**Lesson Plan: Digestion & Excretion**

*Last Updated: 11/4/22*

**Total Expected Time**

This set of labs includes five labs, approximately 30–60 minutes each, for a total expected time of 3 hours.

**Resources**

Required resources for students:

* Visible Body’s Anatomy Learn Site articles and glossaries
  + Digestive System Overview: <https://www.visiblebody.com/learn/digestive/digestive-10-facts>
  + Accessory Organs: <https://www.visiblebody.com/learn/digestive/digestive-accessory-organs>
  + Propulsion and Peristalsis: <https://www.visiblebody.com/learn/digestive/digestive-propulsion-and-peristalsis>
  + Absorption and Elimination: <https://www.visiblebody.com/learn/digestive/digestive-absorption-and-elimination>
  + Urinary System Structures: [https://www.visiblebody.com/learn/urinary/urinary-system-structures](https://www.visiblebody.com/learn/urinary/urinary-system-structures%5C)
  + Urine Creation:   
    <https://www.visiblebody.com/learn/urinary/urine-creation>
  + Urine Storage and Elimination: <https://www.visiblebody.com/learn/urinary/urine-storage-and-elimination>
  + Digestive System Glossary:   
    <https://www.visiblebody.com/learn/digestive/glossary>
  + Urinary System Glossary:   
    <https://www.visiblebody.com/learn/urinary/glossary>
* Worksheet (see below)

Additional resources for students and teachers:

* This lesson assumes that students have a basic understanding of the digestive and urinary systems.
  + They can read this Visible Body eBook to learn more about the digestive system: <https://www.visiblebody.com/hubfs/eBooks/2019%20eBooks/VisibleBody_DigestiveSystem_eBook_2019.pdf>
  + They can read this Visible Body eBook to learn more about the urinary system: <https://www.visiblebody.com/hubfs/eBooks/2020%20eBooks/VisibleBody_Urinary_System_eBook_Nov2020.pdf>
  + They can read this OpenStax page to learn more about the digestive system: <https://openstax.org/books/concepts-biology/pages/16-2-digestive-system>
  + They can read this OpenStax page to learn more about the kidneys’ role in osmoregulation: <https://openstax.org/books/concepts-biology/pages/16-1-homeostasis-and-osmoregulation>

**Objectives**

At the end of this lesson, students should be able to:

1. Define digestion. Identify and describe each of its six steps.
2. Compare mechanical and chemical digestion.
3. Identify/label the structures of the alimentary canal and describe their basic functions.
4. Identify the substances produced by the body to aid in chemical digestion.
5. Identify the accessory digestive organs and explain the role each one plays in digestion.
6. Explain the role of the kidneys in osmoregulation.
7. Describe the three steps of urine formation.
8. Describe the path of urine through the urinary system and the process of micturition.
9. Compare the male and female urinary systems.

**Essential Questions**

1. What are the six steps of digestion and which structures are involved in each one?
2. What are the accessory organs of the digestive system and what are their functions?
3. How does the urinary system help maintain homeostasis in the blood?
4. What are the key differences between the male and female urinary system structures?

**Key Structure Identification**

In their answers, students will identify the following structures:

* Digestive system: Alimentary canal, oral cavity, teeth, tongue, pharynx, esophagus, epiglottis, stomach, small intestine, villi, large intestine, cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum, anus (anal canal), internal anal sphincter, and external anal sphincter.
* Accessory digestive organs: Common bile duct, cystic duct, hepatic duct, salivary glands, pancreas, liver, and gallbladder.
* Urinary system: Kidney, renal vein, renal artery, nephrons, ureter, urinary bladder, detrusor muscle, urethra (female), urethra (male), internal urethral sphincter, and external urethral sphincter.

**Introduction**

10 minutes: Use the Anatomy Learn Site materials, as well as the eBooks and OpenStax pages referenced in the additional resources above, to give students a brief introduction to the basic structures and functions of the digestive and urinary systems. Give a brief summary of the path ingested food takes through the digestive system, highlighting the role of each structure along the way. Explain the path of urine from its creation in the kidneys to its storage in and release from the bladder. Describe the differences between the male and female urethra.

**Student Activities**

These lab activities are designed to be modular and can be used as individual labs or grouped together into one lab session.

* Background Questions: These could be assigned as homework before lab
* Lab 1: Digestive System Overview (30-minute lab session)
  + Activity 1: Label the key structures of the digestive system
  + Activity 2: Explore the functions of digestive system structures
* Lab 2: Accessory Organs of the Digestive System (30-minute lab session)
  + Activity 1: Label the accessory digestive organs
  + Activity 2: Explore the functions of the accessory digestive organs
* Lab 3: Digestion, Absorption, and Elimination (60-minute lab session)
  + Activity 1: Explore how food travels through the digestive system
  + Activity 2: Simulate digestion
  + Activity 3: Explore the structures involved in absorption and elimination
* Lab 4: Urinary System Overview (30-minute lab session)
  + Activity 1: Explore urinary system structures
  + Activity 2: Compare female and male urinary anatomy
* Lab 5: Urine Creation, Storage, and Elimination (30-minute lab session)
  + Activity 1: Explore the three stages of urine creation that occur in the kidneys
  + Activity 2: Explore the structure of the bladder and the process of micturition

Check students’ work using the answer key.

**NGSS and State Science Correlations**

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| **Next Generation Science Standards (NGSS)** |

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| **Science** |

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| Grades **9-12** - Adopted: **2013** | | | |
| **STRAND** | **NGSS.HS-LS** | **LIFE SCIENCE** |
| **TITLE** | **HS-LS1** | **From Molecules to Organisms: Structures and Processes** |
|  |  | **Students who demonstrate understanding can:** |
| **PERFORMANCE EXPECTATION** | **HS-LS1-2** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **PERFORMANCE EXPECTATION** | **HS-LS1-6** | **Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** |

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| **Texas Essential Knowledge and Skills (TEKS)** |

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| **Science** |

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| Grades **9-12** - Adopted: **2017** | | | |
| **TEKS** | **§112.34** | **Biology (One Credit), Adopted 2017 – The provisions of §§112.34, 112.35, 112.38, and 112.39 of this subchapter adopted in 2017 shall be implemented by school districts beginning with the 2018-2019 school year.** |
| **STUDENT EXPECTATION** | **§112.34.c** | **Knowledge and skills.** |
| **GRADE LEVEL EXPECTATION** | **§112.34.c.3** | **Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:** |
| **INDICATOR** | **§112.34.c.3.E** | **evaluate models according to their limitations in representing biological objects or events** |

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| **TEKS** | **§112.34** | **Biology (One Credit), Adopted 2017 – The provisions of §§112.34, 112.35, 112.38, and 112.39 of this subchapter adopted in 2017 shall be implemented by school districts beginning with the 2018-2019 school year.** |
| **STUDENT EXPECTATION** | **§112.34.c** | **Knowledge and skills.** |
| **GRADE LEVEL EXPECTATION** | **§112.34.c.9** | **Science concepts. The student knows the significance of various molecules involved in metabolic processes and energy conversions that occur in living organisms. The student is expected to:** |
| **INDICATOR** | **§112.34.c.9.A** | **compare the functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids** |
| **INDICATOR** | **§112.34.c.9.C** | **identify and investigate the role of enzymes** |

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| **TEKS** | **§112.34** | **Biology (One Credit), Adopted 2017 – The provisions of §§112.34, 112.35, 112.38, and 112.39 of this subchapter adopted in 2017 shall be implemented by school districts beginning with the 2018-2019 school year.** |
| **STUDENT EXPECTATION** | **§112.34.c** | **Knowledge and skills.** |
| **GRADE LEVEL EXPECTATION** | **§112.34.c.10** | **Science concepts. The student knows that biological systems are composed of multiple levels. The student is expected to:** |
| **INDICATOR** | **§112.34.c.10.C** | **analyze the levels of organization in biological systems and relate the levels to each other and to the whole system** |

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| **California Content Standards** |

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| **Science** |

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| Grades **9-12** - Adopted: **2013** | | |
| **CONTENT STANDARD / DOMAIN / PART** | **CA.HS-LS.** | **LIFE SCIENCE** |
| **PERFORMANCE STANDARD / MODE** | **HS-LS1.** | **From Molecules to Organisms: Structures and Processes** |
| **EXPECTATION / SUBSTRAND** |  | **Students who demonstrate understanding can:** |
| **FOUNDATION / PROFICIENCY LEVEL** | **HS-LS1-2.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **HS-LS1-6.** | **Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Key Ideas and Details** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.2.** | **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.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Craft and Structure** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.4.** | **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.** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.5.** | **Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Integration of Knowledge and Ideas** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.7.** | **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.** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.9.** | **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.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Range of Reading and Level of Text Complexity** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.10.** | **By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Text Types and Purposes** |
| **EXPECTATION / SUBSTRAND** | **WHST.9-10.1.** | **Write arguments focused on discipline-specific content.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.1.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.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Text Types and Purposes** |
| **EXPECTATION / SUBSTRAND** | **WHST.9-10.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.2.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).** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Production and Distribution of Writing** |
| **EXPECTATION / SUBSTRAND** | **WHST.9-10.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **EXPECTATION / SUBSTRAND** | **WHST.9-10.5.** | **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.** |

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| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **PERFORMANCE STANDARD / MODE** |  | **Range of Writing** |
| **EXPECTATION / SUBSTRAND** | **WHST.9-10.10.** | **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.** |

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| **Florida Standards** |

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| **Science** |

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| Grades **9-12** - Adopted: **2008** | | |
| **BODY OF KNOWLEDGE** | **FL.SC.912.N.** | **Nature of Science** |
| **BIG IDEA** | **SC.912.N.1.** | **The Practice of Science - A: Scientific inquiry is a multifaceted activity; The processes of science include the formulation of scientifically investigable questions, construction of investigations into those questions, the collection of appropriate data, the evaluation of the meaning of those data, and the communication of this evaluation. B: The processes of science frequently do not correspond to the traditional portrayal of ''the scientific method.'' C: Scientific argumentation is a necessary part of scientific inquiry and plays an important role in the generation and validation of scientific knowledge. D: Scientific knowledge is based on observation and inference; it is important to recognize that these are very different things. Not only does science require creativity in its methods and processes, but also in its questions and explanations.** |
| **BENCHMARK** | **SC.912.N.1.1.** | **Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:** |
| **INDICATOR** | **SC.912.N.1.1.7.** | **Pose answers, explanations, or descriptions of events** |

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| **BODY OF KNOWLEDGE** | **FL.SC.912.N.** | **Nature of Science** |
| **BIG IDEA** | **SC.912.N.3.** | **The Role of Theories, Laws, Hypotheses, and Models - The terms that describe examples of scientific knowledge, for example: ''theory,'' ''law,'' ''hypothesis'' and ''model'' have very specific meanings and functions within science.** |
| **BENCHMARK** | **SC.912.N.3.5.** | **Describe the function of models in science, and identify the wide range of models used in science.** |

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| **BODY OF KNOWLEDGE** | **FL.SC.912.L.** | **Life Science** |
| **BIG IDEA** | **SC.912.L.14.** | **Organization and Development of Living Organisms - A. Cells have characteristic structures and functions that make them distinctive. B. Processes in a cell can be classified broadly as growth, maintenance, reproduction, and homeostasis. C. Life can be organized in a functional and structural hierarchy ranging from cells to the biosphere. D. Most multicellular organisms are composed of organ systems whose structures reflect their particular function.** |
| **BENCHMARK** | **SC.912.L.14.32.** | **Describe the anatomy and physiology of the endocrine system.** |
| **BENCHMARK** | **SC.912.L.14.45.** | **Describe the histology of the alimentary canal and its associated accessory organs.** |
| **BENCHMARK** | **SC.912.L.14.46.** | **Describe the physiology of the digestive system, including mechanical digestion, chemical digestion, absorption and the neural and hormonal mechanisms of control.** |
| **BENCHMARK** | **SC.912.L.14.47.** | **Describe the physiology of urine formation by the kidney.** |
| **BENCHMARK** | **SC.912.L.14.48.** | **Describe the anatomy, histology, and physiology of the ureters, the urinary bladder and the urethra.** |

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| **BODY OF KNOWLEDGE** | **FL.SC.912.L.** | **Life Science** |
| **BIG IDEA** | **SC.912.L.18.** | **Matter and Energy Transformations - A. All living things are composed of four basic categories of macromolecules and share the same basic needs for life. B. Living organisms acquire the energy they need for life processes through various metabolic pathways (primarily photosynthesis and cellular respiration). C. Chemical reactions in living things follow basic rules of chemistry and are usually regulated by enzymes. D. The unique chemical properties of carbon and water make life on Earth possible.** |
| **BENCHMARK** | **SC.912.L.18.4.** | **Describe the structures of proteins and amino acids. Explain the functions of proteins in living organisms. Identify some reactions that amino acids undergo. Relate the structure and function of enzymes.** |
| **BENCHMARK** | **SC.912.L.18.11.** | **Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.** |

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| Grades **9-12** - Adopted: **2014** | | |
| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
| **BIG IDEA** | **LAFS.910.RST.1.** | **Key Ideas and Details** |
| **BENCHMARK** | **LAFS.910.RST.1.2.** | **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.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
| **BIG IDEA** | **LAFS.910.RST.2.** | **Craft and Structure** |
| **BENCHMARK** | **LAFS.910.RST.2.4.** | **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.** |
| **BENCHMARK** | **LAFS.910.RST.2.5.** | **Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
| **BIG IDEA** | **LAFS.910.RST.3.** | **Integration of Knowledge and Ideas** |
| **BENCHMARK** | **LAFS.910.RST.3.7.** | **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.** |
| **BENCHMARK** | **LAFS.910.RST.3.9.** | **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.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
| **BIG IDEA** | **LAFS.910.RST.4.** | **Range of Reading and Level of Text Complexity** |
| **BENCHMARK** | **LAFS.910.RST.4.10.** | **By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
| **BIG IDEA** | **LAFS.910.WHST.1.** | **Text Types and Purposes** |
| **BENCHMARK** | **LAFS.910.WHST.1.1.** | **Write arguments focused on discipline-specific content.** |
| **INDICATOR** | **LAFS.910.WHST.1.1.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.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
| **BIG IDEA** | **LAFS.910.WHST.1.** | **Text Types and Purposes** |
| **BENCHMARK** | **LAFS.910.WHST.1.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
| **BIG IDEA** | **LAFS.910.WHST.2.** | **Production and Distribution of Writing** |
| **BENCHMARK** | **LAFS.910.WHST.2.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **BENCHMARK** | **LAFS.910.WHST.2.5.** | **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.** |

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| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
| **BIG IDEA** | **LAFS.910.WHST.4.** | **Range of Writing** |
| **BENCHMARK** | **LAFS.910.WHST.4.10.** | **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.** |