

## 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 Human Body Systems

*PLTW Human Body Systems* is a course designed to engage students in the study of basic human physiology and the care and maintenance required to support the complex systems. Using a focus on human health, students will employ a variety of monitors to examine body systems (respiratory, circulatory, and nervous) at rest and under stress, and observe the interactions between the various body systems. Students will use appropriate software to design and build systems to monitor body functions. 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: 5216
- Recommended Grade Level: Grade 10
- Recommended Prerequisites: PLTW Principles of the Biomedical Sciences
- 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 10012: Human Body Systems
  - 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: Identity

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**Core Standard 1:** Students investigate the body systems and functions that all humans have in common, and then examine differences between tissues, such as bone and muscle, and in molecules, such as DNA, to pinpoint unique identity.

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| <b>HBS.1.1</b> | Understand the hierarchical structure and organization of the human body in terms of body systems, organs, and tissues.   |
| <b>HBS.1.2</b> | Explain the functions of the human body systems and describe how multiple body systems are interconnected. Indicate how damage to one system can impact other functions in other systems. |
| <b>HBS.1.3</b> | Identify the main types of tissue that comprise the organs and relate the structure of a tissue to its function.  |
| <b>HBS.1.4</b> | Describe how differential gene expression within different cell types is related to unique functions and identities of different tissues.   |
| <b>HBS.1.5</b> | Explain how individuals exhibit variation in tissue distribution and structure and how this contributes to personal identity.   |
| <b>HBS.1.6</b> | Describe how the body systems work together to maintain homeostasis.  |

### Domain 2: Communication

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**Core Standard 2:** Students investigate modes of communication within the human body as well as the ways humans communicate with the outside world. Students investigate the roles of electrical and chemical signals in communication and response in the human body.

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| <b>HBS.2.1</b> | Describe the structure and function of the central nervous system. |
| <b>HBS.2.2</b> | Describe how brain functions are mapped onto physical locations    |

within the brain (brain mapping) and determine the regions of the brain responsible for specific human actions and emotions.

- HBS.2.3** Describe the relationship between neuron structure and function, including an understanding of how signals are created, transmitted and received in the human body.
- HBS.2.4** Describe ways that communication could be disrupted and how that would impact the function of the human body.
- HBS.2.5** Compare reflex and reaction times and relate to processing in the brain.
- HBS.2.6** Distinguish between various nervous system disorders and describe their impact on quality of life.
- HBS.2.7** Identify the endocrine and exocrine glands and their functions within the human body.
- HBS.2.8** Describe how hormones interact with target cells in the human body.
- HBS.2.9** Demonstrate use of negative feedback in the endocrine system to control body functions.
- HBS.2.10** Explain how stimulus in the form of light is processed by the eye and interpreted by the brain.
- HBS.2.11** Describe the structures within the human eye that work to focus and process light.
- HBS.2.12** Identify diseases and dysfunction within the eye and how these are related to the functioning of the eye.

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**Domain 3: Flow of energy and matter/ resources to sustain life**

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**Core Standard 3:** Students investigate the human body systems that work to obtain, distribute, or process the body's primary resources for energy and power—food, oxygen, and water.

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- HBS.3.1** Describe the relationship between the body systems that process and distribute food, water and oxygen.
- HBS.3.2** Describe the structure and function of the organs in the digestive system.

- HBS.3.3** Describe the mechanical and chemical activity of the digestive organs, including the action of accessory organs.
- HBS.3.4** Describe the effects of temperature, pH, and enzyme concentration on enzyme activity.
- HBS.3.5** Explain how energy is stored and released from ATP. Describe how ATP is recycled in cells.
- HBS.3.6** Describe the relationship between calorie consumption, expenditure and overall health.
- HBS.3.7** Describe the structure of the respiratory system, the mechanics of breathing and how the structure of the lungs facilitates gas exchange.
- HBS.3.8** Describe how oxygen transport is facilitated between the respiratory and cardiovascular systems and determine the effect of a variety of diseases on oxygen transport.
- HBS.3.9** Analyze lung volume and oxygen absorption data at rest and after exercise to understand lung efficiency and capacity.
- HBS.3.10** Describe the structure and function of the component parts of the urinary system.
- HBS.3.11** Describe the normal composition of blood and urine and how this composition is affected by disease states.
- HBS.3.12** Explain how the body uses hormones to maintain water balance and interpret the effect of two different hormones on the nephron and overall water balance.
- HBS.3.13** Describe fluid and ion movement in the various sections of the nephron.
- HBS.3.14** Explain the relationship between the heart and lungs; trace the path of major circulatory routes.
- HBS.3.15** Describe the structure of blood vessels and identify the major arteries and veins; name the body region supplied by each.

Describe the major circulatory routes.

- HBS.3.16** Describe the conduction system of the heart and identify the pathway of impulses through this system.
- HBS.3.17** Describe how to measure blood pressure and understand the relationship between blood pressure and pulse points. Use this information to recognize disease states.
- HBS.3.18** Apply knowledge of heart rate to calculate and interpret cardiac output values; relate cardiac output values to the health of other body systems.

#### **Domain 4: Musculoskeletal System**

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**Core Standard 4:** Students investigate the movement of the human body. Student will examine bones and joints and how muscles and bones work together to move the body. Students will combine information about power and movement to describe how the body fuels and responds to exercise.

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- HBS.4.1** Describe the structure and function of the skeletal system and the main bones of the human skeleton.
- HBS.4.2** Compare the structure and function of compact and spongy bone.
- HBS.4.3** Describe the changes in bone structure as we age.
- HBS.4.4** Describe the types of bone fractures; interpret X-rays to determine fracture types and possible damage to organs.
- HBS.4.5** Describe bone remodeling and distinguish between each stage of this process. Understand the role of hormones (e.g. calcitonin and parathyroid hormone) and calcium balance in this process.
- HBS.4.6** Apply knowledge of bone markings, landmarks and bone measurements to human identification.
- HBS.4.7** Describe the structure and function of the different types of joints in the human body.
- HBS.4.8** Describe the range of motion for different joints and determine ways to improve joint flexibility.

- HBS.4.9** Describe the structure and function of the different types of muscle tissue in the human body. Describe how the structure of muscles can differ between individuals and how this contributes to human identity.
- HBS.4.10** Identify the requirements for muscle contraction and explain the sliding filament mechanism.
- HBS.4.11** Describe how different muscles work together in a group.
- HBS.4.12** Understand the role of nerves in the functioning of muscles.
- HBS.4.13** Describe the role of exercise on skeletal muscle tissue.
- HBS.4.14** Understand how to measure muscle fatigue and how feedback, competition and coaching affect an athlete's ability to overcome muscle fatigue.
- HBS.4.15** Describe how the body responds to the physical stress of an athletic event and how an athlete prepares to overcome this.

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**Domain: Skin**

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**Core Standard 5:** Students will identify key layers of tissues as well the epithelial and connective tissue at the core of human skin. They will relate the tissues and the accessory organs such as sweat glands and hair follicles to the many functions of the skin. Students will be able to discuss how damage to the skin can affect function of the skin and of other body systems.

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- HBS.5.1** Describe the structure and function of human skin.
- HBS.5.2** Explain how the human body senses and processes signals of pain.
- HBS.5.3** Explain why pain can be considered a protective mechanism.
- HBS.5.4** Distinguish between different degrees of burns and relate to damage in skin layers.
- HBS.5.5** Interpret how burn damage to the skin will affect the function of the organ and overall homeostasis in the body.
- HBS.5.6** Describe how burn damage to skin can affect quality of life.

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**Domain 6: Lymphatic and Immune Systems**

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**Core Standard 6:** Students will research the structure and function of the lymphatic and immune system. Students will understand lymphatic and immune system functions to drain and distribute fluid in the body as well as protect the human body against specific invaders.

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- HBS.6.1** Describe the structures and functions of the lymphatic and immune systems.
- HBS.6.2** Describe the interaction between antigens and antibodies.
- HBS.6.3** Explain how blood cells are involved in specific immunity; apply knowledge of specific immunity to describe how vaccines work.
- HBS.6.4** Interpret a pedigree to determine blood types; apply knowledge of antigen-antibody interactions to determine potential blood donors for a transfusion.
- HBS.6.5** Describe how antibody concentrations are affected by infection.
- HBS.6.6** Relate knowledge of antibody response to specific actions of cell types in the immune system.

### **Domain 7: Investigating Medical Data**

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**Core Standard 7:** Students use medical data to investigate human body systems. Students use current techniques in biotechnology to unlock the clues of identity found in DNA.

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- HBS.7.1** Evaluate medical data and use this information to build a unique case study and design a medical intervention.
- HBS.7.2** Use current biotechnology processes and techniques in order to compare similarities and differences in DNA samples from different individuals.
- HBS.7.3** Describe and apply biometric techniques, such as fingerprint analysis, facial feature recognition and retinal pattern analysis, to establish human identity and recognize the ethical issues associated with biometrics.

## **Process Standards**

### **Reading Standards for Literacy in Science**

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10.

#### **Key Ideas and Details**



- 9-10.RS.1** Cite specific textual evidence to support analysis of science texts, attending to the precise details of explanations or descriptions.
- 9-10.RS.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 summary of the text.
- 9-10.RS.3** Follow precisely a complex multistep procedure when carrying out experiments or taking measurements, attending to special cases or exceptions defined in the text.

#### **Craft and Structure**

- 9-10.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 9-10 texts and topics*.
- 9-10.RS.5** 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.RS.6** 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.

#### **Integration of Knowledge and Ideas**

- 9-10.RS.7** Translate quantitative 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.RS.8** Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific problem.
- 9-10.RS.9** 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.

#### **Range of Reading and Level of Text Complexity**

- 9-10.RS.10** By the end of grade 10, read and comprehend science texts in the grades 9-10 text complexity band independently and proficiently.

### **Writing Standards for Literacy in Science**

#### **Text Types and Purposes**

- 9-10.WS.1** Write arguments focused on *discipline-specific content*.

- a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- c. Use words, phrases, and clauses 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.

**9-10.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 with well-chosen, relevant, and sufficient 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 and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
- e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

- 9-10.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**

- 9-10.WS.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 9-10.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.
- 9-10.WS.6** Use technology, including the Internet, 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.

#### **Research to Build and Present Knowledge**

- 9-10.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.
- 9-10.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 selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- 9-10.WS.9** Draw evidence from informational texts to support analysis, reflection, and research.

#### **Range of Writing**

- 9-10.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.