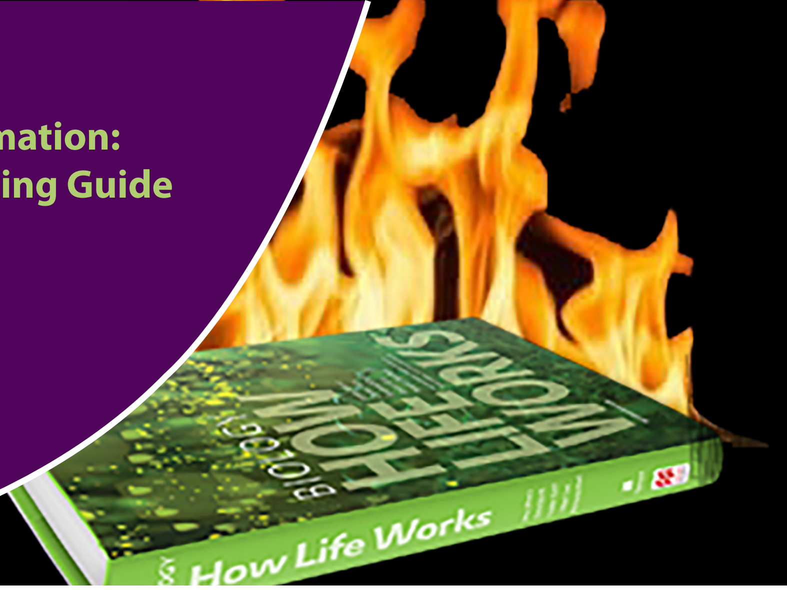
FEATURE ARTICLE

Managing Misinformation: An *ABT*-Based Teaching Guide



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Abstract

This paper catalogs previous articles in American Biology Teacher *on various aspects of teaching about science misinformation and identifies which of the core concepts are addressed in each. A concise overview of relevant themes is provided, along with how the concepts align with the Next Generation Science Standards. This may serve as a practical guide for organizing and planning science media literacy education, to help students negotiate the growing flood of misinformation.*

Key Words: *misinformation; credibility; expertise; consensus; epistemic trust; uncertainty; science media; conflicts of interest; persuasive tactics; peer review.*

Misinformation about biological science has reached crisis proportions, from climate change to vaccines to pandemics. Much is deliberate *dis*information, designed to discount the science that can inform personal and social decision-making—about public health, the environment, nutrition, health risks, and other biological topics (for example, see the four books reviewed in *ABT*, March 2024). As a result, in April 2023, the NABT Board of Directors endorsed the teaching of science media literacy "as part of a complete and responsible biology curriculum" (http://nabt.org/Post/NABT-Statement-on-Science-Media-Literacy).

Many relevant articles and lessons have already been published in the pages of this journal. These are catalogued in Figure 1. Some lessons are contemporary, some historically based. One from 1974(!) focuses on conflict of interest. Another highlights the role of identity politics (ref. 11). Others highlight methods of persuasion, hoping to "inoculate" students against deceptive tactics in the media—a strategy known as "pre-bunking" (refs. 3, 18, 19). All are available free to NABT members through the *ABT* archive (https://online.ucpress.edu/abt).

Many conceptual themes are relevant (for a more detailed summary, see Allchin, 2023). These are summarized briefly below, organized under the rubric of the widely influential Next Generation Science Standards. Each section concludes with a corresponding teaching objective, expressed in terms of a student competence (in a first-person perspective). The various *ABT* articles that address each theme are indicated in Figure 2.

> *Students should have guided experience in evaluating real media sources.*

○ Building On and Elaborating the NGSS

Misinformation was not mentioned explicitly in the original 2011 documents that led to the current Next Generation Science Standards (NGSS) (National Research Council et al., 2011). Nevertheless, the aim of science media literacy aligns closely with some of its "scientific practices" and "crosscutting concepts." First, NGSS advocates nurturing skills in evaluating information (Science and Engineering Practice [SEP] 8). Equally important, perhaps, students need to understand the social practices of argumentation and developing a consensus that help warrant trust in scientific knowledge (SEP 7). In addition, students should appreciate the limited nature of models and scientific theories (SEP 2, 4, Crosscutting Concepts [CC] 2, 4) and the human dimension that can introduce bias and error into science (CC 2, 4). The specter of misinformation has grown rapidly, so the relevant detailed benchmarks are not yet included in many state standards or curricula (or their corresponding exams). But this hardly diminishes the importance and urgency of addressing science media literacy.

○ SEP 8: Obtaining, Evaluating, and Communicating Information

NGSS Practice 8 states (rather succinctly) that students should be able to "assess the credibility, accuracy, and possible bias of each publication" (Vol. 2, p. 65). That includes "media reports" (in addition to "technical texts"). SEP 8 also refers repeatedly to drawing

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Figure 1. Misinformation bibliography from *American Biology Teacher*.

- Stein, R.A. & Davis, D.L. (2014). Conflicts of interest: Manipulating public health. 76 (Mar.), 173–177.
- Scott, G. & Ahmed, S.A. (2020) A writing-to-learn approach for improving students' evaluation of science web sources. 82 (Nov./Dec.), 638–640.
- Proudfit, M. (2020). Sorting fact from fiction: media literacy in the biology classroom. 82, 631–633.
- Osterhage, J.L. & Rogers-Carpenter, K. (2022). Combatting misinformation through science communication training. 84 (Sept.), 390–396.
- Hoskins, S.G. (2010). "But if it's in the newspaper, doesn't that mean it's true?": Developing critical reading & analysis skills by evaluating newspaper science with CREATE. 72 (Sept.), 415–420.
- Hofer, B.K. & Sinatra, G.M. (2022). How to prevent science denial: Tips for biology teachers [guest commentary]. 84 (Nov./Dec.), 523–524.
- Gardner, G.E. et al. (2009). Popular media in the biology classroom: Viewing popular science skeptically. 71 (Aug.), 332–335.
- De Beer, J. & Van Wyk, B.-E. (2022). Learning about science & pseudoscience as critical consumers: Activity on the rationality of plant, medicinal & cosmetic products use. 84 (Oct.), 488–495.
- Brinkman et al. (2012). Media-savvy scientitic literacy. 74 (Aug.), 394–379.
- Bramschreiber, T. & Westmoreland, D. (2015). Preparing students for science in the face of social controversy. 77 (Apr.), 284–288.
- Bonney, K. (2018). Fake news with real consequences: The effect of cultural identity on the perception of science. 80 (Nov./Dec.), 686–688.
- Barrett, S.J. (1974). The politics of health nonsense. 36 (Nov.), 508–511.
- Allchin, D. (2012). What counts as science. 74 (April), 291–294.
- Allchin, D. (2012). Skepticism and the architecture of trust. 74 (May), 358–362.
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- Allchin, D. (2015). Global warming: scam, fraud, or hoax? 77 (Apr.), 308–312.
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- Allchin, D. (2020). The credibility games. 82, 535–541.
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- Allchin, D. (2022). The vaccine skeptics of 1721. 84 (Jan.), 53–54.
- Allchin, D. (2024). Managing misinformation and the gendered lessons of women primatologists. 86 (Mar.).

on "reliable" media, reflecting an implicit assumption that a student also develops skills in determining which sources are reliable, and which not. The emphasis is clearly on evaluating the quality of the information—directly relevant, of course, to the deluge of misinformation about science in the media. But, notwithstanding the NGSS's economy of words, it also seems a pretty tall order. Fortunately, experts in media literacy can help fill in the details of the corresponding concepts and skills.

Epistemic Trust

In modern society, specialized knowledge is widely distributed. We rely on each other for expertise across a broad swath of topics, and at various levels—medicine and law, plumbing and electrical work, bridge-welding and tech repair. Or immunology, climate modeling, and forensic DNA analysis. Philosophers call this *epistemic trust.* Even something as "simple" as reading a textbook involves placing our trust in the authors, and that they (or—even more indirectly—the publisher's staff) have vetted all the information it contains.

The ready availability of information via the internet and electronic media may easily feed an illusion that we can always learn enough to become experts on our own. It is tempting to think that we will always be able to judge the evidence and the arguments for ourselves. But what if the evidence has been cherry-picked and is inherently misleading? What if the argument, however plausible, is incomplete? What if it fails to address important alternative hypotheses? What if there is some critical experimental source of error that only an experienced investigator can spot? Today, social media and the internet are rife with bogus scientific claims—artfully crafted to deceive us. Indeed, all these considerations frame the core challenge of misinformation: namely, without specialized expertise, how do we sort genuine science from junk imitations? Assessing "the credibility, accuracy, and possible bias of each publication" involves far more than merely digging deeper on the internet or collecting more information from scientific journals brimming with jargon we can barely understand.

Ironically, this is true even for scientists. The contributors to the authoritative IPCC reports on climate change inevitably trusted each other for their respective expertise. No one, alone, could vouch for the whole. Ultimately, we must keep in check the alluring myth of intellectual independence. Namely, *we cannot judge all scientific* *evidence fully and effectively for ourselves.* This posture of intellectual humility is perhaps the most important lesson, even if it seems counterintuitive to the aspiring scientist.

To tap into the expertise of others, we must learn *how to exercise epistemic trust in an informed way*. It is not blind faith or trust based on moral standing. It is not trust based on loyalty, or commitment, or promise-keeping. Rather, epistemic trust is solely about knowledge, and it is measured based on expertise and credibility, the next two basic concepts. For *ABT* articles addressing this concept, see Figure 2.

- *"I can describe how specialized knowledge in our society is distributed among experts in many fields, including science."*
- *"I can recognize the limits of my own scientific knowledge."*
- *"I can acknowledge when others know more about a scientific topic that I do, and respect their contributions."*

Expertise

Expertise is a matter of depth and breadth of knowledge. It is expressed as mastery or proficiency in a specialized field, which non-experts do not share, whether it be in science or music. In science, expertise includes, ironically, familiarity with many potential sources of error (in observation, in reasoning) and being able to apply the methods that safeguard against them—for example, knowing how to apply controls in an experiment or how to recognize logical fallacies. Scientific expertise is also limited to specific

Figure 2. Guide to conceptual themes addressed in the misinformation lessons and articles in *American Biology Teacher* (for article references, see Figure 1).

	Concepts														
Article	**epistemic trust**	**expertise**	**credibility**	**role of media**	**conflict of interest**	**source bias**	**persuasive tactics**	**internet, social media, AI**	**uncertainty**	**error / scientist bias**	**peer review / criticism**	**consensus**	**scientific institutions**	**Student activity**	**Inquiry-based**
1					■	■	■								
2		■	■		■		■							✓	
3			■		■	■								✓	✓
4	■			■											
5				■										✓	
6	■	■							■		■				
7			■	■	■	■	■		■					✓	
8							■				■				
9			■	■										✓	
10	■		■	■							■			✓	
11						■	■							✓	
12					■	■	■								
13			■	■	■		■								
14	■	■	■		■										
15	■	■	■				■								
16	■	■			■	■									
17			■		■										
18	■						■								
19	■	■	■	■		■	■					■		✓	✓
20	■	■	■			■	■		■	■	■	■	■	✓	✓
21	■	■	■			■			■	■	■	■		✓	✓
22	■	■	■	■			■			■	■				

fields. A "scientist" (generically) is not an expert in all science. Consumers of science need to know to rely on only the *relevant* experts.

Expertise may be documented by passing an exam (as lawyers or doctors do when they enter their profession). Or there may be forms of certification or licensing (tradesmen, nursing, engineers). Students should understand that for scientists, expertise is associated with an advanced degree, a record of publications and, perhaps most importantly, respect by peers as a fellow expert. One can judge the level of expertise, variously, by someone's track record, by their stature among peers, institutional affiliation, positions of professional leadership, and awards (again, see Figure 2, refs. 2, 14).

- ► *"I can exercise informed trust in drawing on the expertise of others, including identifying who is an expert and who is not, and explaining why."*

Credibility

Credibility is what makes a source of scientific information trustworthy. The first element is being knowledgeable enough to vouch for the claims in question. That will be closely linked to the access to and ability to interpret the relevant experts (as noted above). Both credentials and experience may be important indicators here. A second element is a track record of reliability—namely, a history of transparently reporting the status of the scientific consensus and any remaining uncertainties or qualifications. In a sense, is the person honest? A posture of independence (or neutrality, where any controversy may exist) is a favorable sign—especially in contrast to a noticeable conflict of interest (included as a concept, below). By these criteria, veteran science journalists, for example, may be considered credible sources, even if they are not scientists themselves or directly involved in the research in question (see 19, 21).

- ► *I can identify credible sources of scientific information, distinguish them from unreliable or questionable sources, and explain why they are credible.*

Role of Media and Filters in Communication

For anyone outside the expert scientific community, knowledge of the relevant science is inevitably indirect. It is communicated through scientific reports, through news channels, through interviews, podcasts, and websites, and through second-hand, third-hand (or longer-chained) accounts via social media. Knowing the provenance of a particular claim and the reliability of the transmission can be challenging. Moreover, not every purported claim available on public media necessarily reflects scientific consensus. Bogus claims or imitations are possible. That is, consumers must learn to cope with "science in the wild"—outside the domain where professional experts are able to keep each other in check. Competent outsiders must thus understand the *role of the media themselves* in the communication of scientific claims (see 4, 5).

- ► *I am aware how information about science is communicated through various media and can evaluate how intermediaries in the process may alter or possibly misrepresent the nature of the claims.*

Source Bias

It may be worth noting that even with its brevity, the NGSS makes explicit note of possible bias in communication. *Source bias* may be exhibited in several ways: theoretical commitment, ideological views, personal relationships, contexts of power, commerce, or perhaps gender, race, class, or nationality (depending on the case). Any may distort the message, whether consciously or subconsciously (see 3, 7).

- ► *I can inquire into the motives behind appeals to science, especially those related to political, commercial, or ideological contexts.*

Conflict of Interest

Sources of funding can influence scientific research, even when the scientists regard their work as independent of any sponsor. When the epistemic aims of science intersect with personal benefit, it is termed a *conflict of interest*. Such contexts can influence what questions are asked or which researchers receive grants (SEP 1), which results and arguments are made public (SEP 7), and what claims are communicated (or not)(SEP 8). Abstractly, or in an ideal world, scientific practices transcend such influences. In reality, however, conflicts of interest are a major source of bias in scientific claims and misinformation (see 1, 12, 16, 17).

- ► *I can describe how sources of funding may influence science: the questions that are asked, and the results and arguments that are published.*
- ► *I can describe how conflict of interest may bias the content of claims in public media.*

Persuasive and Deceptive Tactics

Science-in-the-wild—on the internet, on social media, on television, or in advertisements—is not subject to peer review or the watchful eye of responsible media "gatekeepers." *Persuasive and deceptive tactics*, familiar in advertising, may be used to convince the unwary consumer of facts contrary to science. Purveyors of science disinformation may sometimes pretend to speak for science. Students should be familiar with their psychological vulnerabilities and how others may play on their emotions [see 7, 15, 18].

- ► *I can recognize persuasive and deceptive tactics in media messaging and provide several examples related to science.*

Internet, Social Media, AI

New media pose special problems. For example, false claims travel faster, farther, and more broadly on social media (compared with true ones). Manipulated images and videos, along with computer-generated text, challenge conventional skills in interpreting what is "real" and what is fake. With new technologies constantly emerging, media literacy problems continue to evolve.

- ► *I can describe several benefits and potential pitfalls of electronic and social media related to trustworthy scientific information.*

○ SEP 7: Engaging in Argument from Evidence

Consumers of science also need to understand some of the key elements that help ensure the basic trustworthiness of scientific knowledge. Empirical evidence, logical reasoning, and various forms of argument—long-time familiar elements in science education—are certainly among these. However, the social practices of science are equally important, and these are less widely known or taught.

The NGSS refers to this dimension of scientific practices somewhat obliquely. For example, Practice 7 indicates that students should be able to "respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions" (Vol. 2, p. 63). Namely, *dialogue* is essential. Without labeling it as such, or underscoring its importance, this standard alludes to the distinctive system of checks and balances in science, whereby the claims of individuals are vetted by peers. Sociologist Robert Merton aptly called it "organized skepticism."

Peer Review / Criticism

A key element of this social dynamic is *peer review*. Before publication, scientific papers are submitted to fellow experts, who assess whether the research and reporting has been done responsibly, according to professional standards. Technical errors (including lack of controls), flaws in statistical analysis, or interpretive problems (such as overgeneralizations or unaddressed alternative explanations) are often flagged at this stage, and addressed before an editor decides to publish the paper (see 8, 10).

Peer review also continues after publication, through ongoing mutual criticism. Here, scientists may legitimately disagree about the interpretations of evidence (narrowly or broadly). Debates may flare. Follow-up research may be targeted to acquire new data relevant to resolving disagreements. This is all part of normal, healthy science (e.g., Hull, 1988; Machamer et al., 2000). Lively debate among scientists is not a sign of weakness in science, as some contend. Rather, it is an indicator that science is actively engaged in trying resolving critical ambiguities or remaining uncertainties. One should not understate the significance of the social process mentioned (but all too briefly) in SEP 7.

NGSS's Nature-of-Science concepts add that "scientists' backgrounds, theoretical commitments, and fields of endeavor influence the nature of their findings" (Vol. 2, p. 100). Peer review helps to minimize the adverse effects of such biases.

- ► *I can describe the process of <u>peer review</u> in science and explain <u>how scientific communities develop consensus</u>.*
- ► *I can explain how competent scientists may <u>justifiably disagree</u>, including some examples.*
- ► *I can describe how scientists <u>resolve their disagreement</u> through appeals to the evidence.*
- ► *I can describe several historical cases of <u>error or bias</u> among scientists and how the scientific community identified and <u>corrected</u> them.*

Consensus

Scientists are just ordinary individuals. However, as a collective, they are much wiser. Reciprocal critique from a diversity of perspectives (peer review) helps strengthen scientific knowledge. It is a process of developing resilience against alternative interpretations of the evidence. When scientists finally concur—when they achieve a *consensus*—one can then regard the conclusions as well justified. While a single expert assessment is valuable, agreement among many different experts is more valuable, and typically more enduring. In a sense, provisional or "tentative" science becomes "settled science." Only then can one truly call it scientific *knowledge*. It can be expected to function as a stable basis for informing public policy. The difference between claims that aspire to "scientific" status (or that have been published, but not yet fully vetted), and claims that responsibly reflect the consensus of the relevant experts is critical for interpreting (mis)information in the media.

- ► *I can explain why <u>consensus</u> in science is important (when compared with the claims of individual scientists).*

Scientific Institutions

Peer review and the development of consensus does not happen in a vacuum. Scientists have established many professional *scientific institutions* that help to organize their efforts. Examples include the IPCC, WHO, EPA, CDC, USGS, NIH, and various national academies, among others. For example, many institutions sponsor journals for the publishing and sharing of results. They also host conferences as forums for critical discourse. Some organize expert panels who help articulate and document areas of consensus. These, too, are important elements in enabling consumers of science to assess the status of current knowledge, and what the experts themselves consider "settled science."

- ► *I can identify many <u>scientific institutions</u> that serve as benchmarks for trustworthy scientific information.*

○ Crosscutting Concepts and the Nature of Science

Additional concepts relevant to managing misinformation and to science media literacy are found among the NGSS's Crosscutting Concepts (Appendix G) and its perspectives on the Nature of Science (Appendix H). These include "science as a human endeavor" and the limits of "science as a way of knowing."

Scientific Uncertainty

Much science relevant to socioscientific issues and public policy is ongoing. For example, emergent viruses and unfamiliar diseases, as well as new environmental threats, pose challenges that require new research. In these cases, conclusions may be incomplete. Expert judgments may differ. Science-in-the-making typically exhibits *uncertainty*. Scientific research takes time! Even with settled knowledge, scientific models typically rely on assumptions and may be limited. Conclusions may be probabilistic. Statistical sources of error may remain. These are all important qualifications, which are often obscured in the public media and may foster confusion or inflate corrosive doubt (Friedman et al., 1999; Michaels, 2020).

In addition, SEP 2 and Crosscutting Concept 4 underscore the use of models in science. "Models are limited." That is, "they only represent certain aspects of the system under study" (Vol. 2, p. 85). As a result, models "bring certain features into focus while obscuring others." They "do not correspond exactly to the real world. . . . All models contain approximations and assumptions that limit the range of validity and predictive power, so it is important for students to recognize their limitations" (Vol. 2, p. 52). Misconceptions about models and theories appear frequently in scientific misinformation, and the mistaken impressions may be leveraged to inappropriately dismiss or discount scientific claims. This has proven to be a major source of confusion for many consumers of science, which effective science education can help remedy.

Another common stumbling block is in understanding the nature of conceptual change. "Scientific findings are frequently revised and/or reinterpreted based on new evidence" (Vol. 2, p. 99). Scientific knowledge is not permanent and, ironically, this is an epistemic virtue. Revisions of our knowledge based on new findings are to be welcomed and celebrated, not disparaged as reflecting an inherent flaw in the process of science. Indeed, we may view it as an ethical responsibility to update our beliefs when new evidence becomes available. This is an occasion to underscore the empirical nature of science. (Again, Figure 2 provides a guide to aligning concepts with relevant *ABT* articles.)

- ► *I can distinguish between settled science and the open uncertainties of ongoing research.*
- ► *I can explain how scientific concepts may change with new evidence.*
- ► *I can explain the importance of empirical evidence in substantiating claims.*

○ Teaching about Misinformation: Best Practices

Following the notion of best practices, science media literacy lessons should actively engage students in their own learning (Chi, 2009). Students should have guided experience in evaluating real media sources. In a moderated classroom context, they should be able to probe and discuss the efficacy of their work. That is, lessons should ideally be framed through inquiry (see 3, 19). Some of these may draw on historical case studies (see 20, 21). Here, the challenge of interpreting the credibility of claims in the media should be

Figure 3. General science media literacy curriculum resources available online.

Cranky Uncle (John Cook)
An interactive game for how to address a staunch climate change skeptic. Available in multiple languages.
http://crankyuncle.com

The Debunking Handbook. 2020 (Lewandowsky et al., 2020)
Written by a team of 22 prominent scholars of misinformation and its debunking. Represents the current consensus on the science of debunking for engaged citizens, policymakers, journalists, and other practitioners
https://www.climatechangecommunication.org/wp-content/uploads/2020/10/DebunkingHandbook2020.pdf

"Go Viral" (Social Decision Making Lab, University of Cambridge)
A 5-minute game (for smart-phone) aimed at inoculating participatns against COVID-19 misinformationon. Ages 15+
https://www.goviralgame.com/en

How to Spot Conspiracy Theories (Stephan Lewandowsky, John Cook, Ullrich Ecker & Sander van der Linden, 2020)
A 7-point guide to identifying conspiratorial claims, with examples.
http://sks.to/conspir

MediaSmarts: *Science & Health Information* (Canada's Center for Digital and Media Literacy)
An overview of media literacy challenges, applied to health and science topics, with some description of the skills for finding reliable sources, being an informed reader, identifying consensus and evaluating authority.
https://mediasmarts.ca/digital-media-literacy/digital-issues/authenticating-information/finding-evaluating-science-health-information

Merchants of Doubt (R. Kenner, 2015. SONY Classic Pictures)
A documentary by based on the book by Oreskes and Conway, describing the playbook on how industry has manufactured or leveraged scientific uncertainty to stall informed policy.
preview trailer: https://www.youtube.com/watch?v=j8ii9zGFDtc

Resisting Science Misinformation. (A. Zucker & P. Noyce, 2018, Tumblehome Books, in conjunction with WGBH/NOVA)
A one-week (5-class) lesson plan. Includes 4 short videos (3-6 mins. each) with accompanying activities and questions and teacher's handbook. Grades 6–12.
https://tumblehomebooks.org/services/resisting-scientific-misinformation/

ScienceUpFirst (Canadian Association of Science Centres)
A coalition that shares the best available science, aiming to debunk health misinformation and stop the spread of misinformation.
https://www.scienceupfirst.com/share

Stories Behind the Science: SpottingPseudoscience (2022–23)
12 historical case study narratives, with questions to probe features of science and misinformed pseudoscience.
https://www.storybehindthescience.org/spotting-pseudoscience

Stopping the Disinformation Playbook (Union of Concerned Scientists, 2018)
An overview of how business interests deceive, misinform, and buy influence at the expense of public health and safety. A series of case studies, organized by 5 major tactics used to mislead.
https://www.ucsusa.org/resources/disinformation-playbook
https://www.ucsusa.org/resources/stopping-disinformation-playbook
https://www.ucsusa.org/resources/disinformation-playbook-stories

Figure 4. A summary of key concepts for science media literacy.

- epistemic trust
- expertise
- credibility
- role of media and filters in communication
- conflict of interest
- source bias
- persuasive and deceptive tactics
- internet, social media, AI
- scientific uncertainty
- error / scientist bias
- peer review / criticism
- consensus
- scientific institutions

problematized for the students. They should be involved in collectively constructing for themselves the relevant concepts cataloged above. Media literacy education is growing rapidly (see Figures 1, 3). However, many lessons currently rely on supplying students with lists of prescribed principles or with prepared checklists. They are not inquiry-based. Rather, the students should be *generating* the checklists through their own work. Currently, the biology teaching community needs more media literacy lessons framed in inquiry mode. Readers should certainly feel encouraged to share their experience and successful activities via this journal.

Additional resources available online, with plentiful examples of relevant cases, are listed in Figure 3.

Developing students skills in "critical thinking" has long been a goal of many science teachers. But we must now consider carefully what this means. The slogan "Do Your Own Research" has been gaining increasing popularity in some media. However, this posture tends to severely discount the importance of expertise and the roles of epistemic trust and epistemic humility. Several studies have now demonstrated that those who embrace this ideology are, ironically, *more* likely to dismiss the scientific consensus and *less* likely to trust science in general (Ballantyne & Dunning, 2022; Burdick, 2018; Carrion, 2017; Chinn & Hasell, 2023; Weill, 2022). They succumb more frequently to scientific misconceptions—about the COVID pandemic, about childhood vaccines, and about flat Earth views. They tend to substitute their own judgment for that of experts, and may then go on to defend their inexpert conclusions as "scientific." With the rise of misinformation, we need to rethink the conventional outlook. The focus of science media literacy needs to shift away from assessing the evidence and arguments for yourself. We must help students, instead, learn how to find credible sources, escape deception, and acknowledge the hard-earned expertise of scientists. We must underscore the social practices of science and the importance of peer review and a critical consensus. In short, we must teach all the concepts described above (Figure 4).

We all need to help students learn how to exercise informed trust in scientists, in scientific institutions, and in the consensus of the relevant experts.

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