FACT • OR • FAUX

Just Because It Sounds Plausible, Doesn't Mean It's True

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ABSTRACT

Equipping students to navigate the maze of misinformation, though, needs clarity about the challenge and clarity about the methods.

Keywords: Argument; misinformation; Antarctic sea ice; climate change; N95

Plausible scientific arguments abound. Those who wish to deceive often weave a tangled web of plausible scientific arguments to support their case. What can the science teacher do to prevent their students being duped? Given that many of the claims are scientific–which says something about the importance of scientific authority in our culture–science education must surely stand at the forefront of building students' capacity to detect the true from the flawed, but seemingly plausible, argument. Fact or faux? Equipping students to navigate the maze of misinformation, though, needs clarity about the challenge and clarity about the methods.

Some might argue that K-12 science education is already doing enough. Sadly, it is not. Why? First, because much "science in the wild" (science outside of schools) is beyond anything covered in the standard curriculum. Second, the smattering of knowledge that it does provide, although valuable, tends to build an illusory confidence that, even as a non-expert, you are capable of evaluating the evidence for yourself. Third, this mix of a modicum of knowledge and common sense is exploited by those who wish to deceive us. Following are three such examples.

Increasing sea ice in the Antarctic: a cooling planet?

Between 1979 and 2014, Antarctic sea ice levels showed a slight increase. Just look at one of the published maps and the ringed sections A and B in Figure 1. Climate change deniers alleged that this was clear evidence that the world was not warming. How could sea ice be increasing if the world is supposedly getting warmer (see https://www.wnd.com/2022/05/inconvenient-truth-globalists-arctic-ice-30-year-high/)? This certainly sounds plausible. After all, ice is produced when the temperature falls, not when it increases.

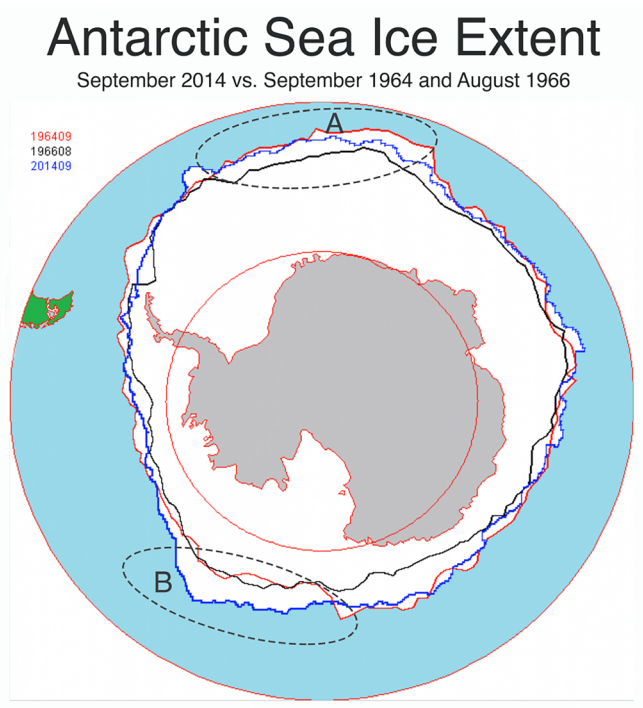
The data did indeed puzzle ocean scientists at first. But there is an explanation, which took further research. First, the Antarctic is a land mass where the amount of sea ice is influenced by a mix of ocean currents and variability in the system itself. Second, ice is freshwater. Freshwater is less dense than salt water. When it melts, it will float above the sea water and freeze again. What matters then is not the *surface area* but the *volume* of sea ice. Since 2014, Antarctic ice levels have dramatically declined, so this particular argument has melted before the climate change deniers' eyes (Mooney, 2015; Wolchover, 2012). Third, the data have been cherry-picked to compare May values, where one was low for the average, with one that was high for the average. Sea ice varies naturally because the weather varies. What matters is the long-term trend shown unequivocally in Figure 2.

Ironically, this example was told to me by the former head of research at a major Silicon Valley tech company, who had been taken in by it! He was already skeptical of environmentalism, so he easily accepted evidence that fitted his worldview. But if he, a scientist himself, was taken in by what seems like a plausible argument–what about the average school student?

How, then, do you avoid being misled? First, do not trust your own judgment, no matter how much science you've learned! What is the expert consensus? In this case, a simple Google search of "Antarctic sea ice climate change" will lead you to several authoritative sources, such as NASA's Earth Science Observatory or NOAA's climate.gov, which all refute this claim. Indeed, here is a case that can be used to teach the importance of scientific consensus and which professional organizations can be trusted to report that consensus. In short, don't trust hearsay or social media posts without checking the source.

FIGURE 1

Antarctic Sea Ice 1964, 1966, and 2014.



Source: National Snow and Ice Data Center http://nsidc.org/arcticseaicenews/2014/11/.

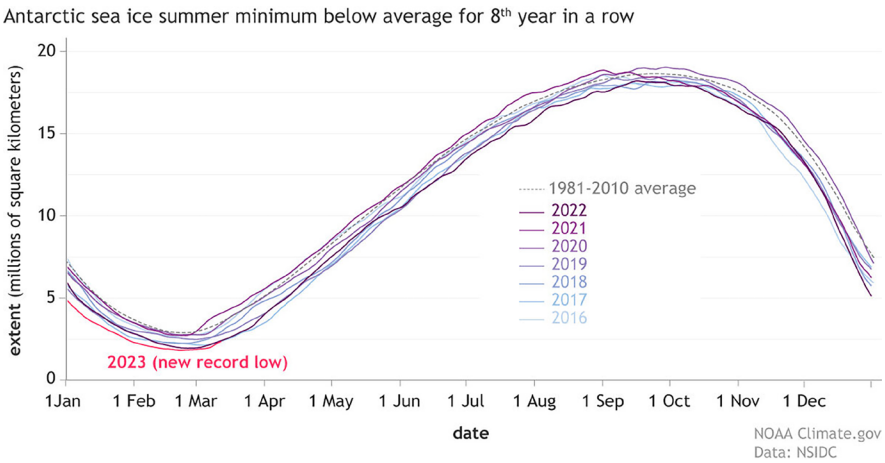
The ineffectiveness of face masks against Covid?

This second example offers another seemingly very plausible argument–about the ineffectiveness of masking during a pandemic–a topic still controversial among non-experts. The arguments is made here that the holes in a N95 mask are 3 microns wide, but the virus is *only 1 micron,* so the virus will sail through the mask like a marble through a chain link fence (see https://eu.usatoday.com/story/news/factcheck/2020/06/11/fact-check-n-95-filters-not-too-large-stop-covid-19-particles/5343537002/) Simple science shows how flawed the argument is, and is used to suggest that this is another case of government trying to limit personal freedom (Figures 3 and 4).

This appealing logic is flawed, however. First, the mask has layers so even if it gets through one 'fence', it may well be caught by the next. Second, the virus doesn't float around as the coronavirus, it sits on something–usually a water drop, which is much bigger. And third, the virus or the particle on which it sits is not moving in some linear fashion, but instead like all particles undergoing random Brownian motion (rather like a drunk trying to get home). All this significantly en-

FIGURE 2

Antarctic ice continues a downward trend, reaching a record low in 2023.



Source: National Oceanographic and Atmospheric Association. https://www.climate.gov/news-features/understanding-climate/understanding-climate-antarctic-sea-ice-extent.

FIGURE 3

"Like a marble through a chain-link fence."

hances the probability that it is going to be caught by the mask.

How many of us could have readily given the counterargument? Again, the solution is to seek out the consensus of experts. Search the internet for "how N95 masks work" and you will find explanations from the American Medical Association, the FDA, the CDC, the Mayo Clinic, and even *Wired* magazine! Begin by asking what a handful of *trustworthy* science sources have to say.

Why Green lawns are a good thing?

If this isn't enough to convince you of the dangers of a little knowledge, take the third example–the science used by the Lawn Institute. This is an industry-funded body that promotes the value of lawns. They use the school science knowledge that grass is a plant, one which captures atmospheric carbon dioxide, and thus contributes to minimizing climate change. Moreover, planting lawns "is the most effective way to return these disturbed soils into a more

FIGURE 4

"A multi-layered chain-link fence, like the mesh of an N-95 mask."

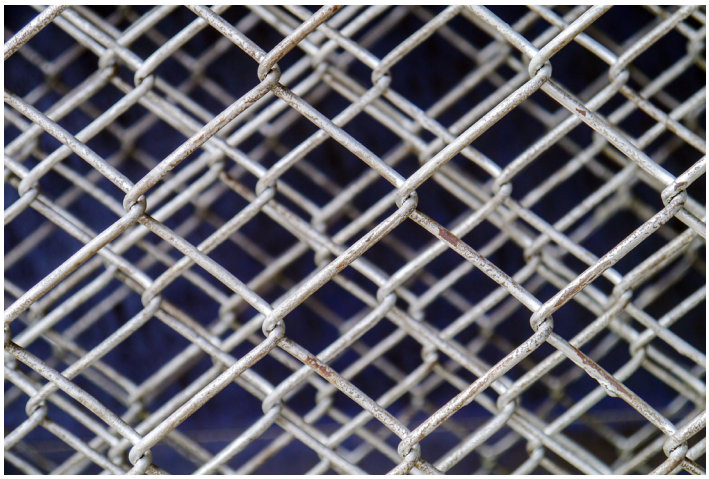
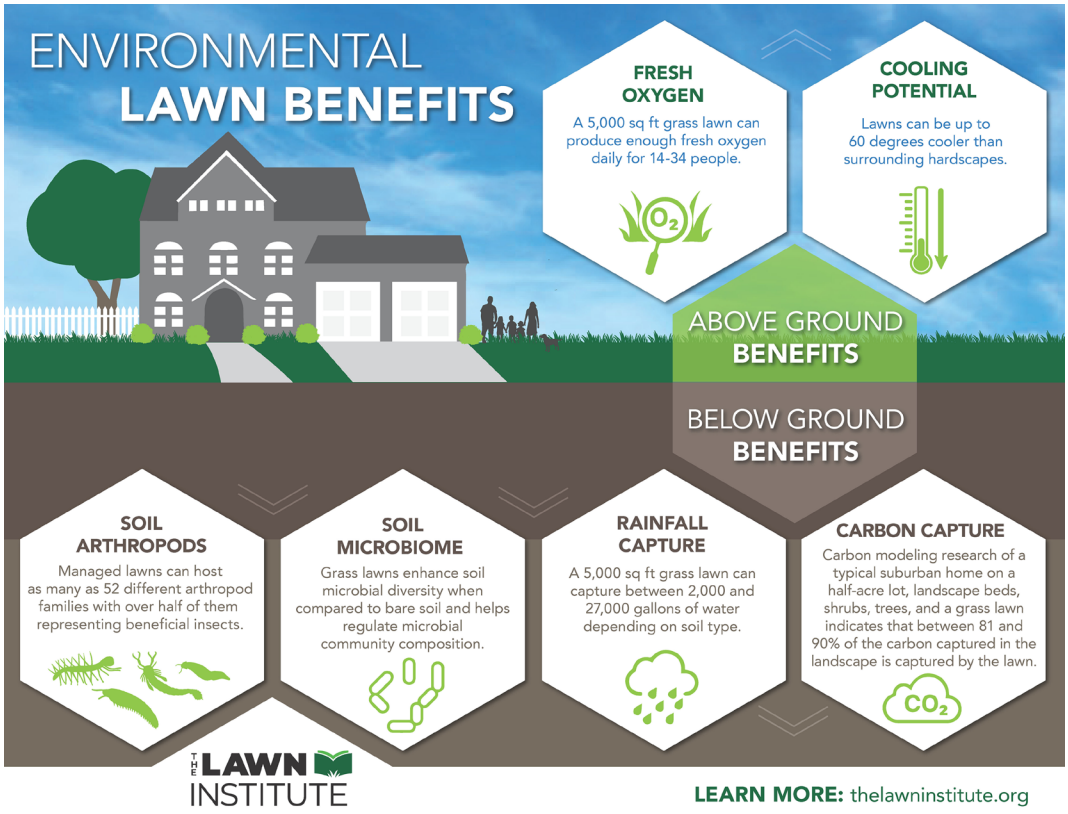


FIGURE 5

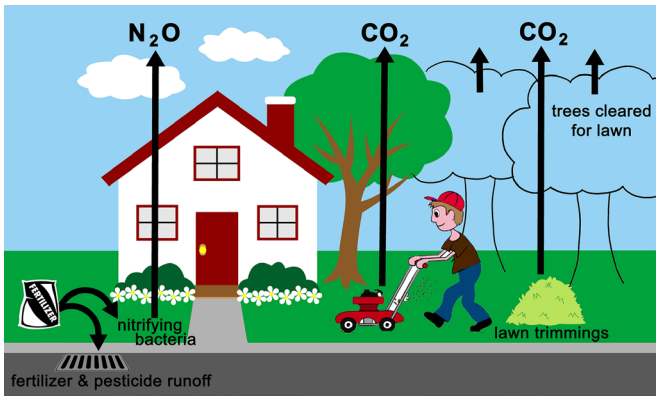
The environmental benefits of lawns, according to the Lawn Institute.



Source: The Lawn Institute. https://www.thelawninstitute.org/wp-content/uploads/2021/02/TLI-LawnBenefits-FINAL.pdf.

FIGURE 6

The environmental costs of lawns, hidden from the promotional account.



Source: The Lawn Institute. https://www.thelawninstitute.org/wp-content/uploads/2021/02/TLI-LawnBenefits-FINAL.pdf.

native state." This they supplement with an argument that lawns have been found to host as many as 52 different arthropods, supporting biodiversity! (Figure 5) (see https://www.thelawninstitute.org/environmental-benefits/thriving-ecosystems/). Sounds like good science and sounds appealing if you happen to have a much-loved lawn.

The problem is that the argument is cherry-picked. It ignores the substantial water resources needed to sustain a lawn. Or the fact that a lawn is essentially a monoculture which can only be sustained in its pristine condition using pesticides. Or that decomposition of lawn trimmings and rotting thatch just returns carbon dioxide back to the atmosphere again (Figure 6) (Allchin, 2023a). And, if the native state is so

valuable, why not let it go back to its native state–essentially rewilding it? These are all arguments which can be found by searching for "eco-friendly lawns?" on the internet.

Becoming a Savvy science consumer

There are many, many more such examples. What is the best defense against what are seemingly plausible arguments? Hard as it might seem for any teacher who promotes the virtues of scientific thinking, the last thing for students to do is evaluate the science. Start by acknowledging that you are not an expert. As noted in the cases above, begin by seeking out the consensus of recognized scientific experts.

If that is not immediately possible, exercise skepticism. Arguments are not to be believed until evidence from credible experts can be found that they are true. This means asking a series of critical questions as shown in Figure 7. Failure to pass any of these tests suggests that such arguments are best disregarded (Allchin, 2023b; Osborne et al., 2022).

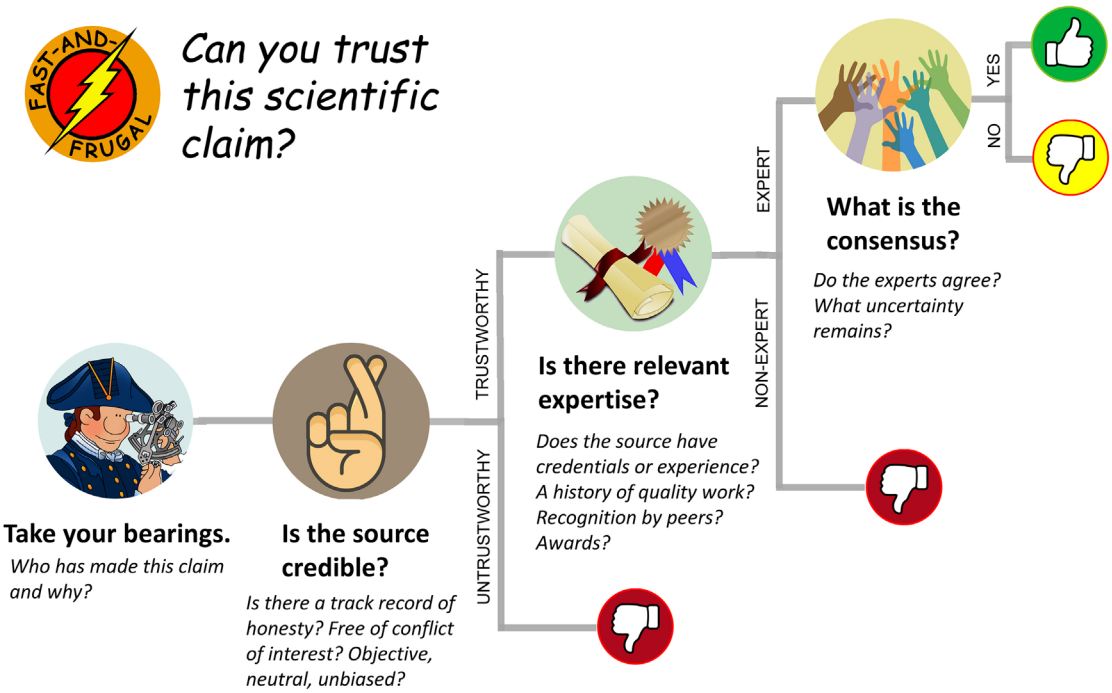
First off–does the source have a *conflict of interest*? In the case of the Lawn Institute–most definitely. In the case of the argument about masks and sea ice, the information originated with those who needed a good scientific-sounding argument to bolster their world view, and they hid their lack of scientific expertise and bias well, making it hard to discover their deceit. The conclusion: If you cannot track the origin of the information, the source is probably biased.

Nevertheless, you might go to the second level: does the source have *expertise* in this area? Robert Kennedy, Jr., for instance, is not an expert on vaccines. Anthony Fauci is. So is WHO, the CDC, the NIH, and the AMA. If they fail the expertise test, then you really should be dubious about the claim.

If they pass that particular test, you may go to the third level and ask if there is a *scientific consensus* on this matter, or is there substantial uncertainty within *the professional scientific community*? Scientific consensus is the ultimate goal of science. Once achieved, science moves on to the next problem. Scientific consensus is basically what fills high school textbooks. But, what about Galileo–and Wegener, Mendel, Avogadro, and others–who were ultimately right, but struggled for acceptance against the majority? Well, they are not the norm. And at the time there were good reasons for hesitating to believe their claims. Ultimately, if there isn't a consensus, it's

FIGURE 7

A basic approach to fact checking (adapted from The Science Teacher, June, 2023).



not settled science. No lone individual can claim authoritatively that they, and they alone, are right.

Step back

What these arguments really mean is that if you want to keep students from being tricked by those who practice deceit, the best thing you can do for them is *not* to teach them more science facts! Most of these flawed arguments rely on science way beyond anything K-12 science education will ever cover. Rather, the best thing you can do is teach your students the habit of checking sources, asking the three questions captured in the fast and frugal heuristic (Figure 7), or to find the scientific consensus on their own using the internet. Nobody is claiming that this will cover all cases, but it is a basic start to building the capacity to detect the abuse of science. And like, all capabilities, it is acquired through regular practice.

Every lesson, however small, contributes to empowering students by fostering the skills to detect and resist misinformation. Don't wait. Start as soon as you can.

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