**Lesson Plan: Photosynthesis**

*Last updated: 3/27/2024*

**Total Expected Time**

This set of labs includes three labs, approximately 30–45 minutes each, for a total expected time of 2 hours.

**Resources**

Required resources for students:

* Visible Biology: <https://www.visiblebody.com/teaching-anatomy/courseware-biology>
	+ Use Visible Body’s interactive 3D models and 3D simulation models to learn about the process of photosynthesis. Select the info icon to learn more about each model. Select any structure and then select the book icon to read its definition and select the audio icon to hear the pronunciation of the structure name.
* Visible Body’s Biology Learn Site articles and glossaries
	+ Overview of Photosynthesis: Reactants and Products: <https://www.visiblebody.com/learn/biology/photosynthesis/reactants-products>
	+ Leaf Structures Involved in Photosynthesis: <https://www.visiblebody.com/learn/biology/photosynthesis/leaf-structures>
	+ Light-Dependent and Light-Independent Reactions: <https://www.visiblebody.com/learn/biology/photosynthesis/reactions>
	+ Photosynthesis Glossary: <https://www.visiblebody.com/learn/biology/photosynthesis/glossary>
* Lab Activity: Photosynthesis: <https://www.visiblebody.com/hubfs/lab-activities/biology-site-license/visible-biology-site-license-lab-activities_photosynthesis_student.pdf?hsLang=en>

Additional resources for students and teachers:

* This lesson assumes that students have a basic understanding of photosynthesis. Students can read each of the following sections of the OpenStax Concepts of Biology textbook to learn more about the following topics:
	+ [Overview of Photosynthesis](https://openstax.org/books/concepts-biology/pages/5-1-overview-of-photosynthesis)
	+ [The Light-Dependent Reactions of Photosynthesis](https://openstax.org/books/concepts-biology/pages/5-2-the-light-dependent-reactions-of-photosynthesis)
	+ [The Calvin Cycle](https://openstax.org/books/concepts-biology/pages/5-3-the-calvin-cycle)
* Before starting the Floating Leaf Disk Experiment, students could watch this Youtube video, which outlines the procedure followed in the lab: <https://www.youtube.com/watch?v=ZnY9_wMZZWI>.

**Objectives**

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

1. Identify and explore the reactants and products of photosynthesis.
2. Identify the leaf structures that are involved in photosynthesis.
3. Identify the chloroplast structures that are involved in photosynthesis.
4. Explore the roles plant structures play in photosynthesis.
5. Describe the process of photosynthesis.
6. Draw a chloroplast and label its key structures.
7. Identify how the processes of photosynthesis and cellular respiration are related.

**Essential Questions**

1. What are the reactants and products of photosynthesis? What is the photosynthesis equation?
2. Why is photosynthesis important for a plant’s survival?
3. What are the main steps in the process of photosynthesis?

**Key Structure Identification**

In their answers, students will identify the following structures:

* Reactants and products of photosynthesis: Carbon dioxide (CO2) molecules, glucose (C6H12O6) molecule, oxygen (O2) molecules, photons of light, and water (H2O) molecules.
* Leaf structures: Guard cells, lower epidermis, palisade mesophyll, phloem, spongy mesophyll, stoma, upper epidermis, and xylem.
* Chloroplast structures: Carbon dioxide (CO2) molecules, chlorophyll, glucose (C6H12O6) molecule, granum, inner membrane, outer membrane, oxygen (O2) molecules, photons of light, stroma, thylakoid, and water (H2O) molecules.

**Introduction**

10 minutes: Use the content in Visible Biology and the Biology Learn Site, as well as the OpenStax pages referenced in the additional resources above, to give students a brief introduction to photosynthesis. Focus on the reactants and products, leaf and chloroplast structures, and light-dependent and light-independent reactions.

**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: Plant Structures, Reactants, and Products of Photosynthesis (45 minute lab session)
	+ Activity 1: Label the reactants and products of photosynthesis
	+ Activity 2: Label the leaf structures involved in photosynthesis
	+ Activity 3: Label a chloroplast
	+ Activity 4: Explore the roles plant structures play in photosynthesis
	+ Activity 5: Explore the reactants and products of photosynthesis
* Lab 2: Observe Photosynthesis—Floating Leaf Disk Experiment (45 minute lab session)
* Lab 3: Put It Together—Photosynthesis in the Chloroplast (30 minute lab session)

Check students’ work using the answer key.

**NGSS and State Science Correlations**

| **Next Generation Science Standards (NGSS)** |
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| **Science** |
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| Grades **9-12** - Adopted: **2013** |
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| **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-LS1-5** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |

| **STRAND** | **NGSS.HS-LS** | **LIFE SCIENCE** |
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| **TITLE** | **HS-LS2** | **Ecosystems: Interactions, Energy, and Dynamics** |
|  |  | **Students who demonstrate understanding can:** |
| **PERFORMANCE EXPECTATION** | **HS-LS2-5** | **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |

| **Texas Essential Knowledge and Skills (TEKS)** |
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| **Science** |
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| Grades **9-12** - Adopted: **2017** |
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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.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** |
| **INDICATOR** | **§112.34.c.2.H** | **communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports** |

| **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.** |
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| **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.A** | **analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student** |
| **INDICATOR** | **§112.34.c.3.E** | **evaluate models according to their limitations in representing biological objects or events** |

| **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.** |
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| **STUDENT EXPECTATION** | **§112.34.c** | **Knowledge and skills.** |
| **GRADE LEVEL EXPECTATION** | **§112.34.c.4** | **Science concepts. The student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells. The student is expected to:** |
| **INDICATOR** | **§112.34.c.4.B** | **investigate and explain cellular processes, including homeostasis and transport of molecules** |

| **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.** |
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| **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.B** | **compare the reactants and products of photosynthesis and cellular respiration in terms of energy, energy conversions, and matter** |

| **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.** |
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| **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.B** | **describe the interactions that occur among systems that perform the functions of transport, reproduction, and response in plants** |
| **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** |

| **California Content Standards** |
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| **Science** |
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| Grades **9-12** - Adopted: **2013** |
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| **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-LS1-5.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.HS-LS.** | **LIFE SCIENCE** |
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| **PERFORMANCE STANDARD / MODE** | **HS-LS2.** | **Ecosystems: Interactions, Energy, and Dynamics** |
| **EXPECTATION / SUBSTRAND** |  | **Students who demonstrate understanding can:** |
| **FOUNDATION / PROFICIENCY LEVEL** | **HS-LS2-5.** | **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
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| **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.** |

| **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).** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
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| **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.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.RST.9-10.** | **Reading Standards for Literacy in Science and Technical Subjects** |
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| **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.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
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| **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.** |
| **FOUNDATION / PROFICIENCY LEVEL** | **WHST.9-10.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
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| **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).** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
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| **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.** |

| **CONTENT STANDARD / DOMAIN / PART** | **CA.WHST.9-10.** | **Writing Standards for Literacy in Science and Technical Subjects** |
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| **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.** |

| **Florida Standards** |
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| **Science** |
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| Grades **9-12** - Adopted: **2008** |
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| **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.1.1.6.** | **Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs)** |
| **INDICATOR** | **SC.912.N.1.1.7.** | **Pose answers, explanations, or descriptions of events** |

| **BODY OF KNOWLEDGE** | **FL.SC.912.N.** | **Nature of Science** |
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| **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.** |

| **BODY OF KNOWLEDGE** | **FL.SC.912.L.** | **Life Science** |
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| **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.14.2.** | **Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).** |
| **BENCHMARK** | **SC.912.L.14.7.** | **Relate the structure of each of the major plant organs and tissues to physiological processes.** |

| **BODY OF KNOWLEDGE** | **FL.SC.912.L.** | **Life Science** |
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| **BIG IDEA** | **SC.912.L.17.** | **Interdependence - A. The distribution and abundance of organisms is determined by the interactions between organisms, and between organisms and the non-living environment. B. Energy and nutrients move within and between biotic and abiotic components of ecosystems via physical, chemical and biological processes. C. Human activities and natural events can have profound effects on populations, biodiversity and ecosystem processes.** |
| **BENCHMARK** | **SC.912.L.17.9.** | **Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.** |

| **BODY OF KNOWLEDGE** | **FL.SC.912.L.** | **Life Science** |
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| **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.18.7.** | **Identify the reactants, products, and basic functions of photosynthesis.** |
| **BENCHMARK** | **SC.912.L.18.9.** | **Explain the interrelated nature of photosynthesis and cellular respiration.** |

| Grades **9-12** - Adopted: **2014** |
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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.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.** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
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| **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).** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
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| **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.** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.RST.** | **READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12** |
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| **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.** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
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| **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.** |
| **INDICATOR** | **LAFS.910.WHST.1.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
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| **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.** |
| **INDICATOR** | **LAFS.910.WHST.1.2.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).** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
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| **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.** |

| **BODY OF KNOWLEDGE** | **FL.LAFS.910.WHST.** | **WRITING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS** |
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| **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.** |

| **Pennsylvania STEELS Standards (AD 2022/IMP 2025)** |
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| **Science** |
| Grades **9-12** - Adopted: **2022** |
| **Discipline** |  **3.1.** | **Life Science** |
| **Strand** |  | **Structure and Function** |
| **Standard** |  **3.1.9-12.B.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **Discipline** |  **3.1.** | **Life Science** |
| **Strand** |  | **Organization for Matter and Energy Flow in Organisms** |
| **Standard** |  **3.1.9-12.E.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |
| **Discipline** |  **3.1.** | **Life Science** |
| **Strand** |  | **Cycles of Matter and Energy Transfer in Ecosystems** |
| **Standard** |  **3.1.9-12.K.** | **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |

| **Illinois Learning Standards** |
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| **Science** |
| Grades **9-10** - Adopted: **2014** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.HS-LS.** | **LIFE SCIENCE** |
| **LEARNING STANDARD / DISCIPLINE** |  **HS-LS1.** | **From Molecules to Organisms: Structures and Processes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  | **Students who demonstrate understanding can:** |
| **STANDARD** |  **HS-LS1-2.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **STANDARD** |  **HS-LS1-5.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.HS-LS.** | **LIFE SCIENCE** |
| **LEARNING STANDARD / DISCIPLINE** |  **HS-LS2.** | **Ecosystems: Interactions, Energy, and Dynamics** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  | **Students who demonstrate understanding can:** |
| **STANDARD** |  **HS-LS2-5.** | **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |
| Grades **9-10** - Adopted: **2010** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Key Ideas and Details** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.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.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.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.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Craft and Structure** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.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.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.5.** | **Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Integration of Knowledge and Ideas** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.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.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.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.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Range of Reading and Level of Text Complexity** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.RST.10.** | **By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Text Types and Purposes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.WHST.1.** | **Write arguments focused on discipline-specific content.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Text Types and Purposes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.WHST.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.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.** |
| **STANDARD** |  **CC.9-10.WHST.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).** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Production and Distribution of Writing** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.WHST.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.WHST.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.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Range of Writing** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.9-10.WHST.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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| **Illinois Learning Standards** |
| **Science** |
| Grades **11-12** - Adopted: **2014** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.HS-LS.** | **LIFE SCIENCE** |
| **LEARNING STANDARD / DISCIPLINE** |  **HS-LS1.** | **From Molecules to Organisms: Structures and Processes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  | **Students who demonstrate understanding can:** |
| **STANDARD** |  **HS-LS1-2.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **STANDARD** |  **HS-LS1-5.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.HS-LS.** | **LIFE SCIENCE** |
| **LEARNING STANDARD / DISCIPLINE** |  **HS-LS2.** | **Ecosystems: Interactions, Energy, and Dynamics** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  | **Students who demonstrate understanding can:** |
| **STANDARD** |  **HS-LS2-5.** | **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |
| Grades **11-12** - Adopted: **2010** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Key Ideas and Details** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.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.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.3.** | **Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Craft and Structure** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.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 11-12 texts and topics.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.5.** | **Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Integration of Knowledge and Ideas** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.8.** | **Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.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.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Range of Reading and Level of Text Complexity** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.RST.10.** | **By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Text Types and Purposes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.WHST.1.** | **Write arguments focused on discipline-specific content.** |
| **STANDARD** |  **CC.11-12.WHST.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.** |
| **STANDARD** |  **CC.11-12.WHST.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Text Types and Purposes** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.WHST.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **STANDARD** |  **CC.11-12.WHST.2.a.** | **Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.** |
| **STANDARD** |  **CC.11-12.WHST.2.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.** |
| **STANDARD** |  **CC.11-12.WHST.2.c.** | **Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.** |
| **STANDARD** |  **CC.11-12.WHST.2.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.** |
| **STANDARD** |  **CC.11-12.WHST.2.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).** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Production and Distribution of Writing** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.WHST.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.WHST.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.** |
| **STATE GOAL / DISCIPLINARY CONCEPT** |  **IL.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **LEARNING STANDARD / DISCIPLINE** |  | **Range of Writing** |
| **DESCRIPTOR / CONTENT DISCIPLINE** |  **CC.11-12.WHST.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.** |

| **New York State Learning Standards and Core Curriculum** |
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| **Science** |
| Grades **9-10** - Adopted: **2016** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.HS.6.** | **Structure and Function** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Students who demonstrate understanding can:** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS1-2.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.HS.7.** | **Matter and Energy in Organisms and Ecosystems** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Students who demonstrate understanding can:** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS1-5.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS2-5.** | **Develop a model to illustrate the role of various processes in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |
| Grades **9**-**10** - Adopted: **2011** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Key Ideas and Details** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.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.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.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.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Craft and Structure** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.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.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.5.** | **Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Integration of Knowledge and Ideas** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.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.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.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.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Range of Reading and Level of Text Complexity** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.RST.10.** | **By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Text Types and Purposes** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.1.** | **Write arguments focused on discipline-specific content.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Text Types and Purposes** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **9-10.WHST.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).** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Production and Distribution of Writing** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.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.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.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.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.9-10.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Range of Writing** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **9-10.WHST.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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| **New York State Learning Standards and Core Curriculum** |
| **Science** |
| Grades **11-12** - Adopted: **2016** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.HS.6.** | **Structure and Function** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Students who demonstrate understanding can:** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS1-2.** | **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.HS.7.** | **Matter and Energy in Organisms and Ecosystems** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Students who demonstrate understanding can:** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS1-5.** | **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **HS-LS2-5.** | **Develop a model to illustrate the role of various processes in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** |
| Grades **11-12** - Adopted: **2011** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Key Ideas and Details** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.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.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.3.** | **Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Craft and Structure** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.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 11-12 texts and topics.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.5.** | **Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Integration of Knowledge and Ideas** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.8.** | **Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.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.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Range of Reading and Level of Text Complexity** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.RST.10.** | **By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Text Types and Purposes** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.WHST.1.** | **Write arguments focused on discipline-specific content.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.1.e.** | **Provide a concluding statement or section that follows from or supports the argument presented.** |
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| **CATEGORY / CLUSTER / KEY IDEA** |  | **Text Types and Purposes** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.WHST.2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.2.a.** | **Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.2.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.2.c.** | **Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.2.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.** |
| **EXPECTATION / CONTENT SPECIFICATION** |  **11-12.WHST.2.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).** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Production and Distribution of Writing** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.WHST.4.** | **Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.WHST.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.** |
| **STRAND / DOMAIN / UNIFYING THEME** |  **NY.11-12.WHST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **CATEGORY / CLUSTER / KEY IDEA** |  | **Range of Writing** |
| **STANDARD / CONCEPTUAL UNDERSTANDING** |  **11-12.WHST.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.** |