INQUIRY & INVESTIGATION

The Credibility Game

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Abstract

Science denial, misinformation, and science con-artists are on the rise. We are plagued by anti-vaxxers, climate change naysayers, and promoters of ineffective fad diets and medical cures. The scientifically literate citizen or consumer needs skills in differentiating good science and trustworthy sources from impostors. Here, I present a series of student-centered activities that help students inquire into the nature of credibility and the problems of expertise, mediated knowledge, and science communication. I open with a playful guessing game about "fantastic beasts" reported in the 16th century, then follow with more modern examples. I then describe a science version of "To Tell the Truth," a reflective exercise on "Finding the Expert," and then a student opportunity to explore deceptive strategies by trying to bluff their classmates with false news stories about science. These all develop basic concepts in science media literacy and prepare students for more serious investigation into a contemporary scientific controversy.

Key Words: *science communication; media literacy; credibilty; expertise.*

Science denial, misinformation, and science con-artists are on the rise (for summaries in *ABT*, see Allchin 2012a, 2015, 2018; Dean, 2017; Proudfit, 2020). We are plagued by anti-vaxxers, climate change naysayers, flat-Earthers, and promoters of ineffective fad diets and medical cures. The scientifically literate citizen or consumer needs skills in differentiating good science and trustworthy experts from impostors (Scientific Practice 8, NGSS Lead States, 2013, vol. 2, pp. 64–65). Namely, what is a credible source, and why? How do we help students with this essential lesson?

The challenge is not so much understanding what makes science "science." Rather, it is about differentiating authentic reports from bogus ones. Most imitators mindfully borrow the symbols and markers of good science to "conjure" the illusion of authority (Toumey, 1996). They strive to *appear* scientific. The core problem is thus recognizing deceit versus genuine expertise, far more than appreciating the nature of science per se (Allchin, 2020).

Traditionally, skepticism has been a hallmark of science. Of course, we want students to be alert and wary. But nowadays, monied and ideological interests leverage skepticism to sow doubt and uncertainty, and to discount legitimate science (Markowitz & Rosner, 2002; Michaels, 2008; Oreskes & Conway, 2010; Kenner, 2015). Ironically, students need foremost to understand *trust*. They need to learn about the *social architecture* that justifies what (or who) to trust (Allchin, 2012b, c; Oreskes, 2014, 2019).

In modern society, expertise is distributed. We all depend on each other for know-how, whether about law, medicine, house repairs, news, or science. All the speciallized knowledge we rely on is inevitably *mediated* (Figure 1). Counterintuitively, perhaps, in public discourse science *communication* is as essential as the original scientific research itself. Reporting raises its own questions about reliability. Thus, students need to understand the epistemic dimension of the media (and of social media, too). They need a "bird's-eye" perspective of how scientific information flows (and is transformed) from labs and field sites to the public (Höttecke & Allchin, 2020). How is trustworthy knowledge established, all along the way "from test tubes to YouTube," or "from field sites to websites"? Several concepts seem essential (see Table 1).

On a more practical level, the challenge in the classroom is to craft activities that will help students explore the flow of expert information and reflect on what makes any particular scientific

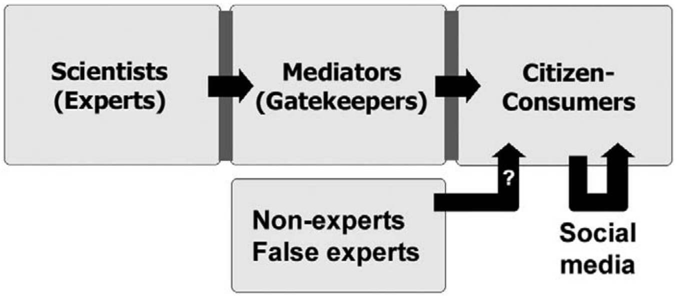

Figure 1. A "bird's-eye" view of science communication, as a baseline for media literacy.

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Table 1. Concept inventory for science media literacy (from Höttecke & Allchin, 2020).

Social structure of expertise and communication
distributed knowledge
epistemic dependence
epistemic trust
expertise
credibility
credentials
peer review
robustness
consensus
Media
mediation
media gatekeeping
conflict of interest
How citizen-consumers engage media & social media
confirmation bias
motivated reasoning
echo chamber
filter bubble
spiral of silence
false consensus

claim trustworthy or not. As always, such activities are ideally (1) student-centered, (2) active, (3) inquiry-based, and (4) authentic. That is, even while the aim is for students to develop (in part) a systematic view of science communication, one should approach the topic from the perspective of the students themselves (considering age, relevant values, local topics, and so on). The activities should also engage students to *do* something, rather than merely listen and scribble notes. Yet they should not just be given instructions and blank worksheets to fill in. They must raise important questions to guide their own investigation and gather information that can motivate compelling discussion. Finally, the cases should be real, not contrived. While many "lessons" in media literacy are already available, few adopt the educational ideals of constructivist pedagogy or inquiry. Here, I present a handful of more fruitful activities that can help students inquire into the fundamantal concepts of credibility about scientific claims in the media. The first two are primarily motivational and designed to bring preconceptions to the fore. The next three explore various dimensions of the problem: expertise, consensus, honesty, credibility and credentialing, and strategies of deceit.

All the visuals and web-browser slideshows (and teacher's guides) are available in electronic form at http://shipseducation.net/credibility

○ Framing the Problem of Credibility (Game 1): Marvels & Monsters

The opening activity is primarily for orientation: a "teaser" to motivate the central question of credibility. (Hence, it is a bit more

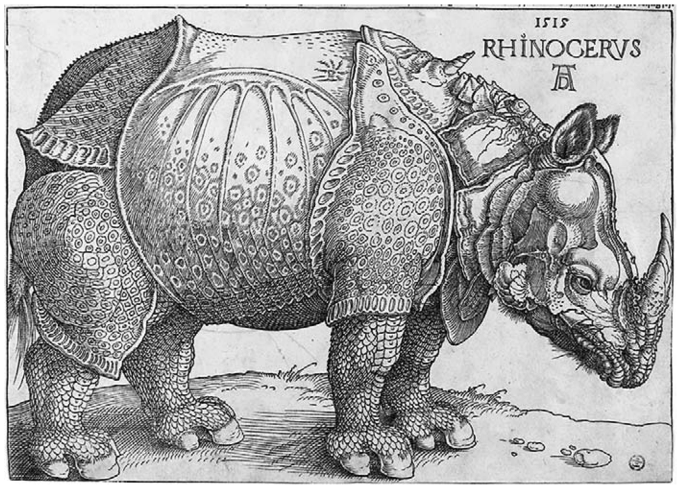

Figure 2. Rhinoceros, by Albrecht Dürer (1515).

Figure 3. A crocodile in the chapel at Oiron, France.

Figure 4. Ostrich egg vessel, 16th century.

guided than the others.) While the ultimate goal of media literacy is to enable students to address contemporary scientific controversy, this activity starts with less contentious and more entertaining cases.

Here is your possible "script." Invite your students back in history, to the 16th century, when European seafarers voyaged the globe, bringing back stories (or sometimes actual specimens) of fantastic beasts (Allchin, 2007). Share with them images (see online resources) of armor-plated cattle with large horns on their nose (Figure 2)! Huge pointed-snout salamanders with viscious teeth (Figure 3)! Eggs the size of a loaf of bread (Figure 4)! Fish covered with porcupine-like spines (Figure 5)! Students should be primed to ask: *What could you believe?*

Ask: "What role does evidence play?" Concede to them that they might dismiss griffins as mythological, but what if someone showed them a griffin claw (see visuals online)? "You might also consider unicorns a Medieval fantasy, but what if someone let you touch a unicorn horn (for good luck)?" Of course, you shouldn't believe everything you see. Naturalist Ulisse Aldrovandi warned his

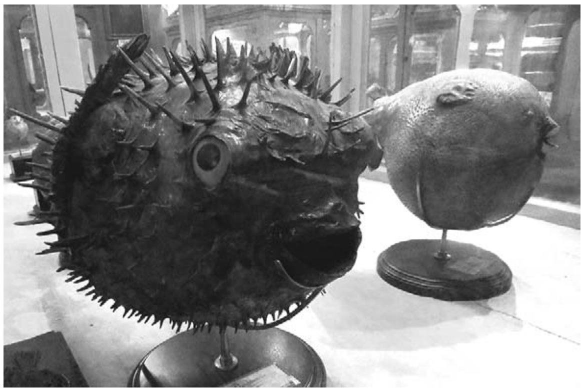

Figure 5. A blowfish collected by Ulisse Aldrovandi in the 16th century.

readers about a fraudulent "sea dragon" that he had purchased, which was actually a skate that had been snipped, reshaped, and dried. The historic cases model for students the need to ask: *What should you believe – and why?*

This period was also marked by the emergence of the printing press. Encyclopedists compiled all kinds of reports from far and wide, printed them in books, and distributed them widely, And then others copied them and spread them still further (sound familiar?). Here, you no longer have access to the physical evidence directly. Knowledge is *mediated* (a core concept; Table 1). You have to trust the author. Encourage students to follow the shift in emphasis: *Who should you trust – and why?*

This activity explores two works in depth. The first is a 1539 map by Olaus Magnus, a Scandanavian bishop who wanted to inform the Pope of his faithful followers in the far north. Show students the map's sea, filled with marvelous creatures. "Without the direct experience yourself, *what should you believe – and why?* A fringe-necked tusked fish the size of a ship, with crew members making a fire on its back (Figure 6a)? If we dismiss that, would we also be justified in rejecting the rather improbable "Ursi albi," or white bear, floating on an ice floe (Figure 6b)? Today, we might discount a huge sea monster attacking another (Figure 6c), but the labels "Balena" and "Orca" clearly refer to what we know today as a baleen whale and a killer whale. But a 300-foot-long sea serpent (Figure 6d)? (There are more cases to possibly consider here – see images and teaching notes online.) How would someone in the 16th century assess the claims about these organisms? If you already knew the answer, there would be no issue. But the problem is that, at this moment, we do not yet know, and our whole conundrum is to determine: *What is credible and what is not?* Students should reflect: *How do we accomplish that?*

A second series of cases for students to consider is from a 1575 book of "Monsters and Prodigies," by French surgeon Ambroise Paré. Elsewhere, he establishes his credibility by describing surgical instruments and their use, and drawing animals that we might recognize today – an elephant, a walrus, a toucan – even if crudely rendered. But his main focus here is human "monsters." Paré presents a man with another body issuing from his belly (Figure 7). *Should you believe that, yes or no?* What about a two-headed monster (Figure 8a)? Such images can be found in

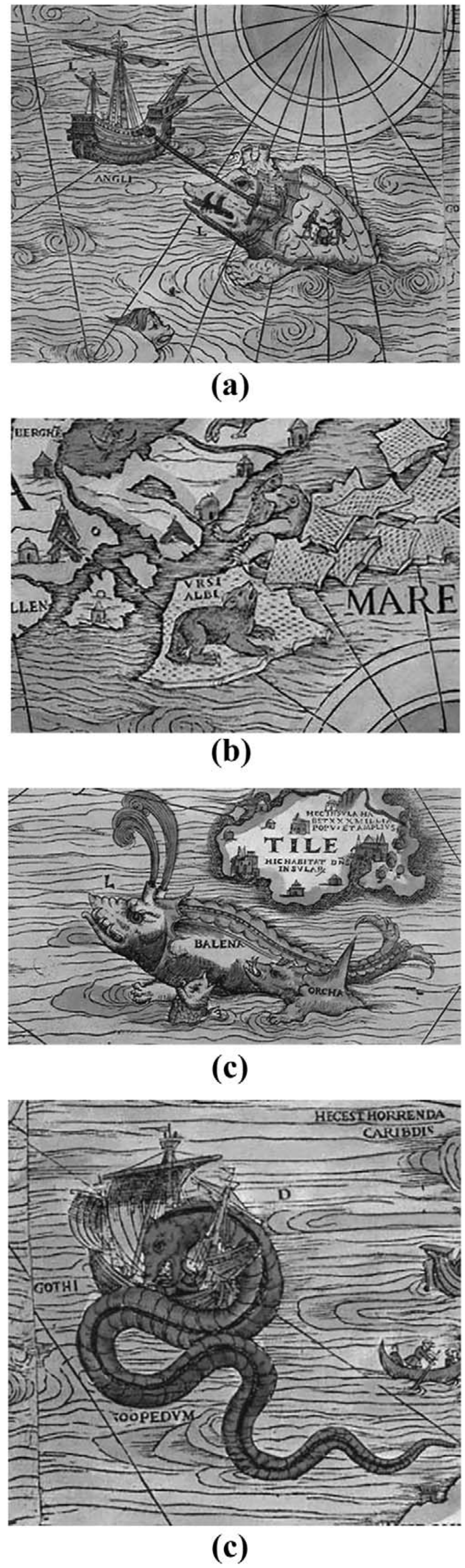

Figure 6. Images from *Carta Marina* by Olaus Magnus (1539).

churches, too, but are they any more real than the nearby gargoyles (Figure 8b, c)? (More cases are included online. Refer to teaching notes.)

Figure 7. From Paré's *Monsters and Prodigies* (1575).

A 1523 pamphlet by Martin Luther and Philip Melancthon presented a "monk-calf" and a "pope-ass" as portents from God: were they real? What should one do with a painting of a man in a courtly robe, with a completely hairy "werewolf" face (cover of *ABT*, November, 2007)? (They say he was born in the wilds of Tenerife, but now lives in the French court!) Again, students should articulate their preconceptions and begin to engage in further thought: *What is the basis for credibility?*

The account above opens many unanswered questions. These are the unknowns to engage students in further inquiry. One can reveal the answers eventually, but the core of the activity is discussion, where students identify the factors that customarily guide their (our) judgments of mediated knowledge. Students might mention such factors as plausibility, prior beliefs, analogies, "intuition," confidence in the speaker's authority, as well as evidence, expertise, and credentials. You might compile a growing list on the board. These are the raw preconceptions (in a constructivist pedagogical approach). The challenge for subsequent activities is to explore which of these factors are well justified and which might reflect cognitive dispositions that may mislead us and which we may wish to learn not to trust fully.

○ Motivating Inquiry (Game 2): Fantastic Beasts

A follow-up (or alternative) activity – also designed to raise awareness and motivate further inquiry – situates the same problem of "fantastic beasts" in today's media environment – now, with an unedited internet (in lieu of printed books) and the prospect of computer graphics that can produce highly realistic, but false, images. Again, these fun examples are designed to engage students before wading into any weighty or possibly contentious (and alienating) socioscientific issue. Claims are *mediated* and media can be manipulated. Can students be more aware of the mediation itself and its potential risks?

Consider a set of six strange mammals (Figure 9, a-f). *If you want to know which is real and which imaginary, how do you decide? Without expert prior knowledge yourself, what criteria do you use to assess what is presented?* The aim, here, is not to reach definitive scientific answers, but to reflect on the problem of mediated reports, the legitimacy of the images, and the methods one might use to assess them (sheer reliance on preexisting knowledge? plausibility? provenance? gut feeling? inclination for something favorable to be true? media source?).

Repeat with six cute mammals, six strange birds, and other strange creatures (see online illustrations). Students should reflect: *How do you decide what is credible, what is not?* This is a guessing

(a)

(b)

(c)

Figure 8. Two-headed monsters?

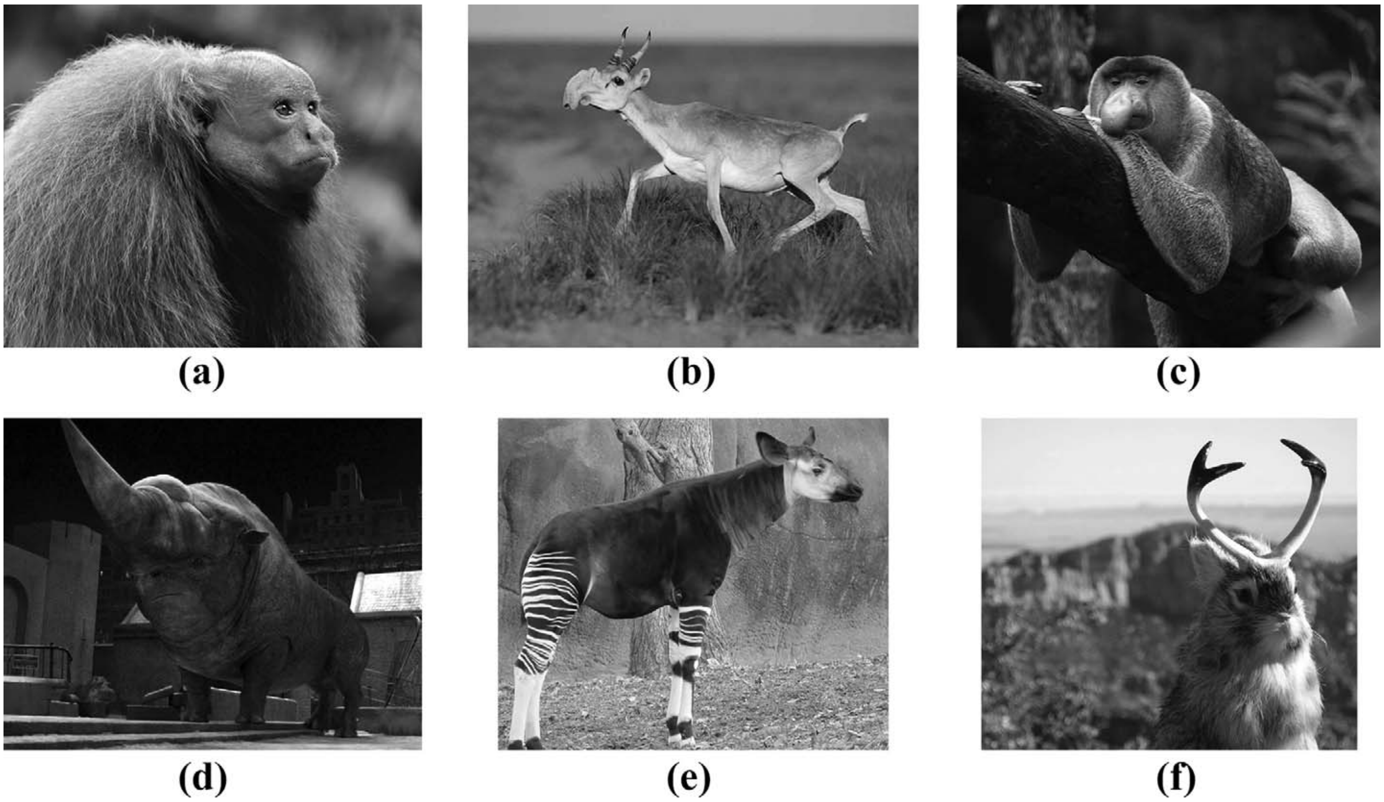

Figure 9. Fantastic beasts: which are real, which imaginary? (a) uakari, (b) saiga antelope, (c) proboscis monkey, (d) erumpent, (e) African okapi, (f) jackalope.

Figure 10. The 1960s game show *To Tell the Truth* as a vehicle for inquiry into expertise and honest communication of scientific consensus.

game, of sorts, but the engaging puzzles can help students reflect on the nature of believing media reports and what serves as justification. Here, the "what-if" context minimizes the risk of being "wrong" and allows students to focus on and comment more freely on the reasoning process. Again, the aim is to open curiosity about credibility, without yet instilling any specific concept.

○ Credibility Game 3: "To Tell the Truth"

Having introduced the core issue, one can begin to explore more specifics. The aim in this exercise is to focus on the problem of *who* to believe. We may all trust scientists. But *who* is a scientist? Who can speak on behalf of science or the scientific community as a whole?

The inspiration/framework is the 1960s game show *To Tell the Truth* (Figure 10), revived by ABC in 2016. Imagine the announcer: "These three individuals claim to represent the science of climate change. Only one is a real scientist. The other two are impostors. *Can you determine who is telling the truth?*"

Here is a sample. *Who can be trusted as a credible scientist?*

- Steve Milloy, author of *Junk Science Judo: Self-Defense against Health Scares and Scams*; adjunct scholar at the Cato Institute; editor of the junkscience.com website, rated a "Hot Pick" by *Science* magazine in 1998, and a frequent science commentator on radio and television?
- James Inhofe, four-term senator and former chair of the Environment and Public Works Committee? or
- Phil Jones, former head of the Intergovernmental Panel on Climate Change, whose hacked e-mails revealed that he discussed suppressing the release of data and the "tricks" used in graphing long-term temperature changes?

This case is an occasion to articulate the core concept of *expertise* (Table 1). We can be easily swayed by prestige, impressive-sounding titles, confident postures, and elegant style, but in terms of *expert knowledge*, those features do not matter (Allchin, 2012a). Phil Jones's position indicates his status as a leader *to other expert scientists*. He is the real, practicing scientist. Of these three, only he can be trusted *epistemically*. Namely, authority and leadership positions (or celebrity status) outside science alone do not substitute for the approrpriate expertise about scientific claims.

Subsequent comparisons of impostors and credible sources (see online material) allow one to underscore more core concepts (Table 1): (1) the role of *relevant* expertise, not just any science PhD or research position; (2) the role of *consensus*, not just one scientist's personal interpretation; and (3) the role of *conflict of interest*, which may foster a lack of honest reporting. These cases help convey a fundamental shift of epistemic principles, from among scientific experts – where one focuses primarily on the evidence and its quality – to outside the scientific community, where the primary concern is expertise, credentials, and honesty. We seek evidence of a different kind: *What can justify trust in someone's competence and integrity in reporting the expert scientific consensus?*

○ Credibility Game 4: Find the Expert

Having highlighted the importance of expertise in science, one can delve deeper into the very concept of expertise itself and how one ascertains that. The problem is not limited to science. We rely on the expertise of plumbers, auto mechanics, dentists, and lawyers, too. *Which can you trust*? (Goldman, 2001). The conundrum, again, is that assessing expertise completely seems to rely on being an expert yourself. An expert can test or *calibrate* another person's expertise. But a non-expert? *Epistemic trust* is essential. It's inevitable (Table 1). How does someone gauge that?

Here, students can form groups to discuss and develop criteria (from Zemplén, 2009). First, they select a form of expertise. Students may want to consider finding someone who is an expert at repairing cell phones, or providing a pregnancy test, or consulting on sexually transmitted disease (or perhaps just who should be trusted to know the answers on the science homework!). Next, identify criteria for assessing that expertise. Groups should then compare their strategies in whole-class discussion. The aim is to engage students in the *problem* of expertise, and the concepts of *epistemic dependence* (and *epistemic trust*). They may propose methods such as asking friends, asking other experts, looking for credentials or training, experience, membership in professional organizations, examining past performance (a *track record*), referrals, or testing the expertise on a small matter or against a second opinion. Maybe it will involve devising a social system of licensure or professional peer validation (such as the bar exam or medical boards)? Maybe online reviews (but can you trust *the reviewers*?). Overall, students should analyze each method for assessing expetise in terms of reliability – or the conditions where they work or that qualify them. Finally, one invites students to consider how those criteria apply to scientists, to science journalists, and to others who make public scientific claims (perhaps even on social media). How do their principles of expertise, interpreting expertise, and institutionalizing trust in expertise transfer to another context?

○ Credibility Game 5: "Bluff the Listener"

Expertise is only one factor in credibility. Honesty, or integrity (versus conflict of interest), is another. Rhetoric and emotions also play a role in gaining trust, even if they are not always correlated with epistemic trustworthiness. This activity allows students some fun, using their own "con-artistry" to explore stratagems to persuade others. It is based on the "Bluff the Listener" game from National Public Radio's *Wait, Wait, Don't Tell Me*.

Students form groups of three. Each finds one weird or incredible science story. (Sources might include the Ig Nobel Awards / Annals of Improbable Research / Journal of Irreproducible Results, "News of the Weird", or Ripley's "Believe It or Not!®.") The group then invents two other stories on the same theme. They present them to the class. Students vote on which they think is true (extra points if they stump the teacher?). Then comes the most important part of the lesson: whole-class discussion of *what made each story convincing when you have no direct access to evidence?* Factors might include plausibility, emotion, language, stories, humor, or vocal quality. Science con-artists, we know, gain confidence through style, disguise, social emotions, conjuring doubt, and flooding the media (Allchin, 2012a). As a supplement, students might consult the "Disinformation Playbook" published by the Union of Concerned Scientists (2018).

Research indicates that making people aware of the methods of deception *inoculates* them and helps neutralize their effects (Cook et al., 2017; Nuccitelli, 2017). You can help "immunize" your students to science con-artists.

○ More Games & Beyond Games

While these activities may be fun and playful – with the immediate aim of engaging students – their intended purpose is, of course, quite serious: to promote science media literacy. Climate change may be "snow joke" to Senator Inhofe, but it is *no joke* to those informed by good science. These lessons adopt an inquiry mode to help students develop concepts *on their own* and thus internalize knowledge about the credibility of sources and the risks of science communication. Once students have worked on such preliminary exercises, they should be well situated for deeper challenges, similar to those they will encounter later as citizens and consumers. For example, in 2012 the Italian Supreme Court ruled that a plaintiff would receive damages because a cell phone caused his brain tumor (Alimenti, 2012). (Surprised? Just watch this alarming video!: https://www.youtube.com/watch? v=V94shlqPlSI.) *Do cell phones cause cancer? Is that true?* Here, students might be let loose on the internet to assess that claim on their own (individually at first, perhaps, but ultimately collectively). Or one might select any controversial claim appropriate to a specific class. This is a rehearsal for credibility-checking in action. Students might read how online fact-checkers go about their business of checking facts (Jackson & Jamieson, 2007).

These activities are just a beginning. I invite others to adapt them – or to invent their own games! (And then share them in *ABT*!). I also encourage others, in keeping with best pedagogical practices, to design their activities (as noted above) as student-centered, active, inquiry-based, and authentic.

The field is wide open. In particular, the challenge of media literacy goes well beyond what I have been able to address here. For example, further lessons might highlight the roles of media "gate-keeping" (traditionally, science journalists), the citizen-consumer's own cognitive filters (confirmation bias, motivated reasoning), the internet (filter bubbles, anonymity of sponsored sites, lack of provenance), or the dynamics of social networks and social media (echo chambers, peer pressure, spirals of silence, false consensus) (Figure 1 and Table 1). With effective education, perhaps, good science will consistently prevail.

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