5 TIPS for writing popular science

LEARN the art of conveying complexity to the general reader

By Charles Sullivan and Cameron M. Smith

SCIENTIFIC information can be used in just about any writing, to support arguments, for example, or simply to inform the reader. That's because science answers a lot of our questions, from the mundane (why is the sky blue?) to the profound (how old is our galaxy?). But science has to be translated before the general reader can appreciate it. The following tips can help you convey the complexities of science to a very broad audience.

1 Avoid overly simplifying your material. A serious danger in writing popular science is "dumbing down." Readers will rightfully feel insulted if they're talked down to. They'll also be befuddled if you overuse technical jargon. The key is to find the middle ground.

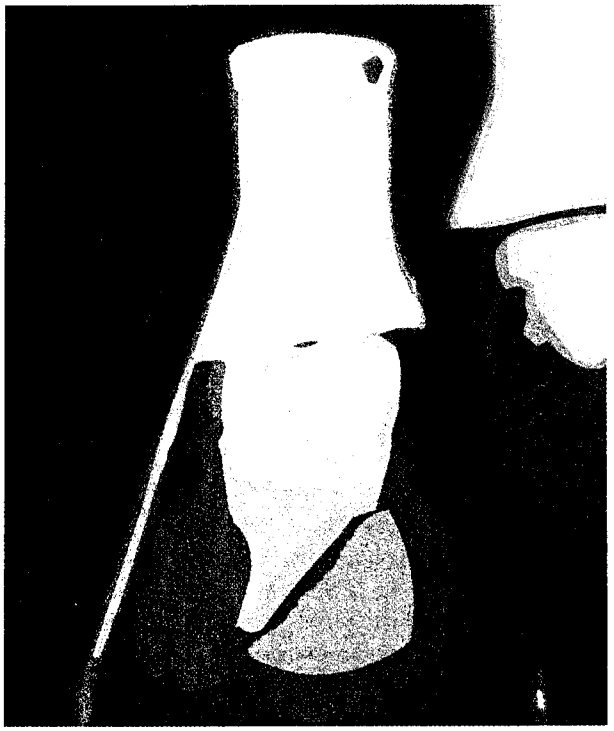
Imagine that you want to write about the cloning process—made famous with Dolly the sheep—called Somatic Cell Nuclear Transfer. This process will need an explanation. Consider how the following explanation is dumbed down:

> All females have eggs, and one of these eggs is extracted from a female's body. Once it's removed, the part in the center of the egg, called the nucleus, is removed. Then, a nucleus is removed from a somatic cell, which is basically any other bodily cell besides egg and sperm cells. Finally, the nucleus of that somatic cell is transplanted into the egg cell, replacing the old nucleus.

To avoid this problem, imagine—while writing—that you're talking to someone at a party who is intelligent, but not a scientific expert. This will help you write in a clear, conversational style.

2 On the other hand, avoid an overly technical explanation. The other danger is going overboard with technical jargon. Academic science writing is loaded with specialized terms, and part of your job is to put them into plain English. Since it's impossible to avoid all specialized terms when writing popular science, you'll need to decide whether certain terms need a brief explanation or not.

Terms such as *DNA*, *atom* and *carbon dating* probably don't need explaining. But others such as *perihelion*, *eukaryotes* and *bucky balls* probably will. In that case, your best bet is to introduce the technical term with a brief explanation. Somatic Cell Nuclear Transfer, for example, could be explained as follows: *the fusing of a somatic cell with an enucleated oocyte.* But that's too technical. Your readers will be left wondering what on earth an *enucleated oocyte* is, and they still won't know what a *somatic cell* is. This would be a better explanation: *the replacement of an adult egg cell nucleus with the nucleus of a somatic cell (any cell other than sperm or egg).*



Taking complicated scientific material and making it understandable and meaningful to readers is a vital part of popular-science writing.

3 To avoid writing with too many tangents, pick a theory or try to find a consensus. Scientists often disagree over which of several hypotheses better explains the evidence. Are signs of the mineral hematite on Mars good evidence for ancient oceans, or can this also be explained by volcanic activity? Does the fossil and DNA

evidence support the out-of-Africa model for modern human origins, or is there evidence for the multiregional model? As a popular-science writer, you need to have an understanding of such disagreements.

Unfortunately, magazines rarely have enough space for writers to explain everything, so you'll have to decide when to mention the disagreements. You don't want to obscure the truth, but you don't want to digress at length about disagreements; and you certainly don't want a lot of qualifying phrases such as "the evidence might suggest" or "it could possibly be the case that."

That's why you need to have a good knowledge of your topic. If a particular hypothesis is so widely accepted among experts in the field that there's virtually no disagreement, then there's no point in digressing. But if a substantial number of scientists reject a particular view or favor another view, then you should make that clear. Typically, all you need to say is that "hypothesis X is the most widely accepted, as opposed to hypothesis Y or Z." Then you'll want to return immediately to the main focus of your article. This helps you avoid both lengthy digressions and weasely qualifying phrases.

Having said all that, when scientists interpret the same evidence differently, it can make for fascinating reading. That's because the disagreements offer us an up-close view of scientific reasoning in progress. So, in the end you'll have to decide whether the disagreements are worth exploring based on your audience, how widely accepted the disagreements are, and whether they add or detract from your main focus.

4 Make your numbers meaningful to readers. Science can be intimidating because it often measures quantities that are very large, or very small, compared to quantities found in daily life. Good popular-science writing trans-

Before and After

Improving a dry, wordy beginning

HERE IS AN early and final draft of a paragraph for an article of ours that eventually appeared as "Getting the Monkey Off Darwin's Back: Four Common Myths About Evolution" in the May/June 2005 issue of *Skeptical Inquirer*. Some of the problems in the early draft are unique to popular-science writing, while some reveal general writing concerns. Keep in mind that there's no shame in having rough early drafts, since most good writing involves lots of rewriting.

Problem

Evolution Is Only a Theory

Maybe you've heard this expression used as a way to dismiss the soundness of an evolutionary explanation. Much of the confusion surrounding the view that evolution is only a theory has to do with two different meanings of the word "theory." A popular sense of the word means "an unsubstantiated guess or assumption." This differs from the scientific sense, which means "a scientifically accepted model or set of principles designed to explain certain observed phenomena [facts]." In this sense, the theory of evolution is as scientific as principles or models in fields such as chemistry or physics.

The problems here are many. The first sentence reading out of the subhead is dry, and starting with the word "maybe" creates a weak beginning. There's no specific example from the real world of people using the word "theory" in a dismissive way. The scientific meaning of the word "theory" was made up without consulting a reliable source. The writing is abstract and lacks visual images. The sentences are excessively wordy and need to be more concise.

Solution

Evolution Is Only a Theory

Have you ever heard people challenge evolution by claiming that it's only a theory? The Cobb County School District in Georgia did just that when it sought to put stickers on high school biology textbooks stating that "Evolution is a theory, not a fact, regarding the origins of living things." The problem with this claim rests with two different uses of the word *theory*. In popular usage the word refers to an unsubstantiated guess or assumption, as when someone theorizes that a light moving across the night sky must be an alien spaceship. When scientists use the word *theory*, however, they're referring to *a logical, tested, well-supported explanation for a great variety of facts*. In this sense the theory of evolution is as well supported as the theory of gravitation or other explanatory models in fields such as chemistry or physics.

The first sentence is now in the form of a question, which speaks directly to readers, drawing them in immediately. A real-world example of a dismissive use of the word "theory" is offered. A researched definition of "scientific theory" is given. A vivid image of a light moving across the night sky being an alien spaceship has been added. The sentences have been tightened up to make them more concise.

—Charles Sullivan and Cameron M. Smith

lates such measurements into familiar terms that mean something on the human scale.

For example, telling your readers that the sun is 93 million miles away from the earth isn't much good, because 93 million is just too huge a number to imagine; even a million is hard to grasp. And it's no better saying that the sun is one Astronomical Unit (AU) away, because what does an AU have to do with daily life? It would be much better to invoke something that people do every day, like driving a car. You can tell your readers that to drive the 93 million miles to the sun at 55 miles per hour (in a very special car) would take them almost 200 years. Or you could say that if Thomas Jefferson had started driving to the sun in 1806, he'd be arriving right about now.

In this example, the vast distance to the sun has been conveyed, but it's also made comprehensible in terms of driving a car, which most people experience every day. Notice that the actual distance (93 million miles) was presented, but that it was then translated.

When writing about numbers, remember that you have to be *accurate* but not necessarily *precise*. Accuracy means checking your translated figures to be sure they're in the correct numerical ballpark, and for popular-science writing, that's sufficient. Precision is reporting the exact figures—for example, declaring that it would take 192.91 years to go 93 million miles at 55 mph—but few readers will pay attention to the decimals, and anyway, popular-science writing is more about general truths and overarching patterns than nitty-gritty details.

5 Use metaphors as another way to make the complex understandable. Just as numbers have to be translated, so do complex concepts, such as those of black-hole formation or evolution. This kind of translation is done with metaphor. Two ways to make your metaphors memorable are to use *drama* or *emotional appeal*.

Dramatic metaphors add a little spice to the writing and can be memorable. A recent *New Yorker* article presented pages of esoteric evidence suggesting that while global warming is slow now, it might well accelerate very rapidly and cause widespread catastrophe. The article's central metaphor is much easier to recall, though, than the scientific details. In this metaphor, a climate scientist likened our perception of climate change to being in a rowboat that is rocking back and forth. The water comes up one rim of the boat, so you rock it away until the water comes up to the other rim, and you rock it back again, and you eventually think, "I could go on doing this forever." But one day the boat rocks a hair too far, is swamped and sinks like an anchor. The message is that although we're only used to seeing *gradual* climate change, radical change can happen, and this is dramatically conveyed by the scary rocking-boat metaphor.

Emotional appeal can also be effective. In *Shadows of Forgotten Ancestors*, Carl Sagan and Ann Druyan suggest that humanity, largely ignorant of its prehistory, is like a baby found on a doorstep with only a brief note of explanation. This has emotional appeal because people care about orphaned babies.

Two warnings. First, don't get too cute or convoluted with your metaphors; this makes you sound as if you're writing for your own amusement. Second, tailor your metaphors to your audience. British author Steven Mithen, writing about human evolution in *The Prehistory of the Mind*, uses a cathedral metaphor for the structure of the mind, and that works for Britons because cathedrals are all over Britain. But a North American audience, largely unfamiliar with cathedral architecture, might require an entirely different metaphor, like a car or a baseball game.

These steps ultimately involve translating scientific data into terms familiar in daily life. Your goal is to make the readers forget they're reading science and simply think, "Wow, what a fascinating universe!" #

Resources

See the following for excellent popular-science writing:

- **Cosmos** by Carl Sagan
- **Guns, Germs, and Steel** by Jared Diamond
- **The Sacred Balance** by David Suzuki

Workout

HERE IS AN exercise that will help you with writing popular science. Keep the tips in the main article in mind while writing.

Visit a Web site that features recent scientific news (sciencenews.org, sciencedaily.com, livescience.com). Find a news story that interests you. Then locate the primary source for the story—this will most likely be a journal article mentioned in the piece. You may have to visit a college library for this, or you might get lucky searching Google Scholar (scholar.google.com). Compare the writing of the primary source (the journal article) with the secondary source (the news story). Note how the author of the news story has translated the academic prose into prose suited to lay readers. Make this comparison with a few articles.

Now, find another story that interests you, but this time don't read it. Just quickly scan it to find the primary source. No cheating. Now, locate the primary source and try to translate those findings into plain English for the lay reader.

—C.S. and C.M.S.

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"They were afraid he was a snob. And of course he was. He was a colossal snob. He was a snob without shame. He would put up with any affront, he would ignore any rebuff, he would swallow any rudeness to get asked to a party he wanted to go to. ... He was indefatigable. When he had fixed his eye on his prey he hunted it with the persistence of a botanist who will expose himself to dangers of flood, earthquake, fever, and hostile natives to find an orchid of peculiar rarity."

–from *The Razor's Edge* by W. Somerset Maugham

Be a keen observer

"I watch other people's lives, and then like a foraging animal I grab bits of things and take them back to my nest."–Ayelet Waldman, page 66

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