TIDeS
Teaching with Investigation and Design in Science

Guidelines
for the
TIDeS Visionlearning Rubric
Final version, April 2022

This document is intended to provide Visionlearning authors and editors the information they need to be successful in writing modules for the TIDeS project that pass the rubric. The colors indicate different sections of the rubric; each criterion is further explained in the middle column and examples and references are given in the right-hand column. These guidelines are also available on the TIDeS website.

Guiding Principles

Criterion	Description	Examples
Materials engage students in scientific investigation and engineering design to deepen their understanding of core ideas.	• Science concepts are presented through the lens of their development, rather than as established fact. The processes of scientific investigation, often coupled with engineering design (e.g., the building of new data collection or analysis instruments), drives the narrative, highlights cross-cutting concepts (patterns, systems), and offers the reader a deep understanding of core ideas in the discipline. • The module describes the authentic process of science as enacted by scientists, and encourages students to think critically about both concepts and processes.	Oregon State University's history of science collections The Science History Institute has digitized collections and other sources for the stories of the scientists and inventors that have shaped our lives.
Materials cultivate a learning environment where all students are treated equitably, have equal access to learning, and feel valued and supported in their learning.	• The module includes explicit descriptions of contributions to science and engineering from multiple cultures, and the role that location, context, and/or culture play in the development of ideas. • The module acknowledges the different backgrounds and cultures of readers: though it is impossible to anticipate all readers, the text should avoid assumptions that all readers have a shared identity. Examples and metaphors should be carefully chosen and constructed to be familiar to the greatest number of readers, and/or acknowledge multiple identities of readers. • Other aspects of modules support equitable access, including module translation and audio	Scientists and the Scientific Community includes examples that highlight the role that individuals' backgrounds and cultures play in their work. Resources like I Am a Scientist offer profiles of a diverse group of current scientists. The Open Notebook has curated a list of sites highlighting diverse scientists. CalAcademy explains the strategy of concept-first, in context, prior to providing scientific vocabulary and definition.
Materials engage students in addressing questions and solving problems that are relevant to their lives.	• The module includes applications of concepts, stories of scientists, and hooks that emphasize relevance to readers and emphasizes why this material is worth knowing. Relevance can be established through connections to personal, societal, or everyday issues, problems, or contexts.	How to Hook a Reader contains tips including the brain science explanations of why it works. Hook ideas from The Wonder of Science.

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	• Supporting resources provide opportunities for readers to explore connections and relevance.	University of Illinois Phenomena Finder.
Materials engage students in authentic and meaningful scenarios that make use of real data and models and reflect the actual practice of science and engineering.	• Authentic data and models from established or published scientific investigations are described first, then analyzed and interpreted acknowledging the same challenges faced by scientists and engineers. Data themselves are included in the text and/or in graphics. • Modules provide scaffolding and guidance for students in analyzing and interpreting data, and quiz questions ask them to practice those skills. • In selecting the data, models, and scenarios, authors should consider differences in access to technology, tools, and preparation of students.	Uncertainty, Error, and Confidence describes how the process of radiocarbon dating evolved by showing the real, messy, and complicated data and how challenges were overcome. Good data sources from NOAA

Key concepts

Criterion	Description	Examples
Key concepts encapsulate all of the core ideas presented in the module.	• Key concepts reflect and summarize the module text, and include the historical development of scientific ideas, relevance of concepts, and types of data involved; key concepts are not limited to the disciplinary core ideas. • Key concepts use the same language and are presented in the same way as in the module.	Tool: Reverse outlining can help assess this
Key concepts are aligned with the three dimensions of the Next Generation Science Standards.	• Key concepts include science and engineering practices and connections to cross-cutting concepts used to establish disciplinary core ideas; they describe the nature of and use of data as evidence in constructing explanations. • Although they cannot/should not be phrased as performance expectations, they should go beyond stating just the disciplinary core ideas.	NGSS Science and Engineering Practices (SEPs) NGSS Crosscutting Concepts (CCCs) See this Process of Science Module
Key concepts are clearly stated in language suitable for the level of the students.	• Key concepts are intentional, concise, detailed, and presented in language that is understandable by the audience, while also promoting science literacy (i.e. appropriate vocabulary should be used)	How to use Microsoft Word to check reading level (strive for grade 8/9 using Flesch-Kincaid Test)

Module

Criterion	Description	Examples
Module text is coherent and well-written.	• Text is unified, with a consistent voice and easily followed structure; • Generalizations are supported by examples and examples are carried throughout the text. • The conclusion ties back to the introduction in a meaningful way.	Tool: Reverse outlining

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Module includes content that is relevant for readers and sparks curiosity to read more.	• The text elicits observations, thoughts, ideas, questions through an introductory hook and connections throughout the module. • "Sparking curiosity" can be through asking questions and telling a story; "relevant for readers" can mean making the connection between scientific content and people/everyday life, while acknowledging the range of possible identities of students.	Tool: Storytelling using And, But, Therefore (thorough explanation, brief explanation)
Module respectfully presents multiple ways of knowing.	• Western science relies on *empirical* and experiential knowing; other ways of knowing are personal, aesthetic, cultural. Module text recognizes and highlights the funds of knowledge that readers may bring from their own experiences and avoids use of words and phrases that privilege and/or assume a specific way of knowing.	Local and indigenous knowledge systems Article about Hawaiian culture surrounding Limu (seaweed). I find this linked article great for understanding how Traditional Local Knowledge impacts students and researchers alike.
Module presents contributions from scientists and engineers with a range of identities.	• Contributions from individuals with different identities and backgrounds are included. How those contributions have been historically valued differently should be included where possible.	Consider incorporating stories of diverse scientists and their contributions such as found in this profile of Ruth Benerito.
Module includes relevant historical information that supports the process of discovery of the concepts being presented as well as problematic histories.	• The history of the development of ideas should be presented through the experiences of and ideas of scientists with reference to the literature and biographical information. Authentic data and models that were part of the process of development are included and explained. • Problematic historical contexts should be presented as such, including cases of marginalization, victimization, or ignoring the contributions of others.	The GeoContext project has good examples of how racism, colonialism, environmental damage, and other detrimental processes were involved in making scientific advances. Consider land acknowledgement where appropriate Be aware of general topics that often exploit groups: medical field/chemistry experimenting on BIPOC. Ecology exploiting indigenous groups. Climate change impacts disproportionately impacting BIPOC, etc.
Module includes connections to modern research and/or applications of the concept	• Historical context is critical to understanding the evolution of ideas, but readers should not be left with the sense that all of the science within a particular concept has been done. Stories of modern scientists and recent research that makes use of or deepens our understanding of the main concepts in the module should be included in the text.	Statistics in Science (several connections to modern research and applications) Social media is a great place to find modern scientists/research, with the bonus that students can follow them later. Twitter, Instagram, Tiktok, are all full of scientists (especially Twitter)! Hashtags like #BlackInSTEM

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		#BlackInChem etc. Also, groups like SACNAS and BEYA are good places to start.
Module title and headings are concise, clear, and support navigation through the material	• Headings are used to create a table of contents; it should be clear from the headings what the reader should expect to read about in that section.	Tool: Reverse outlining can help assess this
Module graphics directly connect to the content of the module and are data-driven.	• Graphics may include figures from published literature where appropriate, and/or tables, graphs, and images developed specifically for the module. When developed for the module they should be scientifically accurate and include authentic data.	Figures from the literature: History of Earth's Atmosphere I Figures created for the module (Figures 2, 4, 6): Factors that control Earth's temperature
Module is current and appropriately cited.	• Text and examples are current at the time of publication. • Scientific articles are cited in the text and included in the reference section; other non-cited references are included in the resources section.	The Modeling in Scientific Research module includes several cited scientific studies.

Assessment

Criterion	Description	Examples
Quiz includes questions that address the core ideas as described in the key concepts.	• Questions in the quiz as a whole should cover all of the key concepts.	
Quiz includes questions that engage students in aspects of scientific investigation and/or engineering design, such as analyzing data.	• Quiz questions may include graphs, tables, equations, or other images that prompt students to analyze and/or interpret data or models. Multiple choice responses to these questions should be based on real and common errors.	The Using Graphs and Visual Data quiz asks students to apply the skills they learned in the module to new graphs.
Quiz consists of questions that address multiple cognitive levels	• Multiple choice questions should include a range of cognitive levels, not all recall or identification. Questions can include images (graphs, etc.) and ask readers to analyze or interpret using the skills and practices described in the text.	Explanations and examples for crafting quiz questions for a variety of cognition levels.
Quiz questions have answer keys with feedback for both right and wrong answers	• Distractors for multiple choice answers should be written based on common misperceptions and facilitate critical thinking. Feedback for wrong answers should prompt readers to return to parts of the module without giving the correct answers. Right answer feedback can be minimal for lower-cognitive level questions but may give more explanation for why it is correct for higher cognitive level questions.	

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Comprehension checkpoints provide meaningful formative assessment for readers.	• Comprehension checkpoints should make the reader reflect back on the content they just read; the questions do not need to be at a high cognitive level to be meaningful.	Consider inviting the reader to make observations that support the content (e.g. putting finger over a straw to hold in liquid and asking the reader to think about how that relates back to what they read on forces)

Related Resources

Criterion	Description	Examples
Technical words and scientists are identified and appropriately defined for inclusion in the glossary.	• Prior to writing new definitions and bios, the glossary should be checked to see if terms already exist, and, if so, do they need to be modified/added to to accommodate the use of the term. • Scientists mentioned in the text should have short biographies for inclusion in the glossary, paying attention to the identities of scientists to achieve diversity within the module and glossary. • Terms should be defined as relevant to the discipline. If necessary for clarity, common-use definitions can be included, but the focus should be on the relevant definition(s).	
Connections are made to other materials on the site and links to other modules are included as appropriate.	• Within the text of the module, links to modules that have further explanations about particular concepts or stories should be made. If the module is part of a series, explicit links and connections to others in the series should be included in the text.	
Links to external resources are included, relevant to the module, and from reputable sources.	• External resources can provide opportunities for readers to explore concepts in more depth, apply their understanding, learn more about the scientists and other people in the module, and or otherwise apply and expand their learning.	Pay attention to the web domain

Alignment

Criterion	Description	Examples
Key concepts, module, assessments, and resources align with one another.	All of the components of the module are in alignment.	Tool: Reverse outlining can help assess this

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