DataWISE:
A tool to Scaffold Critical Data Literacy and Media Literacy Skills

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Abstract: With the rise of misinformation and disinformation spreading on social media, it is becoming increasingly important for science teachers to not only teach accurate science content, but also prepare students with the skills to critically evaluate data-based claims for reliability and validity. A group of science educators, high school teachers, and researchers have developed a free tool called DataWISE and a suite of sample activities for scaffolding critical data analysis and media literacy. The tool purposely sandwiches the critical aspects of multiple Science and Engineering Practices related to data analysis between key media literacy skills to create a flexible framework for evaluating claims that require scientific information to support them. In order for students to internalize the framework into a metacognitive strategy that is useful to them outside of the classroom, we recommend that the tool be introduced early within a course and regularly embedded in classroom activities.

Keywords: misinformation, disinformation, data science, critical data literacy, media literacy, science practices, data analysis

The Version of Record of this manuscript has been published and is available in *The Science Teacher Volume 93, 2026, www.tandfonline.com,* doi.org/10.1080/00368555.2026.2626046.

The Problem: Misinformation in the Media

A recent Gallup poll found that teenagers spend an average of 4.8 hours per day on social media, mostly YouTube and TikTok (Rothwell 2023). Students scrolling these sites today will encounter misleading claims such as Hurricane Helene was manipulated by the government to influence the election, the COVID vaccine is causing infertility, and wind turbines cause cancer. Although these claims are not supported by scientific evidence, many people believe them and share them with others. Students are confronted with scientific misinformation every day, but claims like these are rarely addressed in classrooms for a number of reasons: there is never enough time and always too much to do, avoidance of politically-charged issues, and the speed at which new misinformation appears online. If teachers tried to confront all the misinformation on social media, they would never have time for anything else!

The goal of developing citizens that are "critical consumers" of science is repeatedly mentioned in the National Research Council's *Framework for K-12 Science Education* that guided the development of the NGSS, but very little attention is given to how science is represented in the media. Even Science and Engineering Practice 8: Obtaining, Evaluating, and Communicating Information focuses mostly on reading and interpreting scientific texts. However, it also hints at the importance of media literacy saying,

> Being a critical consumer of science and the products of engineering, whether as a lay citizen or a practicing scientist or an engineer, also requires the ability to read or view reports about science in the press or on the Internet and to recognize the salient science, identify sources of error and methodological flaws, and distinguish observations from inferences, arguments from explanations, and claims from evidence (National Research Council 2012, p. 75).

Media literacy is essential because the internet, and social media in particular, allows anyone to share news that can reach thousands of people within seconds. This excess of information makes deciphering fact from fiction very challenging, especially when the topic is scientifically complex or becomes entangled in political issues. Climate change, energy policies, environmental issues, biomedical technologies, and the COVID-19 pandemic are just a few examples of current topics with an overwhelming amount of conflicting information available online. Compounding this is the fact that some individuals and organizations purposely manipulate or misrepresent scientific evidence to support their

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political or philosophical viewpoints. The abundance of unintentionally misleading misinformation and intentionally misleading disinformation is overwhelming to many citizens and can lead people to give up hope that deciphering fact from fiction is even possible.

The National Academies is concerned about the prevalence of misinformation and commissioned a consensus report released in 2025 titled, Understanding and Addressing Misinformation about science (National Academies of Sciences, Engineering, and Medicine, 2025). A recent report from Stanford University argues that "education, and science education in particular, has a fundamental responsibility to address this challenge and to develop a competency in the general public to distinguish credible scientific information from misinformation" (Osborne et al. 2023). The need to help students become critical consumers of information is also highlighted by a joint position statement on data science released by the National Science Teaching Association in collaboration with other national teacher organizations that says, "students must learn to question the sources of data, such as individuals, devices, or systems that generate or contribute to its creation and track the various transformations and processes applied to data, such as cleaning, aggregation, or analysis" (NSTA 2024).

Our Solution: The DataWISE Tool

Others have developed separate tools and resources for teaching data analysis skills, identifying science denial tactics, or fostering media literacy, but we wanted a simple tool that combined all of these into one framework. Drawing on the relevant literature and collaborating with a group of master teachers, we developed a flexible tool for high school students that we call DataWISE (available online at https://ncse.ngo/datawise).

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User guide for the DataWISE tool for evaluating data-based claims

Is this Worthy of attention?	**Who is presenting this?** *Consider: individual and organization qualifications, conflict of interest, and trustworthiness.*	Is this published by a reputable source (individual, organization, or publication)? Is it peer reviewed? Is the author qualified? If they are a scientist, do they have expertise in this particular subject area? Who funded this? Does the funding source introduce any conflicts of interest? Do an online search to find out what others say about the trustworthiness of the author, publication, or organization.
	What claim are they making or implying?	Is there a claim that requires scientific evidence to support it? Is there a subtle claim implied by the presentation of the data?
	Why are they making the claim? *Do an online search for purpose and motive.*	What is the purpose of the information? Is the intention clearly stated or subtly implied? Is the point of view objective and impartial? Is there evidence that this is opinion, propaganda, marketing, or politically motivated?
	When was the claim made?	When was it published or posted? Has there been an update since then? If it is not a primary source, can you trace the information back to the original source?
Inspect the data.	**What data support this claim?**	Is specific evidence given? If not, why didn't they use evidence and where might we find evidence to support or refute the claim? If they provided evidence, what variables were measured? Who collected the data and for what purpose?
	How are the data represented? *Pay careful attention to the labels on the axes of graphs.*	What variables are represented in the data display (charts, graphs, etc.)? Are the variables and axes labeled appropriately? Are the data presented in a straightforward way, or are they misleading? What relationships among the variables are suggested by the shape of the graph?
	Is the graph appropriate? *Consider: scale, units, cherry-picking, categories, grouping, oversimplification, truncation, etc.*	Is the scale of the graph appropriate? Is the graph showing only data that supports the claim while leaving out other data (cherry-picking)? Is the graph showing too much data so that it is difficult to see relevant trends? Are the axes truncated to make differences seem exaggerated (bar graphs should start at zero)? Does the way the data are grouped (categories) support the claim? Should other categories or different ways to visualize the data be considered?
Does this make Sense?	**Are the data relevant and sufficient to support the claim?**	Is causation implied for a correlation without sufficient evidence or reasoning? Could another variable account for some or all of the change? How could you design an investigation to test whether these variables could be interacting, while controlling as many other variables as possible?
	Are there signs that the data are biased?	How and why was this sample chosen? Was it chosen for convenience? Did the author only use data that would support their argument to the exclusion of other relevant data? Is the sample size large enough to be representative?
	Are there other ways to interpret the data?	How do you interpret the data? Do your conclusions match the claim presented? Could other claims be supported through different interpretations?
	How does this claim compare with other reliable sources? *What do the experts say?*	Look at other reliable sources. Can you find other studies on the same topic? Is there consensus in the relevant field of study? Has the claim been debunked by a fact-checker or other experts? If other studies disagree with this one, which claim is supported by the strongest evidence and reasoning?
What Emotion is activated?	**How do the claim and evidence make me feel?**	If you feel a strong emotion, ask yourself what belief it supports or challenges. When feeling strong emotions, we must work even harder to be objective. Is the author purposely activating specific emotions? Remember that extraordinary claims require extraordinary evidence.
	Is this what I already believed before I read it?	We have a tendency to interpret evidence in ways that confirms our beliefs. Confirmation bias makes it difficult to accept evidence contradicting our beliefs.
	What might make me change my mind?	Whether you agree or disagree with the claim, consider what it would take to change your mind. What kind of evidence? How much evidence? If no amount of evidence could ever change your mind, your view isn't based on data.

Note: The student worksheet of the tool does not include the prompts in the column on the right and instead is blank space for students to write.

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The DataWISE tool is a graphic organizer that scaffolds the steps we should follow when analyzing a data-based claim. WISE stands for the four key aspects that should be considered when we encounter a claim that requires scientific information to support it:

W - Is this **worthy** of attention?

I - **Inspect** the data.

S - Does this make **sense**?

E - What **emotion** is activated?

Of course, we like that the acronym spells *wise*, which reminds students of the importance of using good judgment. However, the order of the WISE steps is intentional. When we are doing science, we are always asking one key question: **IS** the claim supported by evidence? The **Inspect** and **Sensemaking** steps represent NGSS SEP 4, Analyzing and Interpreting Data, and SEP 7, Engaging in Argument from Evidence. However, when we encounter claims in everyday life, **WE** have to be careful. Not everyone plays by the rules of science, so we need to consider potential motives, biases, mistakes, and appeals to emotion with the **Worthiness** and **Emotion** steps. Therefore, the WISE acronym purposely sandwiches the science practices between the necessary media literacy skills for establishing motives and credibility.

Worthiness comes first in the DataWISE tool because when we encounter scientific claims in the media, we aren't sure whether or not the author is playing by the rules of science. Therefore, we should first ask ourselves, *Is this worthy of attention?* by considering the who, what, and why behind the claim. The DataWISE tool prompts students to consider the author's motives and qualifications to establish credibility before spending time and energy analyzing whether the data supports their claim. Credibility is rarely addressed in science classrooms, and when it is, it generally includes only aspects of the scientific process, such as peer review and consensus. However, the **Worthiness** step also has a more practical purpose in digital environments because our attention is a limited resource. Media literacy researchers have described the importance of "critical ignoring: choosing what to ignore, learning how to resist low-quality and misleading but cognitively attractive information, and deciding where to invest one's limited attentional capacities" (Kozyreva et al. 2023, p.82). The **Worthiness** aspect of the DataWISE tool will likely be the least familiar to science teachers because it feels like the opposite of the deep engagement and analysis that is encouraged in science. However, preparing students for life outside of the classroom requires

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that they learn how to sift through the information overload online and are keenly aware of the threat of misinformation.

The **Inspect** step of the DataWISE template scaffolds students in analyzing the data that supports the claim. It prompts students to first recognize whether or not specific evidence is given and where they might look to find supporting or disconfirming evidence if it is lacking. Next, students are guided in analyzing any graphs or charts while drawing attention to some of the most common errors and misrepresentations associated with visual representations of data. The tool reminds students to look closely at the axes, make sure they understand the variables, and consider whether the scaling and grouping of variables are appropriate. It also alerts students to watch out for oversimplification, truncation, or the possibility of cherry-picking data in which disconfirming data is purposely omitted.

The **Sensemaking** part of the DataWISE template guides students in considering whether the data is relevant and sufficient to support the claim. It alerts students to the common problem of attributing causation to a correlation between variables without sufficient evidence and reasoning. Students are also prompted to think about alternative explanations, whether the sample is large enough and representative of the population, and what additional data might be necessary to better support the claim. Finally, students are encouraged to compare the claim to other reliable sources. Looking to other reliable sources is very important, especially for non-experts who may not have the necessary skills and knowledge to critique the data themselves.

The **Emotions** part of the DataWISE template is the last step. Like the **Worthiness** step, considering our own emotional response to a claim is also generally overlooked in science classes. The peer review process helps ensure that scientists' personal beliefs don't cloud their judgment by holding their claims up to the scrutiny of a group of experts. However, tentative scientific claims are often taken out of context in the media, and we know that appealing to emotions is one of the most effective ways to persuade someone to change their mind, buy a product, or join a cause. Students must be explicitly taught to reflect on how our emotions can cloud our judgment and how appeals to emotion can purposely be used to manipulate us.

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The DataWISE tool was designed to scaffold student thinking using a cognitive apprenticeship model (Collins, Brown, and Holum 1991). The WISE steps apprentice students into scientific habits of mind by making visible the complex thinking processes involved in evaluating an evidence-based claim. The tool is simply a template that prompts students to consider multiple aspects of data analysis and source evaluation. Unfortunately, templates can sometimes be used in ways that are rote, especially if completing the template becomes the main goal. Our hope in creating the DataWISE tool was that it will be used in a more purposeful way. The tool should serve to structure a meaningful task within the context of normal classroom learning.

Recommendations

- **Introduce DataWISE early in the course** within discussions of the nature of science. In order to appreciate how science is different from other ways of knowing, students must have the opportunity to reflect on the "values, commitments, and habits of mind that have led to the practices of modern science and that give them meaning" (Johnson 2016, p.374). Discussion of the **Inspect** and **Sensemaking** steps of DataWISE provide an ideal context for considering how the practices of analyzing data and arguing from evidence are shaped by scientists' shared values such as curiosity, objectivity, and skepticism and their commitment to developing naturalistic explanations supported by empirical evidence.
- **Give students regular opportunities to practice** using the tool. When we are reasonably certain we are "playing by the rules of science," we can focus our attention mainly on the **Inspect** and **Sensemaking** steps. For example, students can practice the **Inspect** and **Sensemaking** steps any time the curriculum presents trustworthy data or when analyzing data collected through their own investigations. When claims from unknown sources are introduced, students should learn to recognize that the **Worthiness** and **Emotions** steps become essential for establishing credibility and detecting biases.
- **Provide a purpose for using the tool**. Students can easily fall into the trap of interpreting scaffolding tools as simply a worksheet to complete. For this reason, the classroom activities we have developed utilizing DataWISE (which can be found at ncse.ngo/datawise) are always framed around a specific task. For example, in one activity, students evaluate claims from a tobacco-industry-funded group and then write a short article or record a short video for their peers about the safety of vaping.

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The DataWISE tool would also be especially helpful when students are writing a research paper or engaging in a debate. Completing the tool for each source that they cite would be an excellent way to ensure that they deeply engage with their sources.

- **Consider the background knowledge and skills** necessary for certain topics. While our goal is that the DataWISE tool is used frequently and flexibly in classrooms, we caution teachers to consider whether students have the background knowledge and skills for interacting with certain content. For example, some climate change deniers are very savvy and manipulate data in convincing ways. The Heartland Institute's publications about climate change use accurate data from well-respected sources such as NOAA, but they masterfully cherry-pick the data and manipulate the graphs to support their misleading claims about climate change. We have students analyze these types of sophisticated disinformation only after they have learned the relevant climate science necessary to detect the errors so that they don't inadvertently fall prey to the misleading claims.

Ideally, students would engage in authentic experiences throughout their school careers that would allow them to develop the criteria embedded in the DataWISE tool for themselves and have ample opportunities to practice applying it to real-world examples. However, the challenges of classroom teaching and the explosion of misinformation and disinformation online convinced us of the need for a flexible scaffolding tool that can be embedded into any lesson. We developed the DataWISE tool in collaboration with classroom teachers and data and media literacy experts to help students organize their thinking so they can engage in more complex tasks than they would be capable of on their own. Through regular practice using the DataWISE tool, students can begin to internalize the complex metacognitive processes necessary for evaluating data-based claims while practicing the skills and habits they will need to discern fact from misinformation outside of the classroom.

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