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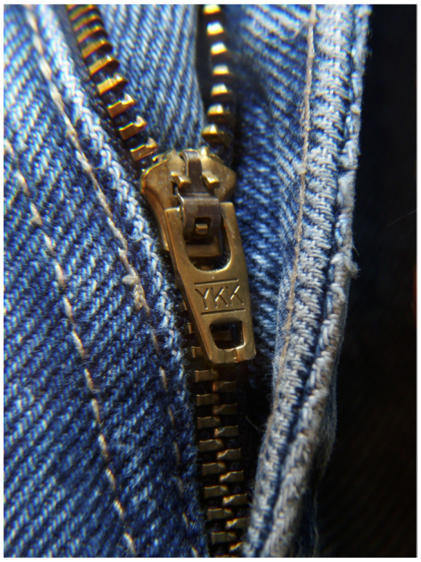
ABSTRACT

Fact-or-Faux addresses issues of misinformation and science media literacy. This article describes the importance of intellectual humility as a dimension of effectively using expert scientific knowledge in the media and presents a few activities that can foster this disposition among students.

Keywords: Misinformation; disinformation; intellectual humility; Dunning–Kruger effect; *NGSS*; scientific change; fallibility salience

How confident are you, on a scale from 1 to 10, that you understand how a zipper works? Without looking it up, take a moment and try to explain it. Are you confident in your response? Now, would you score your confidence higher or lower than before? If you're like most people, your confidence rating likely decreased after trying to explain it in detail. Why does that happen?

This phenomenon is known as the *illusion of explanatory depth* (IOED): the tendency to overestimate our understanding of something when it feels familiar (Sloman & Fernbach, 2017). The illusion unravels as soon as we try to explain it. The IOED can foster a false sense of security, making us more susceptible to pitfalls. For example, we may accept a claim simply because it sounds plausible (e.g., Osborne 2024). It also contributes to another bias you might recognize, the Dunning-Kruger effect, or the tendency



for those with limited knowledge or skill in a domain to overestimate their competence in that area (Kruger and Dunning 1999). Together, the Dunning-Kruger effect and IOED can be particularly problematic when it comes to disinformation. Purveyors of disinformation are familiar with these tendencies and encourage our overconfident judgements, making them seem like common sense when they're incomplete, polluted with cherry-picked arguments, etc. But mistaking familiarity for mastery can be dangerous because it invites error and it risks crowding out the voices of the relevant experts (e.g., Zemplén and Allchin 2024).

Fortunately, there is an antidote to overconfidence. It lies in tapping into our intellectual humility (IH). IH is our capacity to recognize the limits of what we know and to be willing to learn from others (Porter et al. 2022). In this essay, I explore what IH is and how to encourage it in your classroom to help students navigate today's complex information landscape.

Intellectual humility (and why it matters)

IH has multiple components: (1) recognizing that one's knowledge is fallible ("I might be wrong"), (2) being open to revising beliefs in light of new evidence ("I'm willing to change my mind"), and (3) being receptive to other perspectives ("What do others think?") (Porter et al. 2022). Psychological research shows that individuals high in IH are better at (a) differentiating strong and weak arguments, (b) have more accurate memory recollection, and (c) demonstrate a higher motivation to learn. These are all helpful for learning science. In social situations, they are also less hostile to "outsider" groups, more cooperative with those of differing viewpoints, and positively contribute to the overall cohesion of groups they are in Porter et al. (2022).

Individuals with high IH are also more likely to scrutinize misinformation, making it an essential disposition for science media literacy. Studies have shown that IH is associated with reduced susceptibility to misinformation about topics like COVID because the reader is more likely to fact-check, investigate claims and evidence, and revise their beliefs based on experts' evaluations (Koetke, Schumann, and Porter 2022; Koetke et al. 2023). Why? Well, these individuals recognize that their starting position could be wrong. They might need more information. High-quality evidence could help them develop an informed opinion (Koetke, Schumann, and Porter 2022).

Science classrooms are particularly important for developing IH for at least two reasons. First, for students who choose not to become professional scientists, they will inevitably encounter scientific claims in their everyday lives, especially on the internet and social media. With increased IH, these students will be more likely to investigate claims and respect information shared by those with demonstrated domain expertise. They are also less likely to be swayed by confident-sounding, but nevertheless incorrect, messages.

Second, for students who will eventually become scientists, having high IH will likely improve their scientific work. A well-known aspect of the nature of science – as noted in the *NGSS* – is that it is "open to revision in light of new evidence" and "scientific findings are frequently revised and/or reinterpreted based on new evidence" (NGSS Lead States 2013; e.g., SEP #2 on building *and revising* models). Preparing future scientists who are open to revising their thinking will enable them to engage with these aspects of science. And, importantly, scientists who are perceived as intellectually humble are also viewed as more trustworthy by public audiences (Koetke et al. 2025).

To be clear, the goal of fostering intellectual humility in schools is *not* to keep students from believing in themselves. Rather, the aim is to cultivate students who leave the classroom with a sense of self-efficacy and confidence in themselves, while being humble about what they know, or think they know (Grant 2023).

Developing intellectual humility in the classroom

There are several ways that teachers can develop students' intellectual humility. You may be familiar with many of these strategies and are probably using at least one in your classroom already. These strategies include:

1. **Teacher modeling.** Teachers can foster greater intellectual humility in their students by modeling it themselves (Porter, Leary, and Cimpian 2024). This includes saying "I don't know" when they aren't sure of an answer. This demonstrates concretely what it looks like to update beliefs when encountering new evidence, and it shows students how they can use mistakes as an opportunity to learn.
2. **Teach students to track and update their ideas.** Another useful approach is to have students keep track of their ideas and questions before, during, and after learning so that they can see how their thinking changes with new information. Harvard's Project Zero has several Thinking Routines, like the 3–2–1 Bridge, that students can use throughout lessons to track how their thinking has changed over time. This thinking routine asks students to jot down three ideas, two questions, and one metaphor or simile about a topic before and after learning about it, then they connect their initial and revised ideas to track how their understanding has changed (Project Zero 2022). Driving question boards and summary tables, other common strategies in science classrooms, can also be used for this

purpose (Weizman, Shwartz, and Fortus 2008; Windschitl et al., 2018).

3. **Create opportunities for third-person reflection and perspective-taking.** A final approach invites students to write about their own thinking and experiences using the third person (i.e., replacing "I" with "he/she/they"). This approach has been shown to increase objectivity and promote perspective-taking (Porter et al. 2022). A more science-specific take on perspective-taking includes having students reason about the various viewpoints and interpretations, especially ethical considerations, that are relevant to a focal socioscientific issue (Zeidler, Herman, and Sadler 2019).

A growing number of organizations have developed evidence-based materials to support teachers in fostering IH, such as the Constructive Dialogue Institute (https://constructivedialogue.org/) and the Greater Good in Education program at UC Berkeley (https://ggie.berkeley.edu/). Teachers might consider adapting them for science contexts, relevant to misinformation.

Another activity that may help students directly confront the gaps in their scientific knowledge is an adaptation of the zipper challenge that opened this article, adapted to your current science topic.

Activity: You've heard about it, but can you explain it?

The following activity helps students *develop* an explicit awareness that our thinking, knowledge, or beliefs might be wrong (known by cognitive scientists as their "fallibility salience"). Activating this awareness has been shown to increase intellectual humility (Koetke et al. 2023). Namely, create an experience that requires students to confront the *illusion of explanatory depth* phenomenon, as described in the opening. An important consideration is to ensure that you have created a classroom environment where mistakes and "not knowing" are normalized and welcomed, so that students don't feel discouraged by the process. This activity is adapted from a lesson by The Constructive Dialogue Institute.

(1) First, select a specific socioscientific topic that your students are likely to be familiar with (e.g., climate change) and, prior to formal instruction on the topic, have them rate how confident they are in their understanding of it on a scale from 1–10.

(2) Then, task the students with an explanatory challenge. This could be something like, "Experts say that climate change is making hurricanes stronger and more dangerous. Can you explain how that works? What chain of events connects climate change to stronger hurricanes?" Ask students to describe their response in as much detail as possible. (Examples of additional challenge questions are provided in Table 1).

(3) After some time to construct their explanation, ask them to (honestly) re-rate their confidence on a scale from 1–10 again.

(4) The goal of the exercise is to encourage students to notice the gaps in their understanding and to recalibrate their score accordingly. An optional next step is to have students compare their explanation to an exemplar or an expert's account and note what they missed. This can be especially useful if your students are having a difficult time recognizing gaps in their explanations.

Alternate version

If you don't feel quite ready for the activity above, an alternative is to have students try their hand at a climate change self-assessment (for example, Earthday.org's Climate Change Quiz). Similar to the above, first have students predict how they will score on the quiz before taking it. Then, after completing the quiz, have them predict their score again before revealing the answers. The goal is for students to compare how they thought they would do initially with their self-assessment after completing the questions (but before knowing their actual score). Of course, you can also have students compare both of their self-assessments with their actual score as well.

In either version of the activity, it is important for the teacher to emphasize that not knowing everything is acceptable. Normalizing curiosity and asking questions versus "getting it right" is essential, and it helps students feel comfortable discussing the experience. To debrief, consider the following questions:

TABLE 1

Examples of explanation challenge questions.

Domain	Example challenge questions
Biology	1. How do vitamins contribute to your health? 2. How does sunscreen protect your skin? 3. Why do we need to breathe oxygen? 4. How do cancer treatments, like radiation or chemotherapy, work?
Physical Sciences (Chemistry & Physics)	1. How do cell phone towers, like the ones used for 5 G, send information to your phone? 2. How do solar panels turn sunlight into electricity? 3. How does your microwave heat up food? 4. How do filters remove harmful substances from the air?
Earth Science	1. Why are big cities usually warmer than the surrounding rural areas? 2. Why do wildfires start and spread so quickly in some areas and not others? 3. What are the causes of rising sea levels, and how do they work?

1. How did your confidence rating change between your first and second rating?
2. What parts were hardest to explain in detail? Why?
3. How might recognizing what you *don't know* help you better evaluate science information in your everyday life?
4. Where would you turn next for reliable information on this topic?

After the last question, ask students to brainstorm potential sources. Then, challenge them to apply information literacy strategies (e.g., lateral reading) and epistemic trust criteria (e.g., relevant expertise) to evaluate whether each source is credible and trustworthy. For more on each of these concepts, refer to previous *Fact or Faux* articles (Osborne 2025; Pimentel 2025; Wineburg 2024; Zemplén and Allchin 2024).

Every moment in a classroom can be an invitation to develop intellectual humility. When science teachers give students room to confront gaps in their knowledge, they also create space for students to reflect on what they need to learn and where they might turn to learn it. When students have opportunities to pause and ask, "Am I sure?" they are also able to reflect on where to go and who to consult to answer their questions. In a world where misinformation and misplaced certainty are commonplace, science teachers can respond by nurturing students who ask thoughtful questions, seek out reliable sources, and regularly update their views.

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