Select LDC Template Task Adaptations for Use in Science Classrooms

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Katie Van Horne & Philip Bell, University of Washington

Please contact us if you have any questions about these writing tasks, ideas for improving them, or if you are able to make good use of them. We'd love to hear from you.

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We hope that science teachers might be able to make good use of and improvements to this set of Literacy Design Collaborative (LDC) template tasks, which have been adapted for use in the science classroom. The new *NRC Framework for K-12 Science Education* (http://tinyurl.com/ScienceFramework) presents a vision for how science education can continue to be improved over the next 10 to 15 years. That document is currently guiding state teams in developing *Next Generation Science Standards* (http://nextgenscience.org/).

One of the significant changes in the vision for science education is to focus students' learning experiences on eight core practices of science and engineering as students engage in investigations of the natural and built world (e.g., modeling, argumentation, explanation). These practices often involve having students read and deconstruct specific genres of scientific text, as well as produce them. It is important that academic writing tasks be embedded in students' science investigations in order for students to learn how scientists utilize reading and writing in their practices and to learn to participate in those practices themselves. Additionally, literacy tasks allow students to document investigations, engage in important learning processes like making their thinking visible to others, and practice skills like producing and critiquing evidence-based arguments.

This first set of literacy science tasks and accompanying rubrics comes from the Educurious project, which aims to reduce our country's staggering high school drop out rate. Educurious does this by changing the experiences that students and teachers have in high school classrooms. Educurious classroom experiences feature project-based, blended learning curricula that connect students to real issues they care about and equip them with the skills for lifelong success. The Educurious courses deliver on Common Core and the NRC Framework (guiding the development of Next Gen Science Standards) via a web platform, which fosters collaboration among students, teachers, and a global network of real-world experts.

The Educurious Introductory Biology high school course is composed of six-week curriculum units:

- Phytoremediation: Environmental & Human Health
- Contemporary Approaches to Genetics
- Charting the Diversity of Life: Evolution & Extinction
- Predicting and Preventing Infectious Disease
- The Ecological Impacts of Climate Change

In this document, we describe a subset of the literacy tasks embedded in these units and discuss how they are used in the context of the extended project investigations in these units. In addition, we include a generalized version of the literacy tasks that teachers can consider making use of throughout their instruction. Given the vision in the NRC Framework, it is recommended that these literacy tasks are integrated into more extended investigations where students are actively designing and carrying out scientific research or engineering design. To that end, we are in the process of developing full LDC modules that will support the teaching of the tasks included in this document. A set of LDC Educurious Science teaching tasks and modules will be made available in the future on our website.

EDUCURIOUS LDC SCIENCE TASK 1: RESEARCH DESIGN PLAN
For the Educurious Biology Unit on
Phytoremediation: Environmental and Human Health

Adaptation by Leah Bricker, University of Michigan,
Katie Van Horne, Elly Walsh & Philip Bell, University of Washington

A. Research Design Plan LDC Task for Educurious Phytoremediation: Environmental and Human Health Unit

Curriculum Unit Description: In the Educurious unit titled *Phytoremediation: Environmental & Human Health,* students explore a field of biology that affects all of us, wrestling with two big questions: (1) How can we use plants and other living things to remove toxins from our environment?, and (2) Where do these environmental contaminants come from and how do they affect us? By designing and conducting novel investigations related to these questions, students contribute to the scientific knowledge base associated with the use of bioremediation to remove toxins from the environment. Students share their results with scientists and their communities via a multimedia digital journal.

The following teaching task is part of the Phytoremediation investigation and is adapted from LDC Template Task #17. ***Before engaging in this task,*** students read background information on Phytoremediation and the chemicals involved, they conduct local fieldwork to analyze water samples, and they do preparatory work for their research (e.g. plant plants that are used in their investigations).

> **Task 17 Template for Research Design Plan (Environmental and Human Health Unit – Phytoremediation Investigation):** After researching background information on contaminants in the environment and phytoremediation, write a research plan that poses a testable scientific question, discusses why the question is important, states a hypothesis related to your question, outlines the methods you will use to investigate your question, and describes how you will know if your data does or does not support your hypothesis. **(Informational or Explanatory/Procedural-Sequential)**

After engaging in this task, students use their research design plan to conduct a phytoremediation investigation. This involves conducting the outlined investigation, analyzing their data, and communicating research findings and their implications to various audiences (e.g., peers, teachers, scientists, community members).

B. General Science LDC Task for Research Design Plan

The following is a more general research design plan template task that can be customized for a variety of instructional sequences. Please consider engaging students in relevant disciplinary practices before and after engaging in this task based on the eight practices for science and engineering outlined in the *NRC Framework for K-12 Science Education*.

> **General Science LDC Task 17 for Research Design Plan:** After researching background information on _____ (scientific content and methods), write a research plan that poses a testable scientific question, discusses why the question is important, states a hypothesis related to your question, outlines the methods you will use to investigate your question, and describes how you will know if your data does or does not support your hypothesis. **(Informational or Explanatory/Procedural-Sequential)**

EDUCURIOUS LDC SCIENCE TASK 2: BACKGROUND RESEARCH
For the Educurious Biology Unit on Genetics

Adaptation by Leah Bricker, University of Michigan,
Katie Van Horne & Philip Bell, University of Washington

A. Background Research LDC Task for Educurious Genetics Unit

Curriculum Unit Description: How do genetics and the environment interact to impact human health? How do scientists use DNA technology and multi-player gaming to solve related problems? In the Educurious unit titled *Contemporary Approaches to Genetics*, students explore cutting edge approaches to research in the fields of genetics, genomics, and evolutionary biology through: (a) planning and carrying out a DNA barcoding investigation of a species identification problem of their choosing; (b) competing in protein folding puzzles that that address current research problems; and (c) understanding the current state of personal genetic information and the ethical issues related to its widespread availability.

The following teaching task is part of the DNA Barcoding investigation and is adapted from LDC Template Task #18. ***Before engaging in this task,*** students create a research design plan (i.e., pose an investigative question and plan how to carry out their investigations).

> **Task 18 Template for Background Research (Genetics Unit – DNA Barcoding Investigation):** After researching and reading scientific journal publications, book chapters, and other texts on the problem of species identification you are investigating, write a review of the literature that summarizes the current state of the problem, describes the major lines of evidence foregrounded in each source (citing at least 5 sources), and specifies the implications for your research. Identify any gaps or unanswered questions in the literature that your research will address. Include a reference list. **(Informational or Explanatory/Synthesis)**

After engaging in this task, students use their written background research to propose and conduct a DNA barcoding investigation on a species identification-focused question of personal interest. This involves conducting the investigation outlined in their research design plan, analyzing their data, and writing a scientific research abstract to share their evidence-based arguments relative to their identified research question.

B. General Science LDC Task for Background Research

The following is a more general background research template task that can be customized for a variety of instructional sequences. Please consider engaging students in relevant disciplinary practices before and after engaging in this task based on the eight practices for science and engineering outlined in the *NRC Framework for K-12 Science Education*.

> **General Science LDC Task 18 for Background Research:** After researching and reading _____(multiple types of sources including: scientific journal publications, book chapters, and other texts) on the _____ (problem) you are investigating, write a review of the literature that summarizes the current state of the problem, describes the major lines of evidence foregrounded in each source, and specifies the implications of that research for your problem of _____(problem). Identify any gaps or unanswered questions that your research will address. Include a reference list. **(Informational or Explanatory/Synthesis)**

EDUCURIOUS LDC SCIENCE TASK 3: RESEARCH ABSTRACT
For the Educurious Biology Unit on Infectious Disease

Adaptation by Katie Van Horne, University of Washington
Leah Bricker, University of Michigan & Philip Bell, University of Washington

A. Research Abstract LDC Task for Educurious Infectious Disease Unit

Curriculum Unit Description: Have you ever wondered how infectious diseases constantly outsmart us and continue to threaten human populations around the globe? What is it that causes us to get sick? In the Educurious unit titled *Predicting & Preventing Infectious Disease*, students explore transmission of infectious pathogens from the cellular to the global level by leveraging interdisciplinary techniques. Specifically, students explore immune system structure and function, as well as concepts associated with virology and vaccines. As part of the infectious disease module, students engage deeply with software tools and data analysis techniques developed and currently used by scientists (e.g., social network analysis of infection between people and computational modeling of disease transmission across locations).

The following teaching task is part of the infectious disease investigation and builds upon LDC Template Task #1. ***Before engaging in this task,*** students create a research design plan (i.e., pose an investigative question and plan how to carry out their investigations), conduct the outlined investigation, and analyze their data.

> **Task 1 Template for Research Abstract (Prevention and Prediction of Infectious Disease Unit – Infectious Disease Investigation):** After researching infectious disease transmission by conducting a global epidemic modeling study or a local social network study, write a scientific abstract that introduces your research and that specifies your research question, your methods and your major findings, as well as advances a claim in relation to the research question. Support your claim with evidence from your research. Be sure to acknowledge background scientific content and supporting literature (from your previously completed literature review). Additionally, address the implications of your research. **(Argumentation/Analysis)**

After engaging in this task, students communicate the results of their investigations to their peers, teachers, members of their communities and/or professionals.

B. General Science LDC Task for Research Abstract

The following is a more general research design plan task that can be customized for a variety of instructional sequences. Please consider engaging students in relevant disciplinary practices before and after engaging in this task based on the eight practices for science and engineering outlined in the *NRC Framework for K-12 Science Education*.

> **General Science LDC Task 1 for Research Abstract:** After researching _____ (problem or topic of investigation) by _____(methods or type of investigation), write a _____ (scientific abstract or scientific paper) that introduces your research and that specifies your research question, your methods and your major findings, as well as advances a claim in relation to the research question. Support your claim with evidence from your research. Be sure to acknowledge background scientific content and supporting literature (from your previously completed literature review). Additionally, address the implications of your research. **(Argumentation/Analysis)**

Rubric for Science Argumentation / Analysis Tasks • 15 June 2012

Scoring Elements	Not Yet		Approaches Expectations		Meets Expectations		Advanced
	1	1.5	2	2.5	3	3.5	4
Development	Attempts to respond to the prompt but components of the prompt are missing and/or the attempt lacks relevance given the intent of the prompt.		Responds to the prompt using appropriate details but commits errors with respect to evidence usage, reasoning, and/or examples used.		Fully responds to the prompt using appropriate details and does not commit errors with respect to evidence usage, reasoning, and/or examples used.		Fully responds to the prompt using appropriate details and does not commit errors with respect to evidence usage, reasoning, and/or examples used. In addition, suggests additional research that could be conducted given the supported claim and evidence.
Claims	Claims are attempted but they are unrelated to the research question, problem, or topic and/or the claims attempted constitute a different scientific structure (e.g., a hypothesis).		Actual claims are stated but they are only peripherally related the research question, problem, or topic.		Actual claims are stated and are directly related to the research question, problem, or topic.		Actual claims are stated and are directly related to the research question, problem, or topic. In addition, the claims are framed both with respect to empirical research and applicable background research (i.e., the literature).
Evidence	Attempts to provide evidence for claims, but the evidence provided is unrelated to claims and/or not appropriate given the type of research being conducted.		Provides evidence for claims but the evidence used is weak in comparison to other pieces of evidence in the evidence corpus. In addition, some of the evidence used may not be appropriate given the type of research being conducted.		Provides evidence supporting or contradicting claims. The evidence used is appropriate given the type of research being conducted and is necessary and sufficient to support or refute the claim. An explanation is given for how the evidence supports the claim (i.e., evidence-based reasoning).		Provides evidence supporting or contradicting claims. The evidence used is appropriate given the type of research being conducted and is necessary and sufficient to support or refute the claim. An explanation is given for how the evidence supports or refutes the claim (i.e., evidence-based reasoning) and it stems from both empirical research and background research (i.e., the literature).
Organization	Attempts to organize ideas, but lacks clarity and structure. Lacks all or many of the necessary structural elements and/or sections required given the prompt.		Claims, evidence, reasons, and other structural components are somewhat clear and structured coherently. The response includes most of the necessary structural elements and/or sections required given the prompt.		Claims, evidence, reasons, and other structural components are clear and structured coherently. The response includes all of the necessary structural elements and/or sections required given the prompt.		Claims, evidence, reasons, and other structural elements are clear and structured coherently. The response includes all of the necessary structural elements and/or sections required given the prompt. Possible rebuttals to the argument are considered and addressed. The product is of publication quality.
Conventions	Attempts to demonstrate standard language conventions, but lacks cohesion and control of grammar, usage, and mechanics. Sources are used without citation.		Demonstrates an uneven command of standard language conventions and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features. Inconsistently cites sources.		Demonstrates a command of standard language conventions and cohesion, with few errors. Cites sources using appropriate format with only minor errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt.		Demonstrates and maintains a well-developed command of standard language conventions and cohesion, with few errors. Consistently cites sources using appropriate format. Response includes language and tone consistently appropriate to the audience, purpose, and specific requirements of the prompt.
Content Understanding	Attempts to include scientific content knowledge, but understanding of content is weak; content is irrelevant, inappropriate, or inaccurate.		Includes some scientific content knowledge relevant to the prompt but more is needed; shows basic or uneven understanding of content; minor errors in explanation.		Accurately presents integrated scientific content knowledge relevant to the prompt with sufficient explanations that demonstrate conceptual understanding.		Presents relevant and accurate integrated scientific content knowledge with thorough explanations that demonstrate in-depth conceptual understanding and has used scientific concepts beyond the scope of the instructional materials.

Rubric for Informational and Explanatory / Synthesis Tasks • 15 June 2012

Scoring Elements	Not Yet		Approaches Expectations		Meets Expectations		Advanced
	1	1.5	2	2.5	3	3.5	4
Development	Attempts to respond to the prompt but components of the prompt are missing and/or the attempt lacks relevance given the intent of the prompt.		Responds to the prompt using appropriate details but commits errors with respect to prompt details (e.g., about posing a testable scientific question, how the literature is engaged).		Fully responds to the prompt using appropriate and sufficient details and does not commit errors with respect to prompt details (e.g., about posing of testable scientific question, how the literature is engaged).		Fully responds to the prompt using appropriate and sufficient details and does not commit errors with respect to prompt details (e.g., about posing of testable scientific question, how the literature is engaged). In addition, has sought expert feedback and has incorporated that feedback into the product.
Communicating Information*	Attempts to communicate information relative to the prompt but writing lacks clarity and coherence.		Communicates information relative to the prompt but writing lacks sufficient detail and/or is only partially aligned with the purpose of the desired genre of scientific writing,		Clearly communicates information relative to the prompt using sufficient detail and writing is aligned with the purpose of the desired genre of scientific writing.		Clearly and effectively communicates information relative to the prompt using abundant detail and writing is expertly aligned with the purpose of the desired genre of scientific writing. Product is publication ready.
Constructing Explanations*	Attempts to formulate a causal explanation relative to the prompt but lacks clarity and/or links to evidence and/or models.		Formulates a causal explanation relative to the prompt and attempts to link to primary and/or secondary scientific evidence and/or models. The evidence and/or models chosen may not fully support or refute the explanatory account of the phenomenon or topic.		Formulates a compelling causal explanation relative to the prompt and links to primary and/or secondary scientific evidence and/or models to support or refute the explanatory account of the phenomenon or topic.		Formulates a compelling causal explanation relative to the prompt and links to primary and/or secondary scientific evidence and/or models to support or refute the explanatory account of the phenomenon or topic. In addition, potential gaps or weaknesses in the explanatory account are identified.
Obtaining and evaluating Information in Relation to Communicating Information or Constructing Explanations.	Attempts to locate and/or to demonstrate engagement with the scientific literature and/or other textual resources about science but lacks discussion of scientific validity and/or reliability in relationship to the prompt.		Attempts to locate and/or to demonstrate engagement with the scientific literature and/or other textual resources about science. Partially discusses validity and/or reliability of the ideas, data, hypotheses, and/or conclusions presented and in relationship to the prompt.		Successfully locates and/or demonstrates engagement with appropriate scientific literature and/or other textual resources about science. Fully discusses the validity and/or reliability of the ideas, data, hypotheses and/or conclusions. presented and in relationship to the prompt.		Successfully locates and/or demonstrates engagement with appropriate scientific literature and/or textual resources about science. Fully discusses the validity and/or reliability of the ideas, data, hypotheses and/or conclusions presented and in relationship to the prompt. The product draws appropriate generalizations across several pieces of information relative to the purpose of the prompt.
Organization	Attempts to organize ideas, but lacks clarity and structure. Lacks all or many of the necessary structural elements and/or sections required given the prompt.		Ideas are somewhat clear and structured coherently. The response includes most of the necessary structural elements and/or sections required given the prompt.		Ideas are clear and structured coherently. The response includes all of the necessary structural elements and/or sections required given the prompt.		Ideas are clear and structured coherently. The response includes all of the necessary structural elements and/or sections required given the prompt. The product is of publication quality.
Conventions	Attempts to demonstrate standard language conventions,		Demonstrates an uneven command of standard language conventions		Demonstrates a command of standard language conventions and		Demonstrates and maintains a well-developed command of standard

	but lacks cohesion and control of grammar, usage, and mechanics. Sources are used without citation.		and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features. Inconsistently cites sources.		cohesion, with few errors. Cites sources using appropriate format with only minor errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt.		language conventions and cohesion, with few errors. Consistently cites sources using appropriate format. Response includes language and tone consistently appropriate to the audience, purpose, and specific requirements of the prompt.
Content Understanding	Attempts to include scientific content knowledge, but understanding of content is weak; content is irrelevant, inappropriate, or inaccurate.		Includes some scientific content knowledge relevant to the prompt but more is needed; shows basic or uneven understanding of content; minor errors in explanation.		Accurately presents integrated scientific content knowledge relevant to the prompt with sufficient explanations that demonstrate conceptual understanding.		Presents relevant and accurate integrated scientific content with thorough explanations that demonstrate in-depth conceptual understanding and has used scientific concepts beyond the scope of the instructional materials.

* Use either the Communicating Information row or the Constructing Explanations row depending on the scientific practice associated with the prompt.