Introduction to Indiana's Academic Standards for Biomedical Sciences

Indiana's Academic Standards for Biomedical Sciences were created to clarify the areas and content that is in the biomedical area. This new document, Indiana's Academic Standards for Biomedical Sciences, reflects the ever-changing science content and the underlying premise that science education should be an inquiry-based, hands-on experience.

Indiana's Academic Standards for Biomedical Sciences reflect the addition of the Common Core Literacy standards Adopted by Indiana in 2010. The standards are divided into two sections: Content Standards and Process Standards, which are described in greater detail below.

Content Standards

For the high school science courses, the content standards are organized around the domains in each particular course, which are represented by the core standard. The core standard is not meant to stand alone or be used as an individual standard, but instead is meant to help teachers organize their instruction around the "big ideas" in each domain. Beneath each core standard are standards which serve as the more detailed expectations within each of the topics.

Process Standards

The 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 Process Standards from the Content Standards is intentional; in doing so we want to make explicit the idea that what students are doing while they are 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.

As noted in the previous paragraph, Biomedical Sciences courses include Reading and Writing for Literacy in Science. It is important to note that these Process Standards emerged with the adoption of the Common Core State Standards in the area of Reading and Writing for Literacy in Science. The Literacy Standards establish that instruction in reading, writing, speaking, listening, and language is a shared responsibility. The Literacy Standards are predicated on teachers in the content areas using their unique disciplinary expertise to help students meet the particular challenges of reading, writing, speaking, listening, and language in their respective fields. It is important to note that the literacy standards are meant to complement rather than supplant content standards in the disciplines.

Part of the motivation behind the disciplinary approach to literacy promulgated by the Literacy Standards is extensive research establishing the need for college- and career-ready students to be proficient in reading complex informational text independently in a variety of content areas. Most of the required reading in college and workforce training programs is informational in structure and challenging in content. Postsecondary education programs typically provide students with both a higher volume of such reading than is generally required in K-12 schools and comparatively little scaffolding. The Literacy Standards make clear that significant reading of informational texts should also take place outside ELA classrooms in order for students to be ready for college and careers. Future assessments will apply the sum of all the reading students do in a grade, not just their reading in the ELA context. The Literacy Standards demand that a great deal of reading should occur in all disciplines. The Literacy Standards also cultivate the development of three mutually reinforcing writing capacities: writing to

persuade, to explain, and to convey real or imagined experience. College and career readiness requires that writing focus significantly on writing to argue and to inform or explain.

The Literacy Standards use grade level bands to present the standards. Teachers teaching at the beginning of the grade band may need to provide scaffolding for students to be successful, where teachers teaching at the end of the grade band should expect students to demonstrate the standards independently.

PLTW Medical Interventions

PLTW Medical Interventions is a course that studies medical practices including interventions to support humans in treating disease and maintaining health. Using a project-based learning approach, students will investigate various medical interventions that extend and improve quality of life, including gene therapy, pharmacology, surgery, prosthetics, rehabilitation, and supportive care. Students will also study the design and development of various interventions including vascular stents, cochlear implants, and prosthetic limbs. Lessons will cover the history of organ transplants and gene therapy with additional readings from current scientific literature addressing cutting edge developments. Using 3-D imaging software, students will design and build a model of a therapeutic protein. Schools must agree to be part of the Project Lead The Way network and follow all training and data collection requirements. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead the Way network and follow all training and data collection requirements.**

- DOE Code: 5217
- Recommended Grade Level: Grade 11
- Recommended Prerequisites: PLTW Principles of the Biomedical Sciences and PLTW Human Body Systems
- Credits: 1 credit per semester, 2 semesters maximum, maximum of 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas.
- Fulfills a Core 40 Science elective requirement for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas or counts as an Elective or Directed Elective for any diploma
- This course is aligned with the following Post-Secondary courses for Dual Credit:
    - IUPUI
        - BIOL 10013: Medical Interventions
    - Ivy Tech
        - TBD

Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Career and Technical Student Organizations (CTSOs)

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in HOSA Health Occupations Student Association the CTSO for this area.

Content Standards

Domain 1: Medical Interventions

Core Standard 1: Students investigate the variety of interventions involved in the prevention, diagnosis and treatment of disease.

Standard	
MI.1.1	Identify and describe the main categories of medical interventions and when they are necessary to maintain human health.
MI.1.2	Describe how scientists gather evidence about a disease or disorder to determine if a medical intervention is necessary.
MI.1.3	Describe the steps that scientists take to diagnose, treat and prevent diseases and disorders.
MI.1.4	Understand the difference between chronic and acute inherited and non-inherited disorders and communicable diseases.

Domain 2: Infectious Diseases, Treatments and Preventions

Core Standard 2: Students explore the diagnostic process used to identify an unknown infection, the use of antibiotics as a treatment, how bacteria develop antibiotic resistance, and how vaccinations are developed and used to prevent infection.

Standard	
MI.2.1	Describe how infectious diseases are spread throughout a population.
MI.2.2	Compare and contrast bacterial and viral infections with regard to their diagnosis, treatment and outcome.
MI.2.3	Describe how antibiotics disrupt the functioning of bacteria to stop a bacterial infection.
MI.2.4	Understand how bacteria can develop resistance to antibiotics.
MI.2.5	Explain human behaviors that promote the development of antibiotic resistant bacteria in our population.
MI.2.6	Understand the role of vaccination in the prevention and treatment of disease and how this has impacted disease trends.
MI.2.7	Describe the molecular tools and recombinant DNA technologies used to produce vaccines.
MI.2.8	Describe how vaccines activate the body's immune system.

Domain 3: The Ear and Hearing Loss

Core Standard 3: Students investigate the physics of sound as well as learn how hearing works, and will conduct a variety of hearing assessments. Students will explore how damage to the outer,

middle, and/or inner ear results in hearing loss. Students will learn how to interpret audiograms and match up their patient case study with the corresponding audiogram.

	Standard
MI.3.1	Describe the three-dimensional structure of the human ear and how the structure relates to its function.
MI.3.2	Understand how diseases can affect the functioning of the ear.
MI.3.3	Describe how auditory function is measured and used to diagnose hearing problems.
MI.3.4	Understand the treatments for hearing loss and the bioethical concerns related to cochlear implants.

Domain 4: Genetic Screening

Core Standard 4: Students explore how to screen and evaluate the code in our DNA. Students will examine the available types of genetic testing and screening and discuss ethical implications of these tests. Students will focus on prenatal testing, newborn testing, and carrier screening; however, the use of genetic testing to screen for disease risk will also be addressed. Students will examine how the study of genetics will alter the way doctors and scientists treat disease, as well as the way humans reproduce. Students will learn about gene therapy, a potentially life-saving treatment for many debilitating genetic disorders.

	Standard
MI.4.1	Describe the different biotechnologies that are used in genetic testing.
MI.4.2	Describe how genetic testing is used to screen for disease risk.
MI.4.3	Describe the types of prenatal and newborn testing and screening that are available, the information they provide, their limitations, risks and ethical implications.
MI.4.4	Understand the role of gene therapy in treating genetically inherited diseases.
MI.4.5	Describe how vectors are engineered to transfer DNA to human cells.

Domain 5: Cancer

Core Standard 5: Students explore the diagnostic process used to determine the presence of cancerous cells, the risk factors and prevention of cancer, rehabilitation after disease or injury, and the design process for new medications, prosthetics, and nanotechnology.

	Standard
MI.5.1	Describe the different agents that cause changes in genetic material resulting in cancer.
MI.5.2	Describe the fundamental characteristics that all cancers have in common.
MI.5.3	Describe the different types of diagnostic imaging techniques that are currently use to detect and diagnose different forms of cancer.
MI.5.4	Describe the microscopic differences between cancer cells and normal cells.
MI.5.5	Understand that the sequence of an individual's DNA is the same in every cell and when compared with individuals of the same species will be mostly identical. Recognize that there are differences in how genes are expressed in tissues within an individual and between individuals of the same species.
MI.5.6	Describe how microarray technology is used to detect changes in gene

expression from the same tissue types of different individuals.

MI.5.7 Describe the molecular tests that are used to detect inherited cancers.

MI.5.8 Describe ways in which individuals can reduce their risk for developing cancer.

MI.5.9 Describe the most common cancer treatments and how these affect cancerous and noncancerous tissues.

MI.5.10 Describe how new cancer treatments are being developed and tailored to an individual's genetic profile.

Domain 6: Synthesizing Proteins to Treat Human Disease

Core Standard 6: Students learn how to produce and purify a protein in a laboratory setting in order to understand how human insulin is produced to treat diabetics.

Standard	
MI.6.1	Demonstrate how amino acid sequence determines protein shape.
MI.6.2	Explain how bacterial plasmids are used to produce human proteins.
MI.6.3	Describe current techniques in biotechnology that are employed for large scale production of transgenic human proteins.
MI.6.4	Describe the role of insulin and its large scale production in the treatment of diabetes.

Domain 7: ORGAN FAILURE

Core Standard 7: Students investigate current organ transplant technologies and construct an argument from the perspective of different stakeholders.

Standard	
MI.7.1	Describe how organ failure is diagnosed, what the available treatment options are and how a determination is made regarding organ transplant.
MI.7.2	Describe how organs are matched using blood typing and HLA typing.
MI.7.3	Describe general surgical techniques employed in live organ donor transplant.
MI.7.4	Identify which human organs can be replaced and explain why other organs cannot.
MI.7.5	Describe the benefits and risks of using xenotransplantation and tissue engineering for replacement.

Process Standards

Reading Standards for Literacy in Science

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

11-12.RS.1 Cite specific textual evidence to support analysis of science, attending to important distinctions the author makes and to any gaps or inconsistencies in the account..

11-12.RS.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.RS.3 Follow precisely a complex multistep procedure when carrying out experiments or taking measurements; analyze the specific results based on explanations in the text

Craft and Structure

11-12.RS.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 11-12 texts and topics*.

11-12.RS.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

11-12.RS.6 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.

Integration of Knowledge and Ideas

11-12.RS.7 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.RS.8 Evaluate the hypotheses, data, analysis, and conclusions in a science text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

11-12.RS.9 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.

Range of Reading and Level of Text Complexity

11-12.RS.10 By the end of grade 12, read and comprehend science texts in the grades 11-CCR text complexity band independently and proficiently.

Writing Standards for Literacy in Science

Text Types and Purposes

11-12.WS.1 Write arguments focused on *discipline-specific content*.

a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
e. Provide a concluding statement or section that follows from or supports the argument presented.

11-12.WS.2 Write informative/explanatory texts, including scientific procedures/ experiments.

a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

11-12.WS.3 *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/ explanatory texts. In science, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

11-12.WS.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

11-12.WS.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

11-12.WS.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

11-12.WS.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) 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.WS.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectivity to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

11-12.WS.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

11-12.WS.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.