



Science and Engineering Practices

Common Core Reading Anchors

Grades 6-12 Literacy in Science and Technical Subjects

SCIENCE AND ENGINEERING PRACTICE: CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Asking students to demonstrate their own understanding of the implications of a scientific idea by developing their own explanations of phenomena, whether based on observations they have made or models they have developed, engages them in an essential part of the process by which conceptual change can occur.

In engineering, the goal is a design rather than an explanation. The process of developing a design is iterative and systematic, as is the process of developing an explanation or a theory in science. Engineers' activities, however, have elements that are distinct from those of scientists. These elements include specifying constraints and criteria for desired qualities of the solution, developing a design plan, producing and testing models or prototypes, selecting among alternative design features to optimize the achievement of design criteria, and refining design ideas based on the performance of a prototype or simulation. (NRC *Framework*, 2012, p. 68-69)



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CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS – CONTINUED

Supporting CCSS Literacy Anchor Standards and Relevant Portions of the Corresponding Stands for Science and Technical Subjects	Connection to Science and Engineering Practice	Connection to Eco-Schools USA Pathways
<p>CCR Reading Anchor #1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p> <ul style="list-style-type: none"> • RST.6-8.1: “...support analysis of science and technical texts.” • RST.9-10.1: “...support analysis of science and technical texts, attending to the precise details of explanations or descriptions.” • RST.11-12.1: “...support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.” 	<p>Evidence plays a critical role in determining a theory in science and a design solution in engineering. The notion of close reading in Reading Standard 1 emphasizes pursuing investigations into well-supported theories and design solutions on the basis of evidence that is either explicitly stated or implied.</p>	<p>When addressing sustainability students must be able to read for understanding and site factual data and text as supporting evidence for their claims.</p>
<p>CCR Reading Anchor #2: Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.</p> <ul style="list-style-type: none"> • RST.6-8.2: “...provide an accurate summary of the text distinct from prior knowledge or opinions.” • RST.9-10.2: “...trace the text’s explanation or depiction of a complex process, phenomenon, or concept...” • RST.11-12.2: “...summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.” 	<p>Part of the power of a scientific theory or engineering design is its ability to be cogently explained. That ability to determine and clearly state an idea lies at the heart of Reading Standard 2.</p>	<p>When addressing a pathway students must have the ability to conceptualize and summarize several texts’ overarching messages, especially important for our digital natives.</p>



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<p>CCR Reading Anchor #8: Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.</p> <ul style="list-style-type: none"> • RST.6-8.8: “Distinguish among facts, reasoned judgment based on research findings, and speculation...” • RST.9-10.8: “Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.” • RST.11-12.8: “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.” 	<p>Constructing theories and designing solutions both require analysis that is rooted in rational argument and in evidence stemming from an understanding of the world. Reading Standard 8 emphasizes evaluating the validity of arguments and whether the evidence offered backs up the claim logically.</p>	<p>As students begin researching the environmental issues they must separate fact from opinion, experts source versus propaganda in order to make logical, evidence based decisions that will improve the carbon footprint of the school. Beyond research, students must design and carryout science and engineering studies in order to implement cost efficient and effective changes on campus.</p>



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<p>CCR Writing Anchor #2: Write informative/ explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.</p> <ul style="list-style-type: none"> • WHST.6-8.2: “...Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples...” • WHST.9-10.2: “...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...” • WHST.11-12.2: “...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...” 	<p>Building a theory or a model that explains the natural world requires close attention to how to weave together evidence from multiple sources. With a focus on clearly communicating complex ideas and information by critically choosing, arranging, and analyzing information, Writing Standard 2 requires students to develop theories with the end goal of explanation in mind.</p>	<p>Communication is one of the Seven Steps in the Eco-Schools framework and develops overtime as students’ knowledge base grows. In order to be able to effectively communicate about an environmental issue or action students must have an in depth understanding that only comes from reading, writing, debating, and the empirical evidence related to the topic</p>



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<p>CCR Writing Anchor #8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.</p> <ul style="list-style-type: none"> • WHST.6-8.8: "... quote or paraphrase the data and conclusions of others..." • WHST.9-10.8: "...assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas ..." • WHST.11-12.8: "...assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas..." 	<p>Collecting relevant data across a broad spectrum of sources in a systematic fashion is a key element of constructing a theory with explanatory power or a design that meets multiple constraints. Writing Standard 8 spells out the importance of gathering applicable information from multiple reliable sources in order to construct well-honed explanations.</p>	<p>Addressing sustainability on campus and within the community requires students to use multiple resources from multiple sources in order to gather the data and evidence needed to draw conclusions, make informed decisions, fundraise, and facilitate service learning and community service opportunities.</p>
<p>CCR Writing Anchor #9: Draw evidence from literary or informational texts to support analysis, reflection, and research.</p> <ul style="list-style-type: none"> • WHST.6-12.9: "Draw evidence from informational texts to support analysis, reflection, and research." 	<p>The route towards constructing a rigorous explanatory account centers on garnering the necessary empirical evidence to support a theory or design. That same focus on generating evidence that can be analyzed is at the heart of Writing Standard 9.</p>	<p>Proof that a commitment to raising environmental awareness and reducing the schools carbon footprint is in the best interest of the school community comes from the ability to explain the intricacies of your work which come from a variety of sources including fact based, informational text..</p>



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<p>CCR Speaking and Listening Anchor #4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.</p> <ul style="list-style-type: none"> • SL.8.4: “Present claims and findings, emphasizing salient points in a focused manner with relevant evidence, sound valid reasoning...” • SL.9-10.4: “Present information, findings, and supporting evidence, clearly, concisely, and logically...” • SL.11-12.4: “Present information, findings, and supporting evidence, conveying a clear and distinct perspective...alternative or opposing perspectives are addressed...” 	<p>A theory in science and a design in engineering is a rational explanatory account of how the world works in light of the evidence. Speaking and Listening Standard 4 stresses how the presentation of findings crucially relies on how the evidence is used to illuminate the line of reasoning embedded in the explanation offered.</p>	<p>Eco-Action teams and working groups rely on a dynamic skill set which includes, speaking and listening, to communicate the results and actions associated with the Seven Step Framework.</p>