7.ESS.4 Construct an explanation, based on evidence found in and around Indiana, for how large scale physical processes, such as Karst topography and glaciation, have shaped the land.
7.ESS.5 Construct a model, diagram, or scale drawing of the interior layers of the Earth. Identify and compare the compositional (chemical) layers to the mechanical (physical) layers of the Earth's interior including magnetic properties.
7.ESS.6 Research common synthetic materials (i.e. plastics, composites, polyester, and alloys) to gain an understanding that synthetic materials do come from natural resources and have an impact on society.
7.ESS.7 Describe the positive and negative environmental impacts of obtaining and utilizing various renewable and nonrenewable energy resources in Indiana. Determine which energy resources are the most beneficial and efficient.

Life Science (LS)
7.LS.1 Investigate and observe cells in living organisms and collect evidence showing that living things are made of cells. Compare and provide examples of prokaryotic and eukaryotic organisms. Identify the characteristics of living things.
7.LS.2 Create a model to show how the cells in multicellular organisms repeatedly divide to make more cells for growth and repair as a result of mitosis. Explain how mitosis is related to cancer.
7.LS.3 Explain how cells develop through differentiation into specialized tissues and organs in multicellular organisms.
7.LS.4 Research and describe the functions and relationships between various cell types, tissues, and organs in the immune system, circulatory system and digestive system of the human body.
7.LS.5 Compare and contrast the form and function of the organelles found in plant and animal cells.

	Engineering (E)
	6-8.E.1 Identify the criteria and constraints of a design to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
	6-8.E.2 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
	6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
	6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.

Sixth Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

LEARNING OUTCOMES	**LST.1: LEARNING OUTCOME FOR LITERACY IN SCIENCE/TECHNICAL SUBJECTS** **Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences**
	GRADES 6-8
	6-8.LST.1.1: Read and comprehend science and technical texts within a range of complexity appropriate for grades 6-8 independently and proficiently by the end of grade 8.
	6-8.LST.1.2: Write routinely over a variety of time frames for a range of discipline-specific tasks, purposes, and audiences.

KEY IDEAS AND TEXTUAL SUPPORT	**LST.2: KEY IDEAS AND TEXTUAL SUPPORT (READING)** **Extract and construct meaning from science and technical texts using a variety of comprehension skills**
	GRADES 6-8
	6-8.LST.2.1: Cite specific textual evidence to support analysis of science and technical texts.
	6-8.LST.2.2: Determine the central ideas or conclusions of a text; provide an accurate, objective summary of the text.
	6-8.LST.2.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

STRUCTURAL ELEMENTS AND ORGANIZATION	**LST.3: STRUCTURAL ELEMENTS AND ORGANIZATION (READING)** **Build understanding of science and technical texts, using knowledge of structural organization and author's purpose and message**
	GRADES 6-8
	6-8.LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
	6-8.LST.3.2: Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
	6-8.LST.3.3: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

SYNTHESIS AND CONNECTION OF IDEAS	**LST.4: SYNTHESIS AND CONNECTION OF IDEAS (READING)** **Build understanding of science and technical texts by synthesizing and connecting ideas and evaluating specific claims**
	GRADES 6-8
	6-8.LST.4.1: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., *in a flowchart, diagram, model, graph, or table*).
	6-8.LST.4.2: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
	6-8.LST.4.3: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

WRITING GENRES	**LST.5: WRITING GENRES (WRITING)** **Write for different purposes and to specific audiences or people**
	GRADES 6-8
	6-8.LST.5.1: Write arguments focused on discipline-specific content.
	6-8.LST.5.2: Write informative texts, including scientific procedures/experiments or technical processes that include precise descriptions and conclusions drawn from data and research.

THE WRITING PROCESS	**LST.6: THE WRITING PROCESS (WRITING)** **Produce coherent and legible documents by planning, drafting, revising, editing, and collaborating with others**
	GRADES 6-8
	6-8.LST.6.1: Plan and develop; draft; revise using appropriate reference materials; rewrite; try a new approach; and edit to produce and strengthen writing that is clear and coherent, with some guidance and support from peers and adults.
	6-8.LST.6.2: Use technology to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

THE RESEARCH PROCESS	**LST.7: THE RESEARCH PROCESS (WRITING)** **Build knowledge about the research process and the topic under study by conducting short or more sustained research**
	GRADES 6-8
	6-8.LST.7.1: Conduct short research assignments and tasks to answer a question (including a self- generated question), or test a hypothesis, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
	6-8.LST.7.2: Gather relevant information from multiple sources, using search terms effectively; annotate sources; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation (e.g., *APA or CSE*).
	6-8.LST.7.3: Draw evidence from informational texts to support analysis, reflection, and research.

Sixth Grade Science Standards

Physical Science (PS)
6.PS.1 Distinguish between the terms position, distance, and displacement, as well as, the terms speed and velocity.
6.PS.2 Describe the motion of an object graphically showing the relationship between time and position.
6.PS.3 Describe how potential and kinetic energy can be transferred from one form to another.
6.PS.4 Investigate the properties of light, sound, and other energy waves and how they are reflected, absorbed, and transmitted through materials and space.

Earth and Space Science (ESS)
6.ESS.1 Describe the role of gravity and inertia in maintaining the regular and predictable motion of celestial bodies.
6.ESS.2 Design models to describe how Earth's rotation, revolution, tilt, and interaction with the sun and moon cause seasons, tides, changes in daylight hours, eclipses, and phases of the moon.
6.ESS.3 Compare and contrast the Earth, its moon, and other planets in the solar system, including comets and asteroids. (Comparisons should be made in regard to size, surface features, atmospheric characteristics, and the ability to support life.)

Life Science (LS)
6.LS.1 Investigate and describe how homeostasis is maintained as living things seek out their basic needs of food, water, shelter, space, and air.
6.LS.2 Describe the role of photosynthesis in the flow of energy in food chains, energy pyramids, and food webs. Create diagrams to show how the energy in animals' food used for bodily processes was once energy from the sun.
6.LS.3 Describe specific relationships (predator/prey, consumer/producer, parasite/host) and symbiotic relationships between organisms. Construct an explanation that predicts why patterns of interactions develop between organisms in an ecosystem.
6.LS.4 Investigate and use data to explain how changes in biotic and abiotic components in a given habitat can be beneficial or detrimental to native plants and animals.
6.LS.5 Research invasive species and discuss their impact on ecosystems.

Engineering (E)
6-8.E.1 Identify the criteria and constraints of a design to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
6-8.E.2 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.

Fifth Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Fifth Grade Science Standards

Physical Science (PS)
5.PS.1 Describe and measure the volume and mass of a sample of a given material.
5.PS.2 Demonstrate that regardless of how parts of an object are assembled the mass of the whole object is identical to the sum of the mass of the parts; however, the volume can differ from the sum of the volumes. (Law of Conservation of Mass)
5.PS.3 Determine if matter has been added or lost by comparing mass when melting, freezing, or dissolving a sample of a substance. (Law of Conservation of Mass)
5.PS.4 Describe the difference between weight being dependent on gravity and mass comprised of the amount of matter in a given substance or material.

Earth and Space Science (ESS)
5.ESS.1 Analyze the scale of our solar system and its components: our solar system includes the sun, moon, seven other planets and their moons, and many other objects like asteroids and comets.
5.ESS.2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
5.ESS.3 Investigate ways individual communities within the United States protect the Earth's resources and environment.
5.ESS.4 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Life Science (LS)
5.LS.1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
5.LS.2 Observe and classify common Indiana organisms as producers, consumers, decomposers, or predator and prey based on their relationships and interactions with other organisms in their ecosystem.
5.LS.3 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

	Engineering (E)
	3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
	3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
	3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Fourth Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Fourth Grade Science Standards

Physical Science (PS)
4.PS.1 Investigate transportation systems and devices that operate on or in land, water, air and space and recognize the forces (lift, drag, friction, thrust and gravity) that affect their motion.
4.PS.2 Investigate the relationship of the speed of an object to the energy of that object.
4.PS.3 Investigate how multiple simple machines work together to perform everyday tasks.
4.PS.4 Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another form of energy.
4.PS.5 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Earth and Space Science (ESS)
4.ESS.1 Investigate how the moon appears to move through the sky and it changes day to day, emphasizing the importance of how the moon impacts the Earth, the rising and setting times, and solar and lunar eclipses.
4.ESS.2 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
4.ESS.3 Describe how geological forces change the shape of the land suddenly and over time.
4.ESS.4 Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.

Life Science (LS)
4.LS.1 Observe, analyze, and interpret how offspring are very much, but not exactly, like their parents or one another. Describe how these differences in physical characteristics among individuals in a population may be advantageous for survival and reproduction.
4.LS.2 Use evidence to support the explanation that a change in the environment may result in a plant or animal will survive and reproduce, move to a new location, or die.
4.LS.3 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction in a different ecosystems.

Engineering (E)
3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Third Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Third Grade Science Standards

Physical Science (PS)
3.PS.1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3.PS.2 Identify types of simple machines and their uses. Investigate and build simple machines to understand how they are used.
3.PS.3 Generate sound energy using a variety of materials and techniques, and recognize that it passes through solids, liquids, and gases (i.e. air).
3.PS.4 Investigate and recognize properties of sound that include pitch, loudness (amplitude), and vibration as determined by the physical properties of the object making the sound.

Earth and Space Science (ESS)
3.ESS.1 Obtain and combine information to determine seasonal weather patterns across the different regions of the United States.
3.ESS.2 Develop solutions that could be implemented to reduce the impact of weather related hazards.
3.ESS.3 Observe the detailed characteristics of rocks and minerals. Identify and classify rocks as being composed of different combinations of minerals.
3.ESS.4 Determine how fossils are formed, discovered, layered over time, and used to provide evidence of the organisms and the environments in which they lived long ago.

Life Science (LS)
3.LS.1 Analyze evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
3.LS.2 Plan and conduct an investigation to determine the basic needs of plants to grow, develop, and reproduce.
3.LS.3 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
3.LS.4 Construct an argument that some animals form groups that help members survive.

	Engineering (E)
	3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
	3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
	3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Second Grade Science Standards

Science and Engineering Process Standards (SEPS)	
SEPS.1 Posing questions (for science) and defining problems (for engineering)	A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
SEPS.2 Developing and using models and tools	A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
SEPS.3 Constructing and performing investigations	Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: "Does this make sense?" "Could my results be duplicated?" and/or "Does the design solve the problem with the given constraints?"

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)	Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
SEPS.7 Engaging in argument from evidence	Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
SEPS.8 Obtaining, evaluating, and communicating information	Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

Second Grade Science Standards

Physical Science (PS)
2.PS.1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
2.PS.2 Predict the result of combining solids and liquids in pairs. Mix, observe, gather, record, and discuss evidence of whether the result may have different properties than the original materials.
2.PS.3 Construct an argument with evidence that some changes caused by heating and cooling can be reversed and some cannot.
2.PS.4 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Earth and Space Science (ESS)
2.ESS.1 Record detailed weather observations, including cloud cover, cloud type, and type of precipitation on a daily basis over a period of weeks and correlate observations to the time of year. Chart and graph collected data.
2.ESS.2 Investigate the severe weather of the region and its impact on the community, looking at forecasting to prepare for, and respond to, severe weather.
2.ESS.3 Investigate how wind or water change the shape of the land and design solutions for prevention.
2.ESS.4 Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Life Science (LS)
2.LS.1 Determine patterns and behavior (adaptations) of parents and offspring which help offspring to survive.
2.LS.2 Compare and contrast details of body plans and structures within the life cycles of plants and animals.
2.LS.3 Classify living organisms according to variations in specific physical features (i.e. body coverings, appendages) and describe how those features may provide an advantage for survival in different environments.

	Engineering (E)
	K-2.E.1 Pose questions, make observations, and obtain information about a situation people want to change. Use this data to define a simple problem that can be solved through the construction of a new or improved object or tool.
	K-2.E.2 Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
	K-2.E.3 Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.

First Grade Science Standards

Science and Engineering Process Standards (SEPS)	
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SEPS.4 Analyzing and interpreting data	Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”

SEPS.5 Using mathematics and computational thinking	In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
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First Grade Science Standards

Physical Science (PS)
1.PS.1 Characterize materials as solid, liquid, or gas and investigate their properties, record observations and explain the choices to others based on evidence (i.e., physical properties).
1.PS.2 Predict and experiment with methods (sieving, evaporation) to separate solids and liquids based on their physical properties.
1.PS.3 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
1.PS.4 Make observations to collect evidence and explain that objects can be seen only when illuminated.

Earth and Space Science (ESS)
1.ESS.1 Use observations of the sun, moon, and stars to describe patterns that can be predicted.
1.ESS.2 Observe and compare properties of sand, clay, silt, and organic matter. Look for evidence of sand, clay, silt, and organic matter as components of soil samples.
1.ESS.3 Observe a variety of soil samples and describe in words and pictures the soil properties in terms of color, particle size and shape, texture, and recognizable living and nonliving items.
1.ESS.4 Develop solutions that could be implemented to reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Life Science (LS)
1.LS.1 Develop representations to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
1.LS.2 Develop a model mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Explore how those external parts could solve a human problem.
1.LS.3 Make observations of plants and animals to compare the diversity of life in different habitats.
1.LS.4 Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.

	Engineering (E)
	K-2.E.1 Pose questions, make observations, and obtain information about a situation people want to change. Use this data to define a simple problem that can be solved through the construction of a new or improved object or tool.
	K-2.E.2 Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
	K-2.E.3 Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.

Kindergarten Science Standards

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Kindergarten Science Standards

Physical Science (PS)
K.PS.1 Plan and conduct an investigation using all senses to describe and classify different kinds of objects by their composition and physical properties. Explain these choices to others and generate questions about the objects.
K.PS.2 Identify and explain possible uses for an object based on its properties and compare these uses with other students' ideas.
K.PS.3 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
K.PS.4 Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Earth and Space Science (ESS)
K.ESS.1 Make observations to determine the effect of sunlight on Earth's surface and use tools and materials to design and build a structure to reduce the warming effect on Earth's surface.
K.ESS.2 Describe and compare objects seen in the night and day sky, observing that the sun and moon move across the sky.
K.ESS.3 Investigate the local weather conditions to describe patterns over time.
K.ESS.4 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Life Science (LS)
K.LS.1 Describe and compare the growth and development of common living plants and animals.
K.LS.2 Describe and compare the physical features of common living plants and animals.
K.LS.3 Use observations to describe patterns of what plants and animals (including humans) need to survive.

	Engineering (E)
	K-2.E.1 Pose questions, make observations, and obtain information about a situation people want to change. Use this data to define a simple problem that can be solved through the construction of a new or improved object or tool.
	K-2.E.2 Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
	K-2.E.3 Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.