After the Fact | Conversations on Science: What Makes Science, Well, Science?

Originally published September 4, 2020

Total runtime: 00:13:47

TRANSCRIPT

[Opening Music]

Carlo Rovelli, theoretical physicist: Science gave me a fantastic playground and a way to express myself.

France Córdova, astrophysicist and director of the National Science Foundation: It goes to the heart of why we're human to explore the origin and nature of the universe and ourselves.

Pamela Bjorkman, biochemist and Pew biomedical scholar: Why has science become so central to my life? It makes a huge amount of sense to me to get answers where I can prove one way or another.

Sudip Parikh, CEO of the American Associate for the Advancement of Science: Growing up as the son of immigrants, science and studies were a refuge.

Dan LeDuc, host: For the Pew Charitable Trusts, I'm Dan LeDuc, and this is "After the Fact." It's a new season, and we'll be hearing this fall from voices like these—each with a passion for science. New medicines from a lab, the technology that allows you to hear me right now, the analysis of big data—like the epidemiology going on now to better understand how the coronavirus is transmitted—it's all science and it's intertwined with our lives every day.

Ira Flatow, science journalist and host of radio program "Science Friday": We think of it as an encyclopedia of books. There's a fact in a book, and that's going to be that way forever. But it's not. … Science is a process.

Dan LeDuc: That's Ira Flatow, host of the popular podcast "Science Friday," and you'll hear from him again shortly. But first, our data point: 79 percent. According to the Pew Research Center, 79 percent of us agree that science has made life easier for most people. And, as most of us learned in school, there's a method—the scientific method. And it always begins with a question.

Now back to Ira, who began asking questions as a kid.

Ira Flatow: I was always interested in science. I never wanted to be a scientist. I wanted to be an engineer when I was very young, because I wanted to know how things work. And so, I would take things apart. I would take my mother's washing machine apart. I

would learn how to fix black-and-white televisions myself. I would enter science fair projects.

I really wanted to know how the world worked, and I was very curious about how that happens. I was lucky also to have a teacher—Mrs. Pfeffer, my eighth-grade teacher—who had a science club. And I think it's very important for people to know that kids need some sort of mentoring.

If I didn't have Mrs. Pfeffer encouraging me after school to do projects—in one of which I almost burned down my mother's bathroom, but that's another story—I think I would not have kept my interest going. That's how I got started.

Dan LeDuc: So, let me ask you a question where you fill in the blank at the end of the sentence. Without science, we would be…

Ira Flatow: Back in the Stone Age—I mean … the question of, who invented the wheel—how much experimentation did that take? Without science, we wouldn't have the medicines we have today. We wouldn't have the transportation we have today. We wouldn't have the health we have today. I could go on and on. We wouldn't have the stock market.

Dan LeDuc: There is the scientific method. There's a way you follow to do science and guess what—it works. How do you explain that to people?

Ira Flatow: Science, it's basically a snapshot of what we know about the world working at one time, and that's now, and what we might know in the future by doing research.

And the word research is really very important in this central idea, because how does science work? Well, you come up with an idea, and then you search for evidence for your idea. You come up with a conclusion—I think the universe works this way or I think a drug works that way.

We then have to research it. We have to send somebody else out to do the search or many people to go out and do that search. So, science is research over and over again until it becomes accepted. The second thing about science is that people think that all scientists agree with each other, and they don't.

But science looks for the truth, and sort of polls the scientific community about what the general agreement is at any one point in time. But eventually, if there's enough research that goes on, it changes the current thinking, and that changes how we think about something that's going on in the world.

And so, you then publish the data, then it's very important—you publish what you have found so that the rest of the community, the rest of your peers—peer-reviewed things—can comment on what you've done.

But the main idea is that it is not a static thing. We are part of a moving target of history, and science works that way. It's telling us what we know at any one time.

Dan LeDuc: Can we employ the scientific method in our day-to-day lives, just flexing through trying to figure things out?

Ira Flatow: Absolutely. If we didn't call it the scientific method and called it something else, there would be a lot of people who'd be aboard with understanding what it is. The scientific method—whether you're shopping for clothing, or whether you're buying a car, or whether you're trying to believe what your friends are telling you—it's all about listening, and collecting the information, and seeing whether it makes sense.

Dan LeDuc: That whole being able to replicate something shows that there's something to it, as opposed to a one-time wonder.

Ira Flatow: They like to say that science is self-correcting. You may not agree with what's going on now, but over a period of time, enough people who want to prove you wrong—and they're all out there—they will conduct their own experiments and try to prove that you are right or you are wrong. And over time, if you are wrong, science will self-correct itself to bring around a new idea and move on from there.

[Transition music]

Dan LeDuc: So, there's motion to the method. And it can become a wondrous thing to watch. Carlo Rovelli, a world-renowned theoretical physicist and writer, sees a beauty and a depth in science.

Dan LeDuc: Carlo Rovelli, welcome. Thank you so much for being with us today.

Carlo Rovelli: Thank you for having me.

Dan LeDuc: You are a physicist who, I must say, writes like a poet. And your book, *The Seven Brief Lessons on Physics*, is in something like 40 languages around the world. And it ends with this most amazing line that I would like to start our conversation with, if you don't mind. You say that on the edge of what we know, in contact with the oceans of the unknown, shines the mystery and the beauty of the world. Is that science? Is that the pursuit of science for you?

Carlo Rovelli: Yes, definitely. Because science starts, I think, both historically and in the life of each scientist, with a wonder and with the mystery. And, in fact, I think the nature of science is to realize that we do not know things. And therefore, we are curious to go and try to find out. And the nature of science is also based on the discovery that we can find out things. We can discover things that we did not know.

Dan LeDuc: There is a methodology to science. There is a scientific method. But the scientific method is both something that leads us forward, but also makes us pause, makes us re-evaluate. Science, it seems, despite methodology, is not linear.

Carlo Rovelli: It's like painting. Of course, there is a method for painting. You go to school and they teach you how to paint. But then the painter is the guy who does not follow what is being taught, invents something else.

Of course, there are many aspects of science, which are pretty stable and that give it strength. Checking, not trusting ideas unless you find a way to confirm them, try to base your information on actual data and looking at the world, observing, measuring, checking. Putting in doubt, not believing the things you believe in.

There is a beautiful line in Brecht, Galileo, in the play in which at the end Galileo, one of the inventors of science, so to say, with one of his young assistants. And they got an idea, and the assistant says, OK, now let's do everything possible to show that it is right. And Galileo says, no, no, no. Let's do everything possible to show that it is wrong. And if it survives, maybe we start believing it.

Dan LeDuc: Fascinating, yes. So, you know, we are speaking at a time when the world, of course, is facing this terrible pandemic. And scientific research about this is unfolding before our eyes. The public who maybe doesn't follow these things, this methodology, this way of doing business closely, has a real stake in this, to see what's going on. Are there lessons for us all in what we're learning and how this is unfolding?

Carlo Rovelli: Yeah, I think there are lessons. And, in fact, it's an opportunity for seeing how science works. The first thing we all notice is that we don't know anything. We are in the dark. And that's often the starting point of science. The second thing is we are not completely in the dark. The reason we are searching for a way to heal this virus and for vaccines is because we have ways to heal illnesses that are extraordinarily effective.

So, on the one hand, we see the limits of science. On the other hand, we see the immense power of science. A few generations ago—not many, maybe two centuries ago—life expectancy of people was several decades shorter than today. This is because there was a scientific method of some sort that helped us learn how to deal with illness, and that's what is being used.

The second point is that we see that scientists look in different directions. However, there is convergence, and that's the point. There are always a convergence in scientific debates and uncertainty.

So, after the debate, after the search, the knowledge that is acquired is definite knowledge. So, it will take time, but it will come out. We all see how science is crucial. If there's anything that can save us for a lot of pain in this situation is scientific knowledge.

But then the actual decisions are political, are moral, are value decisions. There are a lot of hard decisions that society can only take by negotiating, by politics, by debate, by discussion.

Dan LeDuc: Also, in your book, you write this lovely sentence: “We are like an only child who in growing up realizes the world does not revolve only around himself. He must learn to be among others.” That seems to me—wow, a view of science that talks about our common humanity, and how we learn about each other. Is that what you were trying to get at there?

Carlo Rovelli: Oh yes, definitely. We exist as part of a network, both individually the nature of humanity and humanity as a part of network in biology, and as part of the larger aspect of things.

And this is important. Because one of the major crises humanity is facing probably much bigger than the current epidemics is ecological crisis in the larger sense, the heating of the planet and the collapsing of the species. So, we have to obviously take care of that, and we have to take care of that collectively. And we do that by realizing not that we are a sort of a powerful thing outside nature, but we are part of nature and we have to find the best way to interact with it.

Dan LeDuc: I think what you're saying is science is going to be perhaps one of the most important guides for us in saving the world in the coming years. I mean, we do face some enormous challenges. Is science up to that task right now?

Carlo Rovelli: Science is a tool that we have. And we should not mistake a tool with our ideology or our objective. The value that we have doesn't come from science. Come from our self, from inside our self. We want to survive because we want to survive. We want humanity to survive because we want it to survive.

And then we look for tools. And science, today, is by far the best tool we have—I mean, if you want to go to the moon, you ask a scientist. If you want to heal a person with pneumonia, you ask a scientist. You want to build a bridge, you ask a scientist. Or you ask somebody who relies on knowledge that were developed by scientists.

I think we should be guided by a discussion among us on moral and political values. But then we should be careful do what scientists say because they're raising red flags. And we should listen to the solution that they can offer knowing that they are not necessarily complete solution. It's the best we have so far.

Dan LeDuc: Carlo Rovelli, thank you so much. This has been a fascinating conversation.

[Closing music]

Dan LeDuc: We've learned a lot about what makes science *science*, but are we trusting the science we hear about? In our next episode, more on being in the middle of a living experiment:

Cary Funk, director of science and society research at the Pew Research Center: There's a little nugget of information that's going on here, as a public, we have been learning all sorts of information we didn't know, including the idea that there is such a thing as coronavirus.

Dan LeDuc: We hope you join us to hear more. For The Pew Charitable Trusts, I'm Dan LeDuc and this is "After the Fact."