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8. He argues having a finely honed bullshit detector isn't merely a tool of science — rather, it contains invaluable tools of healthy skepticism that apply just as elegantly, and just as necessarily, to everyday life. If there's something to be explained, think of all the different ways in which it could be explained. If the new idea survives examination by the tools in our kit, we grant it warm, although tentative, acceptance. Consider the grand idea that our Universe and everything in it is just an elementary particle — an electron, say — in a much bigger Cosmos. Sagan presents the contents of his kit as "tools for skeptical thinking," which he defines as "the means to construct, and to understand, a reasoned argument and—especially important—to recognize a fallacious or fraudulent argument." You can see his list of all eight tools, slightly abridged, below. Sagan wrote a number of popular books for layfolk in which he indulged not only his tendencies as a "hopeless romantic," writes Maria Popova, but also as a "brilliant philosopher." He did not fear to venture into the realms of spiritual desire, and did not mock those who did likewise; and yet Sagan also did not hesitate to defend reason against "society's most shameless untruths and outrageous propaganda." These undertakings best come together in Sagan's *The Demon-Haunted World*, a book in which he very patiently explains how and why to think scientifically, against the very human compulsion to do anything but. And yet some of the most thoughtful scientists of modernity—those who most dedicated their lives not only to discovering nature's mysteries, but to communicating those discoveries with the rest of us—have been fully steeped in a philosophical tradition. Of course there are truths to be sought in the many qualitative issues we are obliged to confront, but finding them is more challenging. Ask yourself why you like the idea. 9. This especially goes for Carl Sagan, perhaps the greatest science communicator of the past century or so. Source: *The Baloney Detection Kit: Carl Sagan's Rules for Bullshit-Busting and Critical Thinking* by Maria Popova Always ask whether the hypothesis can be, at least in principle, falsified. Try not to get overly attached to a hypothesis just because it's yours. Occam's Razor. 3. What is vague and qualitative is open to many explanations. 6. Encourage substantive debate on the evidence by knowledgeable proponents of all points of view. *The Demon-Haunted World: Science as a Candle in the Dark* has Sagan sharing nine of these tools: The kit is brought out as a matter of course whenever new ideas are offered for consideration. They will do so again in the future. You must be able to check assertions out. As Popova notes, Sagan not only gives us succinct instructions for critical thinking, but he also makes a thorough list, with definitions, of the ways reason fails us through "the most common and perilous fallacies of logic and rhetoric." Sagan's chapter on "Baloney Detection" is, like the rest of the book, a highly literary, personal, engagement with the most pressing scientific considerations in our everyday life. See the unabridged list at *Brain Pickings*, or read Sagan's full chapter, ideally by getting a copy of *The Demon-Haunted World*. Consider the grand idea that our Universe and everything in it is just an elementary particle—an electron, say—in a much bigger Cosmos. Of course there are truths to be sought in the many qualitative issues we are obliged to confront, but finding them is more challenging. If there's a chain of argument, every link in the chain must work (including the premise)—not just most of them. Occam's Razor. Then think of tests by which you might systematically disprove each of the alternatives. This convenient rule-of-thumb urges us when faced with two hypotheses that explain the data equally well to choose the simpler. Always ask whether the hypothesis can be, at least in principle, falsified. 5. And it is also an informal yet rigorous restatement of Aristotle's classical logic and rhetoric and Francis Bacon's natural philosophy. It's only a way-station in the pursuit of knowledge. Always ask whether the hypothesis can be, at least in principle, falsified... Spin more than one hypothesis. By adopting the kit, we can all shield ourselves against clueless guile and deliberate manipulation. These are all in Sagan's words: Wherever possible there must be independent confirmation of the "facts." Encourage substantive debate on the evidence by knowledgeable proponents of all points of view. What survives, the hypothesis that resists disproof in this Darwinian selection among "multiple working hypotheses," has a much better chance of being the right answer than if you had simply run with the first idea that caught your fancy. Propositions that are untestable, unfalsifiable are not worth much. What survives, the hypothesis that resists disproof in this Darwinian selection among "multiple working hypotheses," has a much better chance of being the right answer than if you had simply run with the first idea that caught your fancy. Try not to get overly attached to a hypothesis just because it's yours. Photo by NASA via Wikimedia Commons It is sometimes said that science and philosophy have grown so far apart that they no longer recognize each other. If you don't, others will. Quantify. 7. Wherever possible there must be independent confirmation of the "facts." 2. If whatever it is you're explaining has some measure, some numerical quantity attached to it, you'll be much better able to discriminate among competing hypotheses. As per our earlier discussion, here is Carl Sagan. Quantify. Compare it fairly with the alternatives. But if we can never acquire information from outside our Universe, is not the idea incapable of disproof? Related Content: *The Wisdom of Carl Sagan Animated Richard Feynman Creates a Simple Method for Telling Science From Pseudoscience* (1966) Noam Chomsky Calls Postmodern Critiques of Science Over-Inflated "Polysyllabic Truisms" Josh Jones is a writer and musician based in Durham, NC. 4. Perhaps a better way to say it is that in science there are no authorities; at most, there are experts. Spin more than one hypothesis. Follow him at @jdmagness Wherever possible there must be independent confirmation of the "facts." Encourage substantive debate on the evidence by knowledgeable proponents of all points of view. Arguments from authority carry little weight—"authorities" have made mistakes in the past. If there's a chain of argument, every link in the chain must work (including the premise) — not just most of them. If you're so inclined, if you don't want to buy baloney even when it's reassuring to do so, there are precautions that can be taken; there's a tried-and-true, consumer-tested method. Perhaps they no longer need each other. Invertebrate skeptics must be given the chance to follow your reasoning, to duplicate your experiments and see if they get the same result. Perhaps a better way to say it is that in science there are no authorities; at most, there are experts. See if you can find reasons for rejecting it. Arguments from authority carry little weight — "authorities" have made mistakes in the past. 1. In one chapter of his book, "The Fine Art of Baloney Detection," Sagan laid out his method, proposing what he called "A Baloney Detection Kit," a set of intellectual tools that scientists use to separate wishful thinking from genuine probability. It's only a way station in the pursuit of knowledge. This convenient rule-of-thumb urges us when faced with two hypotheses that explain the data equally well to choose the simpler. If you don't, others will.

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