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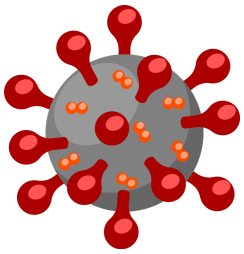
From Lab to Newsfeeds:

Why We Need to Be Skeptical (Like A Scientist) in the Age of COVID-19



Schools? Closed. Offices? Closed. Most shops? Sorry, try again later. Concerts? Canceled. Parties? Nope. Travel? Crowded subways? Nope and nope. Despite being a microscopic not-even-technically-alive thing, coronavirus has turned all of our lives upside down in a hurry. Our best chance to solve the issue? To quote Matt Damon in *The Martian:* We're going to have to science the *bleep* out of this.

Hence, we are witnessing an explosion of science like never before. Any scientist who can (including me) has stopped their own work and turned their focus on COVID-19, trying to do their part to help us understand it and develop vaccines and treatments. It's kind of cool to think of the world's collective professional science minds all focusing on one problem, and understandably, there is a huge interest among the public in the work that's going on. But as we devour news and soundbites, it is critical that we not be passive consumers of information. In short: we need to remember how science works. And spoiler alert? It's not a simple straight-forward process.

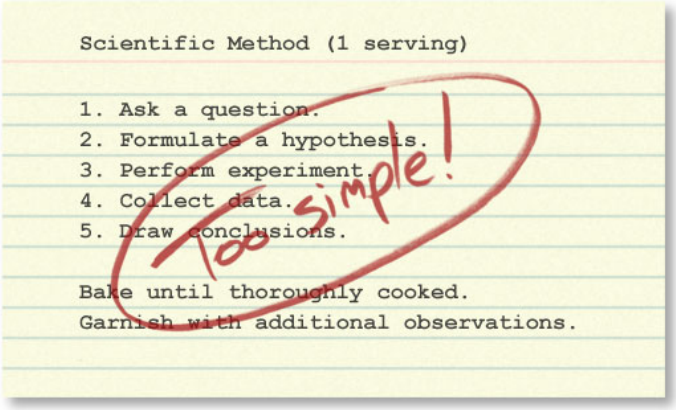


Figure 1. This Isn't Science. *Source:* UCMP Museum of Paleontology.

Usually I study HIV, vaccines, and the immune systems of babies and pregnant people. But now? I'm all about coronavirus, and let me tell you—what's happening now is wild. Everything about how we do science and share the results with the wider world has completely changed.

The Normal Normal

Normally, like when a global pandemic is not raging, going from idea to newspaper is a really long and meandering path. I won't go into too many details here (if you're interested, this awesome site from the University of California is *the best*), but I will say that I spent five years working on one single paper, and that's not weird. Oh, and the paper wasn't done when I finished it. Like most scientists, I submitted it to a journal for publication and peer review. As shown in **Figure 2,** the process of peer review typically takes 3–6 months. Peer review is incredibly important because it helps ensure the validity and integrity of the work, making sure that the study makes sense and to catch any errors. You can think of peer review like a scientific sniff test. If it reeks of bad process, unethical procedures, or sloppiness, it doesn't pass. After peer review, the lucky scientists go through rounds of revisions and then finally publication, but more often, the journal rejects the paper, and you have to start all over at a new journal. I'm working with another paper that has been in a cycle of rejection and revision for almost 4 years! And again, that's not weird. It is just how the scientific community makes sure that incorrect or misleading information does not get published.

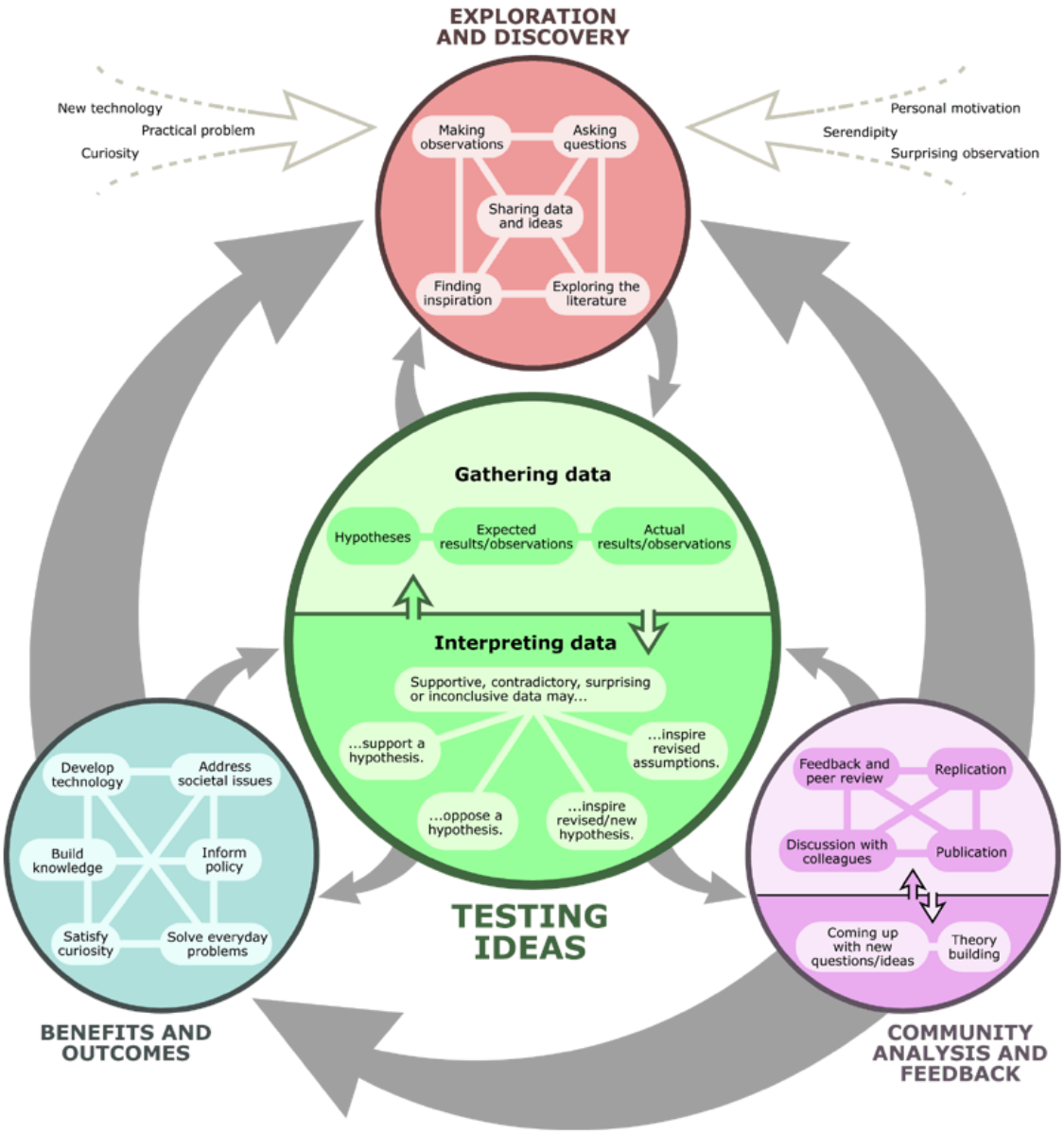


Figure 2. Now This Is Science. And it normally takes a really really really long time.
Source: UCMP Museum of Paleontology.

So are we done once it's published? No, silly. Now the whole *community of science* gets involved, as summarized in **Figure 3**. Science is really tricky, sometimes science done with slightly different materials and methods will yield different results. So, **replication** of the results (repeating the work to make sure that the results are reproducible) in other labs is critical. So, too, is re-analysis of the existing work and community back-and-forth. This can go on for years and even decades, with lots of different teams working independently to verify (or sometimes refute!) science that has been done.

This discussion and disagreement is a pillar of science. It is ultimately such a good thing because it helps us really hone in on the best explanations for a phenomenon. Some might say that it reveals "the truth" of whatever you're studying—but science doesn't often deal in truths or claim to have "proved" something—rather, we gather more and more data in support of an explanation. If data comes up that contradicts the explanation, then the explanation is adjusted or changed entirely. Although that might sound discouraging, it's not. In fact, scientists *want* disagreement, because in hashing out disagreements, and re-doing the work, our understanding of the phenomenon becomes clearer. Science is *self-correcting* in this way.

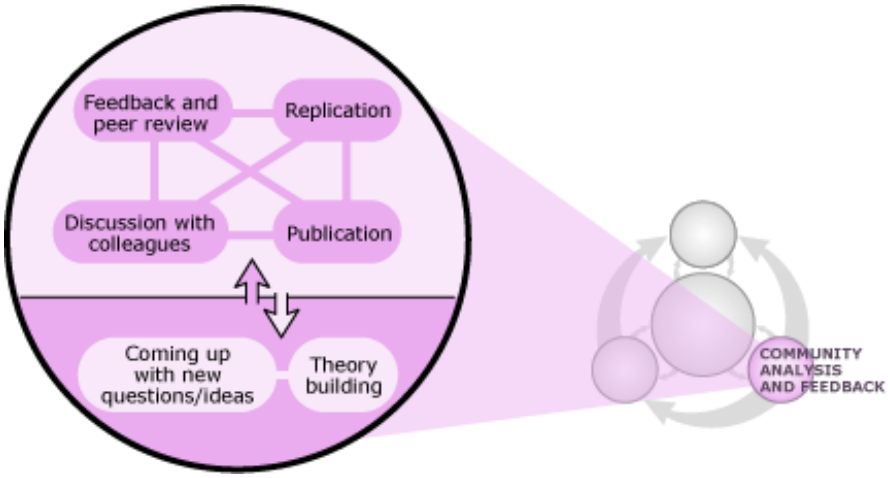


Figure 3. Community Analysis and Feedback. Even after it is published, science goes through many rounds of replication and discussion that ultimately lead to new ideas and stronger theories of how things work.
Source: [UCMP Museum of Paleontology.]

The New Normal

So, that's how it *normally* works, but as you can imagine, things are different right now! Scientists are producing data and trying to get it out into the world at warp speed. After all, we can't exactly wait five plus years before we release the "pause button" on society! We urgently need treatments and vaccines, we need basic research on how bodies fight back against coronavirus and research on how coronavirus spreads through the population. Anything we can find out right now about coronavirus is critical to ending this epidemic and our doctors are public health officials and can't wait for years of peer review to act, we all need the data *right now.* This means that the careful sniff-test process of peer review and in-depth community discussion isn't happening exactly as usual. We are definitely trying, but it's so hard to keep up! A lot of journals are putting articles up online without peer review, or speeding through peer review in just a couple of days. And many scientists don't want to wait at all so they are self-publishing these papers as **pre-prints** on websites where there isn't any review at all. And, because everyone is interested, a lot of science that is in pre-prints, and a lot of manuscripts that have been rushed into publication without tons of peer review, is ending up on our newsfeeds and daily newspapers.

As you can imagine, rushing the science has some downsides.We are skipping what is usually *years of scientific back-and-forth*. And, unfortunately, that probably means that some of what we are reading *is just simply wrong*. This isn't out of the ordinary, remember that it is totally normal for papers to come out that contradict each other as we sort of bounce around until we settle on an accepted explanation for something. But ordinarily, published papers have gone through tons and tons of review, so the degree of wrong-ness is not generally like, "whoa. This is just WRONG," but more, "Huh. But I wonder if it'd work under these slightly different conditions…"

Now, though, because we are in hyperdrive,"Whoa. This is just WRONG" papers are slipping through the cracks and into our news. Here again, there is a range. It might be a case of a few honest mistakes and math problems (whoops! We calculated that test rate wrong…), or it could be a purposefully deceitful study paid for by someone with an agenda (it's totally safe to take this drug because we gave it to this one person, and he was no worse, so go out and buy this drug! *wink wink*), or it could not be a study at all, but straight up lies disguised as science (ahem. Coronavirus was not engineered in a lab).

And it gets even worse, from a science communication standpoint, because not only is science going out to scientists so fast, it is also going to social media and the news extremely fast. Back before coronavirus, most science that was reported as "breaking news" had often been around for years, being **vetted** (checked over) at conference presentations and through slow peer review, and then digested by scientists for a few months, before it even wound up being picked up by a reporter. However, right now, everyone wants to stay informed, and reporters are also reading pre-prints and reporting on them right away! It's exciting as a scientist to see so many people interested in our work, but unfortunately scientific papers are usually extremely dense and in complicated terms meant to be only accessible to scientists, so it can be hard for journalists to report on them accurately. It's sad to say, but as a scientist myself, I can barely understand any papers that aren't directly written in my tiny sub-field, so imagine how hard it is for journalists! We are getting so many stories that can be really scary, that sometimes, just haven't been properly explained for the more general audience. The result: some really misinformed write-ups of already unvetted science making their way to the public.

So what can we do about it? How do we sort through all the news to find the good, and ignore the bad and downright ugly?

We harness some scientific thinking skills and we think critically about the news we read. So how do you make sure that you are reading real science stores? A few tips:

- Find out where the information is coming from. Sometimes, this is easier said than done. If you hear about a story from a friend or see it on social media, you may need to dig a little to find its source. Is it *The New York Times* or *Washington Post*? Probably a good source. Is it a company you never heard of trying to sell you something or your friend's mom's former roommate? Might want to find a second opinion.
- See who the experts quoted in the story are. Most should be doctors and scientists in fields like epidemiology, virology, or public health. If they aren't, is there a good reason?
- If the information comes from a preprint, find out if it is a self-published preprint, or a preprint associated with a good journal. Ones associated with journals have probably been through at least an editorial review and are more trustworthy than self-published ones. (Did you see the images from that Danish-Belgian study showing how joggers leave trails of virus behind them? It was self-published and has been picked apart by researchers, but not before it scared the bejeezus out of people.)
- Learn to be okay with uncertainty. No matter what, don't assume that any science story is complete! It really never is, always assuming some aspect of it will end up being imperfect or incomplete—that's science and it's what makes science so terrific and powerful.

It's so important for everyone to think critically about the science that we read so that we can all be informed and take the right steps to keep us, and our entire communities safe. I'm so excited to see all the science happening, and I'm crossing my fingers that we'll be able to wade through all of the research being done right now and ultimately make cures and vaccines as fast as we possibly can! In the meantime, you have a role to play: Ask questions, don't take news at face value, maintain a healthy scientific skepticism, share good resources with your friends and family, speak up when someone has been baited by a bad one, and, of course, wash your hands.

Thinking Questions

1. Maddy says that it's "wild" to see how science is working right now. What do they mean?
2. In your own words, explain why it's important to think critically about coronavirus headlines.
3. A friend posted a TikTok saying that she heard coronavirus is more contagious than measles so wearing a mask won't do any good. What could you do to evaluate her claim?
4. Often we simplify scientific research into a linear "scientific method" (**Figure 1**), but what happens in scientific research is much more complicated than that (**Figure 2**). Examine **Figures 1 and 2** and answer the following questions.
   a. The scientific method" as described in **Figure 1** involves an experiment, but not all science involves experimentation. For example, many investigations in the fields of paleontology (study of fossils and the history of life), ecology, and human health involve comparisons and observations, but not experimentation. Pick one of those three fields and describe a situation in which a researcher would not perform an experiment. Explain why not and what sort of investigation he/she/they might perform instead.
   b. When scientists start to collect data they need to spend a lot of time interpreting that data. What are some parts of that interpretation and why do you think that often leads to the collection of more data, as modeled in **Figure 2**?
   c. In addition to peer review, scientists often share their work at conferences to get feedback from their peers. Why do you think this is an important part of the process?
   d. Science and society are strongly linked. Why do you think it is important for scientists to consider benefits and outcomes? Think about COVID-19, but also consider other types of scientific research such as environmental research or cancer research.
5. **Take action!** What are some ways you are going to think more critically when you read information about COVID-19 and other scientific research?

BiteScientist Profiles

Maddy Jennewein just finished their PhD at Harvard and is starting their next phase working as a postdoctoral research fellow at the Fred Hutch Cancer Research Center working on immunity to coronavirus. Maddy's graduate work focused on studying antibody transfer across the placenta during pregnancy. Maddy is very passionate about science education and enhancing diversity in the sciences. Outside of the lab, Maddy likes to read and sew and is trying to learn how to roller skate!

As a biologist studying evolution at Wellesley College and Harvard University, **Stephanie Keep**'s research focused on how vertebrates move. Since leaving academia, she has done everything from blogs, podcasts, and videos, to textbooks, assessments, and lessons. She has three daughters, loves sloths, and is co-founder of BiteScis.