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 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.