

# Carl Sagan, *Demon Haunted World* Research Notes

Sagan provides us with a toolkit for “baloney detection,” a set of tactical dos and don’ts for thinking scientifically.

Broadly, the kit steers us towards better, more verifiable and predictable answers to questions we might have about “what’s out there,” and “how to be less wrong.” (pg 210)

(See also Neil Postman’s *crap detector* in *Teaching as a Subversive Activity*)

In science we may start with experimental results, data, observations, measurements, “facts.” We invent, if we can, a rich array of possible explanations and systematically confront each explanation with the facts. In the course of their training, **scientists are equipped with a baloney detection kit.** The kit is brought out as a matter of course whenever new ideas are offered for consideration. If the new idea survives examination by the tools in our kit, we grant it warm, although tentative, acceptance. 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.

What’s in the kit? **Tools for skeptical thinking.**

What skeptical thinking boils down to is **the means to construct, and to understand, a reasoned argument** and—especially important—to **recognize a fallacious or fraudulent argument.** The question is not whether we like the conclusion that emerges out of a train of reasoning, but whether the conclusion follows from the premise or starting point and whether that premise is true.

Among the tools:

· 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. They will do so again in the future. 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.** If there’s something to be explained, think of all the different ways in which it could be explained. Then think of tests by which you might systematically disprove each of the alternatives. **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.** It’s only a way station in the pursuit of knowledge. Ask yourself why you like the idea. Compare it fairly with the alternatives. See if you can find reasons for rejecting it. If you don’t, others will.

· **Quantify.** 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. **What is vague and qualitative is open to many explanations.** 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.** 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. **Propositions that are untestable, unfalsifiable, are not worth much.** Consider the grand idea that our Universe and everything in it is just an elementary particle—an electron, say—in a much bigger Cosmos. But if we can never acquire information from outside our Universe, is not the idea incapable of disproof? You must be able to check assertions out. Inveterate skeptics must be given the chance to follow your reasoning, to duplicate your experiments and see if they get the same result.

**The reliance on carefully designed and controlled experiments is key,** as I tried to stress earlier. We will not learn much from mere contemplation. It is tempting to rest content with the first candidate explanation we can think of. One is much better than none. But what happens if we can invent several? **How do we decide among them? We don’t. We let experiment do it.** Francis Bacon provided the classic reason:

“Argumentation cannot suffice for the discovery of new work, since the subtlety of Nature is greater many times than the subtlety of argument.”

**Control experiments are essential.** If, for example, a new medicine is alleged to cure a disease 20 percent of the time, we must make sure that a control population, taking a dummy sugar pill which as far as the subjects know might be the new drug, does not also experience spontaneous remission of the disease 20 percent of the time.

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In addition to teaching us what to do when evaluating a claim to knowledge, **any good baloney detection kit must also teach us what not to do.** It helps us recognize the most common and perilous fallacies of logic and rhetoric. Many good examples can be found in religion and politics, because their practitioners are so often obliged to justify two contradictory propositions. Among these fallacies are:

· **ad hominem**—Latin for “to the man,” **attacking the arguer and not the argument** (e.g., The Reverend Dr. Smith is a known Biblical fundamentalist, so her objections to evolution need not be taken seriously);

· **argument from authority** (e.g., President Richard Nixon should be re-elected because he has a secret plan to end the war in Southeast Asia—but because it was secret, there was no way for the electorate to evaluate it on its merits; the argument amounted to trusting him because he was President: a mistake, as it turned out);

· **argument from adverse consequences** (e.g., A God meting out punishment and reward must exist, because if He didn’t, society would be much more lawless and dangerous—perhaps even ungovernable.” Or: The defendant in a widely publicized murder trial must be found guilty; otherwise, it will be an encouragement for other men to murder their wives);

· **appeal to ignorance**—the claim that whatever has not been proved false must be true, and vice versa (e.g., There is no compelling evidence that UFOs are not visiting the Earth; therefore UFOs exist—and there is intelligent life elsewhere in the Universe. Or: There may be seventy kazillion other worlds, but not one is known to have the moral advancement of the Earth, so we’re still central to the Universe.) This impatience with ambiguity can be criticized in the phrase: absence of evidence is not evidence of absence.

· **special pleading**, often to rescue a proposition in deep rhetorical trouble (e.g., How can a merciful God condemn future generations to torment because, against orders, one woman induced one man to eat an apple? Special plead: you don’t understand the subtle Doctrine of Free Will. Or: How can there be an equally godlike Father, Son, and Holy Ghost in the same Person? Special plead: You don’t understand the Divine Mystery of the Trinity. Or: How could God permit the followers of Judaism, Christianity, and Islam—each in their own way enjoined to heroic measures of loving kindness and compassion—to have perpetrated so much cruelty for so long? Special plead: You don’t understand Free Will again. And anyway, God moves in mysterious ways.)

· **begging the question, also called assuming the answer** (e.g., We must institute the death penalty to discourage violent crime. But does the violent crime rate in fact fall when the death penalty is imposed? Or: The stock market fell yesterday because of a technical adjustment and profit-taking by investors—but is there any independent evidence for the causal role of “adjustment” and profit-taking; have we learned anything at all from this purported explanation?);

· **observational selection**, also called the enumeration of favorable circumstances, or as the philosopher Francis Bacon described it, **counting the hits and forgetting the misses** (e.g., A state boasts of the Presidents it has produced, but is silent on its serial killers);

· **statistics of small numbers**—a close relative of observational selection (e.g., “They say 1 out of every 5 people is Chinese. How is this possible? I know hundreds of people, and none of them is Chinese. Yours truly.” Or: “I’ve thrown three sevens in a row. Tonight I can’t lose.”);

· **misunderstanding of the nature of statistics** (e.g., President Dwight Eisenhower expressing astonishment and alarm on discovering that fully half of all Americans have below average intelligence);

· **inconsistency** (e.g., Prudently plan for the worst of which a potential military adversary is capable, but thriflty ignore scientific projections on environmental dangers because they’re not “proved.” Or: Attribute the declining life expectancy in the former Soviet Union to the failures of communism many years ago, but never attribute the high infant mortality rate in the United States (now highest of the major industrial nations) to the failures of capitalism. Or: Consider it reasonable for the Universe to continue to exist forever into the future, but judge absurd the possibility that it has infinite duration into the past);

· **non sequitur**—Latin for **“It doesn’t follow”** (e.g., Our nation will prevail because God is great. But nearly every nation pretends this to be true; the German formulation was “Gott mit uns”). Often those falling into the non sequitur fallacy have simply failed to recognize alternative possibilities;

· **post hoc, ergo propter hoc**—Latin for **“It happened after, so it was caused by”** (e.g., Jaime Cardinal Sin, Archbishop of Manila: “I know of ... a 26-year-old who looks 60 because she takes [contraceptive] pills.” Or: Before women got the vote, there were no nuclear weapons);

· **excluded middle, or false dichotomy**—**considering only the two extremes in a continuum of intermediate possibilities** (e.g., “Sure, take his side; my husband’s perfect; I’m always wrong.” Or: “Either you love your country or you hate it.” Or: “If you’re not part of the solution, you’re part of the problem”);

· **short-term vs. long-term**—a subset of the excluded middle, but so important I’ve pulled it out for special attention (e.g., We can’t afford programs to feed malnourished children and educate pre-school kids. We need to urgently deal with crime on the streets. Or: Why explore space or pursue fundamental science when we have so huge a budget deficit?);

· **slippery slope**, related to excluded middle (e.g., If we allow abortion in the first weeks of pregnancy, it will be impossible to prevent the killing of a full-term infant. Or, conversely: If the state prohibits abortion even in the ninth month, it will soon be telling us what to do with our bodies around the time of conception);

· **confusion of correlation and causation** (e.g., A survey shows that more college graduates are homosexual than those with lesser education; therefore education makes people gay. Or: Andean earthquakes are correlated with closest approaches of the planet Uranus; therefore—despite the absence of any such correlation for the nearer, more massive planet Jupiter—the latter causes the former”);

· **straw man**—**caricaturing a position to make it easier to attack** (e.g., Scientists suppose that living things simply fell together by chance—a formulation that willfully ignores the central Darwinian insight that Nature ratchets up by saving what works and discarding what doesn’t. Or—this is also a short-term/long-term fallacy—environmentalists care more for snail darters and spotted owls than they do for people);

· **suppressed evidence, or half-truths** (e.g., An amazingly accurate and widely quoted “prophecy” of the assassination attempt on President Reagan is shown on television; but—an important detail—was it recorded before or after the event? Or: These government abuses demand revolution, even if you can’t make an omelette without breaking some eggs. Yes, but is this likely to be a revolution in which far more people are killed than under the previous regime? What does the experience of other revolutions suggest? Are all revolutions against oppressive regimes desirable and in the interests of the people?);

· **weasel words** (e.g., The separation of powers of the U.S. Constitution specifies that the United States may not conduct a war without a declaration by Congress. On the other hand, Presidents are given control of foreign policy and the conduct of wars, which are potentially powerful tools for getting themselves re- elected. Presidents of either political party may therefore be tempted to arrange wars while waving the flag and calling the wars something else—“police actions,” “armed incursions,” “protective reaction strikes,” “pacification,” “safeguarding American interests,” and a wide variety of “operations,” such as “Operation Just Cause.” Euphemisms for war are one of a broad class of reinventions of language for political pur- poses. Talleyrand said, “An important art of politicians is to find new names for institutions which under old names have become odious to the public”).

Knowing the existence of such logical and rhetorical fallacies rounds out our toolkit. **Like all tools, the baloney detection kit can be misused, applied out of context, or even employed as a rote alternative to thinking. But applied judiciously, it can make all the difference in the world**—not least in evaluating our own arguments before we present them to others.

Small excerpt on the challenges of science (and general) education. (with Ann Druyan, pg 345)

There is no single solution to the problem of illiteracy in science—or math, history, English, geography, and many of the other skills which our society needs more of. The responsibilities are broadly shared—parents, the voting public, local school boards, the media, teachers, administrators, federal, state, and local governments, plus, of course, the students themselves. At every level teachers complain that the problem lies in earlier grades. And first-grade teachers can with justice despair of teaching children with learning deficits because of malnutrition, or no books in the home, or **a culture of violence in which the leisure to think is unavailable.**

I know very well from my own experience how much a child can benefit from parents who have a little learning, and are able to passit on. Even small improvements in the education, communication skills, and passion for learning in one generation might work much larger improvements in the next. I think of this every time I hear a complaint that school and collegiate “standards” are falling, or that a bachelor’s degree doesn’t “mean” what it once did.

Dorothy Rich, an innovative teacher from Yonkers, New York, believes that far more important than specific academic subjects is the honing of key skills which **she lists as “confidence, perseverance, caring, teamwork, common sense and problem-solving.”** To which I’d add **skeptical thinking and an aptitude for wonder.**

At the same time, children with special abilities and skills need to be nourished and encouraged. They are a national treasure. Challenging programs for the “gifted” are sometimes decried as “elitism.” Why aren’t intensive practice sessions for varsity football, baseball, and basketball players and interschool competition deemed elitism? After all, only the most gifted athletes participate. There is a self-defeating double standard at work here, nationwide.

Small excerpt from Chapter 2, *Science and Hope* on the importance of universal scientific literacy (pg. 37)

**For me, there are four main reasons for a concerted effort to convey science — in radio, TV, movies, newspapers, books, computer programs, theme parks, and classrooms — to every citizen. In all uses of science, it is insufficient — indeed it is dangerous — to produce only a small, highly competent, well-rewarded priesthood of professionals.** Instead, some fundamental **understanding of the finding and methods of science must be available on the broadest scale.**

1. Despite plentiful opportunities for misuse, **science can be the golden road out of poverty and backwardness for emerging nations.** It makes national economies and the global civilization run. Many nations understand this. It is why so many graduate students in science and engineering at American universities — still the best in the world — are from other countries. The corollary, one that the United States sometimes fails to grasp, is that **abandoning science is the road back into poverty and backwardness.**

2. **Science alerts us to the perils introduced by our world-altering technologies,** especially to the global environment on which our lives depend. Science provides an essential early warning system.

3. **Science teaches us about the deepest issues of origins, natures, and fates — of our species, of life, of our planet, of the Universe.** For the first time in human history we are able to secure a real understanding of some of these matters. Every culture on Earth has addressed such issues and valued their importance. All of us feel goosebumps when we approach these grand questions. In the long run, **the greatest gift of science may be in teaching us, in ways no other human endeavor has been able, something about our cosmic context, about where, when, and who we are.**

4. **The values of science and the values of democracy are concordant, in many case indistinguishable.** Science and democracy began — in their civilized incarnations — in the same time and place, Greece in the seventh and sixth centuries B.C. Science confers power on anyone who takes the trouble to learn it (although too many have been systematically prevented from doing so). Science thrives on, indeed require the free exchange of ideas; its values are antithetical to secrecy. Science holds to no special vantage points or privileged positions. Both science and democracy encourage unconventional opinions and vigorous debate. Both demand adequate reason, coherent argument, rigorous standards of evidence and honesty. **Science is a way to call the bluff of those who only pretend to knowledge.** It is a bulwark against mysticism, against superstition, against religion misapplied to where it has no business being. If we’re true to its values, it can tell us when we’re being lied to. It provides a mid-course correction to our mistakes. **The more widespread its language, rules and methods, the better chance we have of preserving what Thomas Jefferson and his colleagues had in mind.** But democracy can also be subverted more thoroughly through the products of science than any pre-industrial demagogue ever dreamed.

Finding the occasional straw of truth awash in a great ocean of confusion and bamboozle requires vigilance, dedication, and courage. But if we don’t practice these tough habits of thought, we cannot hope to solve the serious problems that face us — and we risk becoming a nation of suckers, a world of suckers, up for grabs by the next charlatan who saunters along.