**Lesson Plan: Respiration**

*Last Updated: 11/4/22*

**Total Expected Time**

This set of labs includes four labs, 25–45 minutes each, for a total expected time of approximately 2 hours.

**Resources**

Required resources for students:

* Visible Body’s Anatomy Learn Site articles and glossary
	+ 5 Functions of the Respiratory System: <https://www.visiblebody.com/learn/respiratory/5-functions-of-respiratory-system>
	+ Upper Respiratory System: <https://www.visiblebody.com/learn/respiratory/upper-respiratory-system>
	+ Lower Respiratory System: <https://www.visiblebody.com/learn/respiratory/lower-respiratory-system>
	+ Respiratory System Glossary: <https://www.visiblebody.com/learn/respiratory/glossary>
* Worksheet (see below)

Additional resources for students and teachers:

* This lesson assumes that students have a basic understanding of the respiratory system.
	+ They can read this Visible Body eBook to learn more about the structures of the respiratory system: <https://www.visiblebody.com/hubfs/eBooks/UPDATED%20FOR%202017/VisibleBody_Respiratory%20System%20EBook_2017.pdf?hsLang=en>
	+ They can read this Visible Body eBook to learn more about the anatomy and physiology of speech: <https://www.visiblebody.com/hubfs/eBooks/2020%20eBooks/VisibleBody_Anatomy_of_Speech_021020.pdf>
	+ They can read this OpenStax page to learn more about how the circulatory and respiratory systems work together: <https://openstax.org/books/concepts-biology/pages/16-3-circulatory-and-respiratory-systems>

**Objectives**

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

1. Identify/label the major structures of the respiratory system and describe their functions.
2. Define pulmonary ventilation and identify the structures involved. Describe the changes in lung volume and air pressure during pulmonary ventilation.
3. Explain the difference between internal and external respiration.
4. Explain the role of the respiratory system in producing speech and identify the structures involved.
5. Explain the role of the respiratory system in the sense of smell.
6. Describe the series of branching airways that lead to the alveoli.
7. Explain the structural differences between the right and left lungs.
8. Describe the role of the alveoli in gas exchange.

**Essential Questions**

1. What muscle actions and changes in lung volume and air pressure occur during pulmonary ventilation?
2. What are the key structures and airways of the upper and lower respiratory system?
3. What is the role of the respiratory system in olfaction and which structures are involved?
4. What is the role of the respiratory system in speech production and which structures are involved?
5. How do the circulatory and respiratory systems work together to keep the body supplied with oxygen?
6. What is the role of the alveoli in gas exchange?

**Key Structure Identification**

In their answers, students will identify the following structures:

* Upper respiratory system: Epiglottis, hyoid, laryngopharynx, larynx, nasal cavity, nasal septum, nasopharynx, oropharynx, paranasal sinuses, and vocal folds.
* Lower respiratory system: Diaphragm, external intercostal muscles, lungs, primary bronchi, secondary bronchi, trachea, tracheal cartilaginous rings, alveolus, alveolar cavities, bronchiolar smooth muscle, pulmonary capillary beds, pulmonary veins, pulmonary arteries, respiratory bronchiole, and terminal bronchiole.

**Introduction**

10 minutes: Use the Anatomy Learn Site materials, as well as the OpenStax pages and eBooks referenced in the additional resources above, to give students a brief introduction to the basic structures and functions of the respiratory system. Discuss the differences between pulmonary ventilation (breathing), external respiration (gas exchange), and internal respiration. Review the structures and airways of the upper and lower respiratory system and their functions.

**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: Pulmonary Ventilation (25-minute lab session)
	+ Activity 1: Explore the process of pulmonary ventilation
* Lab 2: The Upper Respiratory System (30-minute lab session)
	+ Activity 1: Label the key structures of the upper respiratory system
	+ Activity 2: Explore the functions of the upper respiratory structures
* Lab 3: The Lower Respiratory System (30-minute lab session)
	+ Activity 1: Label the structures of the lower respiratory system
	+ Activity 2: Label the structures of the alveoli
	+ Activity 3: Explore the functions of the lower respiratory structures
* Lab 4: Obstructed Airways (45-minute lab session)
	+ Activity 1: Measure perceived dyspnea
	+ Activity 2: Explore your perceived dyspnea ratings

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.** |

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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.2** | **Scientific processes. The student uses scientific practices and equipment during laboratory and field investigations. The student is expected to:** |
| **INDICATOR** | **§112.34.c.2.F** | **collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as data-collecting probes, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, balances, gel electrophoresis apparatuses, micropipettes, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures** |
| **INDICATOR** | **§112.34.c.2.G** | **analyze, evaluate, make inferences, and predict trends from data** |

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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.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.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.** |

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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.** |
| **EXPECTATION / SUBSTRAND** | **RST.9-10.3.** | **Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.** |

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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.1.1.2.** | **Conduct systematic observations** |
| **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.14.43.** | **Describe the histology of the respiratory system.** |
| **BENCHMARK** | **SC.912.L.14.44.** | **Describe the physiology of the respiratory system including the mechanisms of ventilation, gas exchange, gas transport and the mechanisms that control the rate of ventilation.** |
| **BENCHMARK** | **SC.912.L.14.50.** | **Describe the structure of vertebrate sensory organs. Relate structure to function in vertebrate sensory systems.** |

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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.** |
| **BENCHMARK** | **LAFS.910.RST.1.3.** | **Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.** |

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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.** |