

## Science Educator Resources

A Framework and Resource  
Collection for the 21st Century

*Collection curated by  
Drs. Lara Smetana, Sara Gorman, Jack  
Gorman, David Scales  
Developed February 2023  
Updated January 2024*

*Questions? Other favorites to add? Please contact Dr. Lara Smetana [LSmetana@LUC.edu](mailto:LSmetana@LUC.edu)*

*\*See menu at left for Table of Contents with hyperlinks*

## Science Literacy

### *What this entails:*


- Develop an understanding of what science is and how science works
- Develop [a scientific outlook and employ scientific “habits of mind”](#)
- Understand what it means to [act scientifically](#) and [communicate in scientific ways](#) (Page 47 of [OpenSciEd Teacher Tools 2022](#))
- Piquing curiosity in science, how science works, [science news](#), science endeavors and careers, [scientists from diverse backgrounds](#)
- Develop a scientific world-view *and* the understanding that multiple world-views can co-exist, including [science and religion](#)

### *Practice-based Reflection Questions:*

- What science practices will students have opportunities to be engaged in? How will they reflect on this engagement?
- What scientific communication practices are or could be involved in the learning activities and how will students reflect on this engagement?
- What scientific habits of mind are or could be activated? How will students reflect on this engagement?
- What scientific communication practices are or could be involved in the learning activities? How will students reflect on this engagement?
- How can we motivate students to be ambassadors of good science?
- Is the instruction around science literacy/nature of science explicit, so that students realize when they are “thinking or acting like scientists”
- Where do students have opportunities to consider the relationship between science and other worldviews, such as indigenous ways of knowing?
- Can students identify experts and prepare questions to ask of them?

### *Resources:*

- <https://undsci.berkeley.edu/>
  - Understanding Science: Learn what science is, how it works, and how it connects to our lives
- <https://undsci.berkeley.edu/think-science/>

- Overview of scientific habits of mind
-  **OpenSciEd Teacher Tools and Resources 2022 PUBLIC**
  - Tools and resources for NGSS-aligned instruction
- <https://www.openscienced.org/communicating-poster/>
  - Communicating in Scientific Ways poster for K-12
- <https://thewonderofscience.com/>
  - Tools and resources for NGSS-aligned instruction
- <https://www.nsta.org/nstas-official-positions/nature-science>
  - NSTA position statement on teaching about the nature of science
- <https://static.nsta.org/ngss/AppendixH-TheNatureOfScienceInTheNextGenerationScienceStandards-4.9.13.pdf>
  - NGSS Appendix H - The Nature of Science
- Nature of Science: Seeing Science from a Bird's Eye View (Chapter 2)  
<https://routledge textbooks.com/textbooks/9781138118966/>
- Resources for incorporating science news in the classroom:
  - <https://www.sciencefriday.com/educate/>
  - <https://sciencejournalforkids.org/>
  - <https://www.snexplores.org/>
- <https://projectbiodiversify.org/>
  - Project promotes the humanization, diversification, and inclusivity of biology classrooms, expanding views of who is a scientist
- <https://datanuggets.org/about-nuggets-2/what-teachers-need-to-know-about-nuggets/>
  - Data Nuggets give students practice interpreting quantitative information and making claims based on evidence. Activities also highlight the story of the scientists behind the research, who they are, their study system, and their research process.
- <https://www.nsta.org/science-teacher/science-teacher-marchapril-2021/teaching-scientific-literacy> and  
<https://www.nsta.org/science-teacher/science-teacher-mayjune-2023/promoting-scientific-literacy-science-classroom>
  - Summary of key aspects of scientific literacy and tips for secondary science
- <https://www.storybehindthescience.org/>
  - Stories of major science topics designed to highlight how science works, how scientists think, and the often messy process that leads to the development of scientific knowledge
- <https://sciedandmisinfo.stanford.edu/>
  - Report explores the overall challenge of science in an age of misinformation

- NIH Science Education Resources:

- <https://science.education.nih.gov/#diseases-and-conditions>

- <https://www.thepartnershipineducation.com/>

## Information & Media Literacy

### *What this entails:*

- The ability to access, analyze, [evaluate](#), and utilize print and digital information to understand the world and make informed decisions
- “People need more than just a knowledge base, they also need techniques for exploring it, connecting it to other knowledge bases, and making practical use of it.” - [ALA Information Literacy Report](#)
- This includes:
  - “The ability to access, analyze, evaluate, create, and communicate using a variety of objective forms, including, but not limited to, print, visual, audio, interactive, and digital texts.” - [IL Media Literacy Coalition](#)
  - “The research process and how information is created and produced; critical thinking and using information resources; research methods, including the difference between primary and secondary sources; the difference between facts, points of view, and opinions; accessing peer-reviewed print and digital library resources; the economic, legal, and social issues surrounding the use of information; and the ethical production of information” - [NJ K-12 Information & Media Literacy](#)
- Recognize connections between science (and other content area) practices and media literacy practices (as highlighted in the [IL Media Literacy crosswalk](#))

### *Practice-based Reflection Questions:*

- Which [Media Literacy Practices](#) align with the content-area practices in lessons you have planned this week?
- Do students have opportunities to reflect on the connections between the science practices and media literacy practices?
- Are there opportunities to help students develop an understanding of what safe, responsible, and critical consumption of social media and other media forms entails?
- Are students exposed to positive and negative exemplars of intellectual virtues in the media? Do they have opportunities to reflect on these examples including consequences?

- How do students determine what are reliable and unreliable information sources for science news, and what criteria determine reliability?
- What other colleagues (other subject areas, resource specialists, librarians) would be useful to connect with around these goals?

### **Resources:**

- Collections of resources for information and media literacy more generally:
  - ALA's Literacy Clearinghouse: <https://literacy.ala.org/information-literacy/>
  - IL Media Literacy Coalition resources: <https://ilmlc.org/resources/>
  - CA Department of Education Medial Literacy resources: <https://www.cde.ca.gov/ci/cr/ml/>
- Middle & High School one-week unit helps students examine claims that seem to be based on science but often are not: <https://tumblehomebooks.org/services/resisting-scientific-misinformation/>
- Evaluating Science Messages [checklist](#)
- Media Literacy Now - Integrating Media Literacy in Science Instruction: <https://medialiteracynow.org/impact/science/>
- Media Wise Crash Course Navigating Digital Information collection: <https://www.youtube.com/playlist?list=PL8dPuuaLjXtN07XYqqWSKpPrtNDiCHTzU>
- Resources designed for upper highschool and college courses, including data visualization resources of interest to math teachers: <https://www.callingbullshit.org/tools.html>
- Critical Data Literacy ebook: <https://pressbooks.library.torontomu.ca/criticaldataliteracy/>
- <https://www.storybehindthescience.org/spotting-pseudoscience>
  - Resources developed for post-secondary but could be adapted for secondary
- <https://sciedandmisinfo.stanford.edu/>
  - Report explores the overall challenge of science in an age of misinformation
- Guide to Bad & Misleading Data Visualizations: <https://www.datapine.com/blog/misleading-data-visualization-examples/>
- Review of data visualization techniques:
  - <https://online.hbs.edu/blog/post/data-visualization-techniques>
- Learn to Discern: Media Literacy Trainer's Manual: <https://www.irex.org/sites/default/files/node/resource/learn-to-discern-media-literacy-curriculum-english-3.pdf>
  - curriculum about changing how we consume media, not what we consume
- News Literacy Project: <https://newslit.org/newslit-nation/>

- <https://newslit.org/tips-tools/> - weekly newsletter for educators
- Thinking Routines and Intellectual Virtue Connections  
<http://tinyurl.com/mr3j8j2v>
- Indiana University's OSoMe: <https://osome.iu.edu/>
  - Collection of tools to analyze and counter disinformation and manipulation on social media. Especially like the learning game, [Fakey](#), to use with students

## Understanding of Information Environments & Influences

### *What this entails:*

- Conducting an “information environment” analysis: when is misinformation consequential and toxic? How much exposure does one have to toxic misinformation? What is one’s predisposition to finding misinformation credible? How much access does one have to high-quality information?
- Understanding and being on the lookout for barriers to belief and understanding of accepted, unbiased, scientific information
- Being respectful of different social and political identities and being able to take them into account when responding to misinformation
- Being able to articulate the components of a healthy information environment and how to empower people to access that if possible
- Showing and expressing empathy for and curiosity about viewpoints that diverge from scientific consensus

### *Practice-based Reflection Questions:*

- What misinformation will you be looking out for?
- What barriers to belief/understanding will you be looking out for?
- What misinformation mitigation strategies could you be ready to employ?
- How might your approach to a given lesson change when taking into account all the different influences on students’ processing of the information within the lesson?
- How might an understanding of information environments and different influences on students’ beliefs change the way you approach misinformation?

### *Resources:*

- MediaWise Teen Fact-checking Network:  
<https://www.poynter.org/mediawise/programs/tfcn/>
- Fakey game: <https://fakey.osome.iu.edu/> from [The Observatory on Social Media \(OSoMe\)](#)
- Visualization of socio-ecological model:  
[https://commons.wikimedia.org/wiki/File:Diagram\\_of\\_the\\_social-ecological\\_model.png](https://commons.wikimedia.org/wiki/File:Diagram_of_the_social-ecological_model.png)
- Understanding why misinformation spreads:  
<https://www.c-span.org/classroom/document/?17914>



- More from a civics perspective, students explore why false information is believed and spreads by looking at psychological factors, media environments, and people's news literacy skills.
- Nobel Summit 2023: Truth, Trust and Hope:  
<https://www.nobelprize.org/nobel-prize-summit-2023-key-highlights/>
- Biases Make People Vulnerable to Misinformation:  
<https://www.scientificamerican.com/article/biases-make-people-vulnerable-to-misinformation-spread-by-social-media/?redirect=1>
- Mapping Environmental Disparities:  
<https://southseattleemerald.com/2022/08/06/weekend-reads-mapping-health-disparities/>
  - Article provides a visualization of the Threat x Vulnerability = Risk model for environmental analyses (which can apply to health or information environments). It also includes a discussion of factors that can lead some communities to have higher levels of environmental health issues as compared to others.
- The psychological drivers of misinformation belief and its resistance to correction:  
<https://doi.org/10.1038/s44159-021-00006-y>
  - Discussion of social and affective factors that lead people to form or endorse misinformed views and both preventative and reactive interventions.
- The Information Environment and its Effects on Individuals & Groups:  
<https://royalsociety.org/-/media/policy/projects/online-information-environment/oie-the-information-environment.PDF>
  - Literature review on approaches to information environment analyses for those who really want to dive into theoretical literature!
  - More from the Royal Society here:  
<https://royalsociety.org/topics-policy/projects/online-information-environment/>
- Critica Science: <https://www.criticascience.org/>

## Tolerance of Uncertainty & Ambiguity

### *What this entails:*

- Ability to tolerate uncertainty and ambiguity
- Exposing students to [messy, real-world results](#) and [authentic research and data sets](#)
- Encouraging students to play devil's advocate with their findings and consider multiple alternative explanations for their results.
  - Then, students consider how they would determine which explanations are most robust and most likely to be correct, as well as which should be discarded? What additional information would help them to be convinced by a given explanation?
- Having open discussions about what to do when scientific information is unsettled, as in the case of the early days of the COVID-19 pandemic or Long COVID now.
  - Ex: How can you decide what to believe and what not to believe when so much is unknown? How do you know when someone has legitimate new findings versus someone coming up with explanations that have a thin evidence base?

### *Practice-based Reflection Questions:*

- What natural world phenomena are students exploring, or could be exploring?
- What authentic data sets could students work with?
- Is there room for some messiness in the results or explanations that students grapple with, exposing them to the [messiness that can accompany science data](#)?
- What room is there for students to grapple with uncertainty? competing explanations and evidence?
- What room is there for students to confront scientific issues that are both settled and unsettled? competing explanations and evidence?
- How do students currently understand what scientific consensus is? How can you explain to them the difference between “consensus is not 100% but scientists still have a generally accepted answer for this” and “things are still really unknown in this area?”
- How can students be encouraged to think about how to make real-world decisions about health and science-related topics when not all the information is known yet?

## Tolerance of Uncertainty & Ambiguity

### Resources:

- <https://undsci.berkeley.edu/real-world-results/>
  - Discussion of how to make sense of scientific results with students
- <http://datanuggets.org/>
  - Lessons that engage students in authentic science research
- <https://thewonderofscience.com/datasets>
  - Authentic data sets for students to work with
- <https://www.nsta.org/science-teacher/science-teacher-aprilmay-2020/messy-data-real-science>
  - Article shares tips for creating experiences that equip students to thrive in a world of messy data.
- <https://www.nextgenstorylines.org/>
  - Examples of phenomena-based unit plans
- <https://researchquest.org/cleveland-lloyd/>
  - This web-based activity puts students in the role of paleontologists investigating a question that remains unsettled.
- <https://ambitiousscienceteaching.org/tools-face-to-face/>
  - Instructional toolkit designed to help students as they think and talk about science ideas and build consensus
- <https://www.nsta.org/science-scope/science-scope-marchapril-2024/eliciting-initial-ideas-building-understandings-and>
  - Guidance for three different discussion types: initial ideas, building understandings, and consensus discussions
- Gheihman, Galina, Mark Johnson, and Arabella L. Simpkin. (2020) [Twelve tips for thriving in the face of clinical uncertainty](#). *Medical Teacher* 42(5), 493-499.
  - Article aimed at medical professionals, can apply to education more generally
- <https://www.scientificamerican.com/article/if-you-say-science-is-right-youre-wrong/>
  - Article on the process of science
- <https://www.storybehindthescience.org/>
  - Stories of major science topics designed to highlight how science works, how scientists think, and the often messy process that leads to the development of scientific knowledge

## Ability to Navigate Conflicting Perspectives and Ideas

### *What this entails:*


- Developing an understanding of the [norms of science communication](#)
- Establishing a culture of academically [productive talk](#)
- Consensus building via critical discourse
- Testing a variety of [competing hypotheses](#) and deciding if information/evidence supports or contradicts competing explanations
- Presenting and discussing claims, evidence, interpretation of the evidence, and reaching a consensus about the outcome
- Confronting ideas and perspectives that are different from one's own
- Developing [communication skills](#), understanding of [productive scientific conversations](#), [how to provide peer feedback](#)

### *Practice-based Reflection Questions:*

- What opportunity is there, or could there be for:
  - Sharing ideas?
  - Confronting ideas different from one's own?
  - Science argumentation?
  - Building consensus?
  - Peer feedback?
  - Critical discourse?
  - A science seminar?
- Are students familiar with "talk moves" and can these be modeled in class?
- Can students be encouraged to practice virtuous behaviors and celebrate the enactment of virtuous dispositions in their classroom interactions?

### *Resources:*

- <https://ambitioussciencelearning.org/tools-scaffolding/>

- <https://ambitioussciencelearning.org/tools-face-to-face/#Hypothesis>
- <https://ambitioussciencelearning.org/ab-partner-talk-protocol/>
-  Accountable Talk Sourcebook - University of Pittsburgh.pdf
- [Rahmawati, Y., Taylor, E., Taylor, P.C., Ridwan, A., & Mardiah, A. \(2022\). Students' Engagement in Education as Sustainability: Implementing an Ethical Dilemma-STEAM Teaching Model in Chemistry Learning. \*Sustainability\*.](#)
  - Article introduces an Ethical Dilemma STEAM Teaching Model for socio-scientific topics
- Interdisciplinary collection of lesson plans around critical thinking, counter-arguments, debating with dignity, developing inquiry-based mindsets:  
<https://www.procon.org/background-resources/lesson-plans/>