Alex Schein:

"In these times" has been a handy turn of phrase in 2020, with varying adjectives used to modify it. Difficult, unique, strange. What started as a useful shorthand for the COVID-19 Pandemic, became used to describe worldwide protests and calls for racial justice. This fall, the OMNIA Podcast goes beyond the shorthand, using COVID-19 as a platform for a six episode series that explores the science, social science, and history that has shaped events in 2020. In these times, knowledge is more important than ever.

Alex Schein:

I'm Alex Schein. Today we talk to a biologist, two sociologists, and a philosopher of science. This is Episode 1: Dimensions of the COVID-19 Crisis.

David Roos:

Viruses are non-living entities in that they're not independently viable but they can, infect and co-opt living cells of all kinds, bacterial cells, fungal cells, human cells, plant cells.

Alex Schein:

David Roos is the E. Otis Kendall Professor of Biology. He researches infectious disease biology, viruses, and parasites.

David Roos:

Most, although not all animal viruses are themselves looked a little bit like little cells. They're surrounded by a membrane, the way an animal virus is surrounded by a membrane. And they invade into that cell either by fusing with the membrane of the cell, say in the respiratory epithelium of the lung, releasing their genetic contents into the cell, where it then takes over cellular machinery to replicate.

Alex Schein:

My colleague and OMNIA writer, Jane Carroll, sat down with Professor Roos to talk about the emergence of COVID-19 last spring, while he was teaching a course on infectious disease biology and epidemiology.

Jane Carroll:

As I understand, you were teaching the last spring when the virus outbreak began. So what were your first thoughts when you heard about it?

David Roos:

This year, when I was putting together the syllabus, I did include a sentence indicating that the outbreak in, what was then, in Wuhan might be something that we would wind up wanting to follow. And of course, as it happened, as something we talked about informally in class for the first half of the semester. And, once Penn suspended classes, most of our discussion was about Coronavirus.

Alex Schein:

Many questions still remain about COVID-19. As knowledge evolves, scientists can take into account what they already know about virus behavior.

David Roos:

We take the question of, "Why it is that influenza virus disappears in the summer then we have outbreak in the winter?" We can gain insight into that from looking at the genetic sequence of influenza viruses, ask about their similarities and differences and ask, for example, does the influenza virus that shows up in Philadelphia in December of 2020, look like the influenza virus that it was in Philadelphia in December of 2019 as if it just went to sleep and then woke up again?" Or, does it look like the influenza virus that was circulating in June of 2020 in Australia or Argentina, in the Southern hemisphere during their winter? If the virus is going to sleep, we would want to try to understand where it was sleeping and why. And if the virus is not going asleep, but is migrating, we would want to understand how it migrates and we would like to understand why that virus is not infectious or is not transmissible during the summer time?

Jane Carroll:

Okay.

David Roos:

So, similar kinds of experiments would apply to Coronavirus. Many of them, very low tech. So you could imagine, for example, taking a sample of virus, influenza or Coronavirus or HIV or whatever, and spraying it into the air in small aerosolized droplets. Spraying it into the air of larger droplets, like the droplets you can see if someone coughs or sneezes. Or, painting it let's say onto a tabletop or onto a piece of fruit or onto a computer keyboard or onto a doorknob. And then asking an hour later, two hours later, a day later, two days later, a week later, two weeks later, is the virus still there? These are the kinds of studies that go into the concerns about washing hands or whether you should quarantine even vegetables. And similarly, the viability of virus in large droplets or small droplets are in the air, give rise to the recommendations about whether to stay three feet away or six feet away or ten feet away. Or, wear a cloth mask or an N95 mask or stay indoors or outdoors.

Alex Schein:

There's another aspect of COVID-19 scientists are following closely. Mutation.

David Roos:

One of the real triumphs, I think, of the science in the COVID era have been the extent to which inflammation from around the world has been shared in a variety of different ways.

Alex Schein:

Roos is a particular fan of a site called Nextstrain.org maintained by the Fred Hutchinson Cancer Research Institute or Fred Hutch in Seattle. The site is designed to track the evolution and distribution of viruses.

David Roos:

From that, for example, we can look at the evolution of the virus, the emergence of the virus in China, the accumulation of random mutations in the genome. And by those signatures like fingerprints in individual viruses, we can ask about whether a virus that's observed in Seattle in January came from China or from elsewhere. And from those kinds of studies we know, for example, that there were two major waves of entry of the virus in the US. One that came directly from China in Seattle in I think late

December or early January. And one somewhat later in New York where the most closely related recent ancestors had been in Europe. So they migrated from China to Europe and from there through the US. And of course now there's been much more widespread transmission all over.

David Roos:

But what we see is not the mutations that occur as they've occurred, but the mutations that have persisted and those mutations may have persisted because of random chance, but also by virtue of selection. So that process of natural selection may occur, for example, whereby a rabbit that has acquired random mutations that lead it to run less quickly gets eaten more quickly by a fox and so those mutations that slow the rabbits running will no longer show up. Because those rabbits are dead.

Jane Carroll:

Right.

David Roos:

There are similar situations in viruses. There can be cases of positive selection as well. You might imagine, for example, that mutations that led the rabbit to run more quickly would lead that rabbit to survive, pass along its mutations to its offspring which would then propagate more readily. And we can see the same kinds of signatures in viruses, and statistical techniques have been devised to distinguish between chance mutation and mutation that is under selection. The chief selection pressure in humans is likely to be mediated by the human immune response.

Alex Schein:

Understanding COVID-19 mutations is essential to developing a vaccine. When you're exposed to a virus through infection or vaccination, you develop antibodies. The antibodies protect you from future infection, but only if the virus does not mutate in a major way.

David Roos:

Kids in my generation all got Measles. This is a very highly transmissible virus. It would race through a school and everyone would wind up being infected. I had Measles as a child and that infection gave me an immunity that appears to be lifelong. So even though I may encounter measles virus but I won't get sick as my body fights off that infection. In contrast, the biology of influenza viruses as it migrates around the world means that the virus is being selected and evolving in the Southern hemisphere so that when it comes back to the Northern Hemisphere, my exposure will no longer protect me from that virus. And hence the need for vaccination to prevent that infection every year.

David Roos:

We don't really know in what category SARS-CoV-2 lies, but today looking at the mutations that have arisen and signatures of selection that asks whether this virus seems to be evolving under control or in response to immune attack, suggest that it's probably more like measles in that regard rather than influenza. Which means that a vaccine is likely to be possible and is likely to be reasonably protective. How long that protection will last is at this stage, I believe, completely unknown. But I think that the likelihood is that the vaccine will be possible, the likelihood is that it will be protective for at least some period of time.

Alex Schein:

Professor Roos has been researching and teaching from home since the pandemic began. He's also been talking to people about COVID-19 in all sorts of virtual settings. He welcomed questions from student's family members, and ran Zoom info sessions for people in his hometown in New Hampshire. He cautions that he's a scientist, not a public health worker or a counselor, but he's thought about what to say when people ask his opinion.

David Roos:

I guess my advice to people just be to try to use some common sense to minimize the risk to yourself and to others. That means keeping in mind that whatever risks you might personally want to take, your behavior also affects your neighbors. I'm cognizant of the fact that if I don't wear a mask when I'm outside, it makes my across-the-street neighbor who's in her 90s fearful of walking outdoors. If for no other reason, I would wear a mask for that reason alone. I take whatever precautions I can, but I try not to get too anxious about it. I have little doubt that we will get through this.

Alex Schein:

Roos' point about his neighbor is an important one. Some people are more vulnerable than others and that vulnerability is complicated.

Alex Schein:

We talked about the social factors that impact risk with Regina Baker and Courtney Boen, both assistant professors of sociology. Baker studies how individual, structural and institutional factors create, maintain, and reproduce poverty and inequality. Boen, also an Axilrod Faculty Fellow, focuses on the social determinants of population health inequality. Professor Boen identifies three ways COVID creates differential impacts: risk of exposure, severity of the disease, and access to healthcare. All of these are shaped by inequality.

Courtney Boen:

So we can think about who's an essential worker? Who's able to stay home? Who has care-giving responsibilities, who lives in a multi-generational household, right? So these are all factors that shape how likely you are to come in contact with the virus and be infected. And one thing that's been getting a lot of publicity is thinking about people with chronic disease and pre-existing health conditions being at increased risk. But again, we know that there are inequalities in terms of who has chronic disease and existing health problems that might put them at higher risk. And again, this is really shaped by inequality.

Courtney Boen:

The third thing that I think about is once you're sick and you interface with the healthcare system, there's inequalities there that produce differential outcomes. So number one, do you have access to health insurance? That sort of lifts some of the barriers in terms of accessing care? Do you have access to quality care? We know that there's bias and racism within the healthcare system, for example, that differentially treats people based on things like race, ethnicity, immigration status, language. And so all of these things also serve to create differential patterns of COVID, both the exposure, the severity, and eventually differential risks of death and survival.

Alex Schein:

The phrase essential worker has been used frequently since the pandemic began. Professor Baker points out that being essential doesn't guarantee protection.

Regina Baker:

So when it comes to thinking about the jobs that are basically keeping our society running, and those are likely to be minorities, those are likely to be individuals with lower incomes. So that puts them at a greater exposure to getting COVID. And so all these things I think are so essential when it comes to thinking about COVID, COVID exposure, and disparate outcomes as a result of that. I think that, particularly when it comes to poverty, it's such an important piece to understanding the health outcomes in what's happening here.

Courtney Boen:

I'll just add that, I think we're all talking about COVID, about the pandemic and the inequalities that we're seeing are so real in this moment. But I think for folks that have really been studying population health outcomes, or inequalities and poverty and economic opportunities, these are tragic but they're not surprising. And so I think the important part to remember is that the inequalities that we're seeing in COVID infection rates and in COVID deaths mirror so many of the inequalities that we've been seeing in the United States for centuries. And so none of us should really be surprised. We should be devastated and angered, but not surprised by them.

Alex Schein:

When someone is affected by COVID-19, there is a ripple effect, what Boen calls Collateral Consequences.

Courtney Boen:

So one thing that I've been thinking a lot about is the Collateral Consequences of the pandemic for those not just who are sick, but for all the people who love and care about and think about those people. So there's been lots of work showing what happens when a family member gets sick, lots of research showing the devastating consequences of caring for a loved one when they're sick, of losing a loved one. And the consequences are grave. There financial, if you're taking on new responsibilities in your house for taking care of children or grandparents or helping family members out in times of need.

Courtney Boen:

There have been numerous studies, for example, showing highly unequal deaths by race from COVID. Black Americans are just dying at staggering rates. And that means that black individuals across the United States are carrying a much heavier burden when it comes to COVID, when it comes to the collateral damages of those losses. So even if you are not sick it is much more likely, if you are black, to know people who have been sick or know people who have died. And to carry the weight of that grief of that stress and worry, the financial consequences of that. So, I think it's important in the context of the pandemic... All of us feel worried to some extent for ourselves, for our loved ones, for society in general, but that burden is also very highly unequally shared across the population.

Regina Baker:

You think about how stressful this is for everybody, right? And it's a privilege for people like us to say that Oh we're stressed because we have [inaudible 00:17:22] worry about childcare or having to be home another day, right? That's very different than being stressed and grieving because somebody else in the neighborhood died of COVID. Or another family member is in the hospital. That adds a whole other layer that I think is important for us to think about in terms of these long-term effects on people's mental health, which is tied to your physical health. And just all the dynamics of what that does and thinking about a community itself and the families within it.

Alex Schein:

This is where politics comes in. The inequalities professors Baker and Boen are talking about have existed for a long time. COVID has simply highlighted them. How can we address these inequalities and protect the health of all members of our community in the long-term?

Courtney Boen:

So, lots of countries across the globe have managed to contain COVID in lots of ways, using old-school public health practice, like contact, widespread testing and tracing and isolating combined with robust public investment in things like worker protections, economic relief packages and worker protections, right? And so we're holding out hope for this vaccine. A lot of times in the popular press or in public conversations, without recognizing we have decades of research showing that things like providing universal paid sick leave, providing living wages, providing secure housing, providing stable universal childcare, that these things greatly reduce population health burdens, right?

Courtney Boen:

And so some of our best research comes from seasonal flu data that shows when workers have, for example, access to paid sick leave, unsurprisingly worker infection rates drop. And so we can imagine, that's something we could do tomorrow if we wanted to. So that's not a question of scientific discovery, like we're hinging on with the vaccine, but really a question of political will. Are we willing to put in place the guaranteed social and economic protections for workers and for households and for schools and childcare providers that we know would reduce infection rates. We know how to contain this without a vaccine, other countries have showed us.

Courtney Boen:

And in fact, some States within the United States have showed us that investment in public health investment in social and economic well-being and equity matters. And yet we're choosing not to. Right. And so, so for me, we have many of the answers in our back pocket. It's a question of whether or not politically we can make them happen.

Regina Baker:

Yes. And I totally agree with everything that professor Boen said, she hit the nail on the head there. We should be thinking about the ways that states and the federal government can truly make a difference in what you're seeing and what's going to happen long-term. I think one key thing as Professor Boen pointed out is public investments, right? And even before all his COVID pandemic, our lack of public investments is something that as an equality scholar we've seen makes a difference in terms of the US having high rates of child poverty, for example. Higher than many of our peer countries who are the same economic level as us. And when it comes to the pandemic, some of these same things are

important for helping to constrain the pandemic are also important for helping people stay afloat. And things that we need, like universal childcare or just childcare support. That's something that we need.

Regina Baker:

And at the state level, thinking about the states that have been able to help contain the virus and what are they providing and what are they doing in terms of putting these restrictions in terms of social distancing and not opening things too early? And making masks a requirement and things like that, that we see clearly from other countries are working. But there's so many state governments who for whatever reason are choosing not to do that, choosing to make those informed decisions that are based on decades of health research and choosing not to listen to what the experts are saying. And I think that's so important when we're addressing these types of issues, is that at the end of the day what matters is the well-being of the citizens. Not politics.

Regina Baker:

And also what Professor Boen was saying, I think is important is this idea that at the end of the day, what matters is having the political will to be able to make these important decisions to make the right decisions in order for everybody to be better off in the long-term.

Alex Schein:

Professors Baker and Boen contend that there are tools our government isn't using. There are social tools like paid sick leave and scientific ones like contact tracing. Why aren't people interested in these evidence-based solutions? Philosophy may hold the answer.

Michael Weisberg:

I'm Michael Weisberg. I'm the chair of the philosophy department. And my field within philosophy is philosophy of science.

Alex Schein:

Weisberg has studied all sorts of scientific issues. The controversial ones that tend to be polarized, climate change, evolution, vaccinations. Science has been a lifelong passion, even if his methods have changed.

Michael Weisberg:

For many, many years from the time I was a little kid, always been really enthusiastic about science. And I remember setting a table on fire with my chemistry set and taking model rockets apart. So naturally I majored in chemistry in college, and I just assumed that I would become a natural scientist.

Alex Schein:

But Weiseberg is a philosopher. It's a distinction that hasn't always been so clear.

Michael Weisberg:

In the earliest days of academic inquiry there weren't really the kinds of divisions between areas of knowledge that we now think of. And someone like Aristotle was simultaneously a physicist, a biologist, a logistician, a literary theorist and everything else. And one of the things that's happened as knowledge has as grown is specialization has happened.

Michael Weisberg:

Now, when it comes to philosophy of science and the practice of science, the division between the two has, I would say, never quite severed. And certainly in the end of the 19th century and through the early 20th century many of the great physicists, people like Pierre Duhem, people in the 20th century like Einstein, both wrote about physics and also wrote about philosophical issues.

Alex Schein:

Professor Weisberg studies how the general public understands science differently than scientists do. For scientists, science is messy, full of questions and debate. For people who stopped studying science after high school or an intro college class science might be settled fact, and that difference can cause misunderstandings.

Michael Weisberg:

The problem with ending your scientific education there, is you've learned about the parts of science that are pretty well resolved. So you would come away thinking that science is a set of facts, things that are settled issues. And of course there are parts of science where the issues are fairly well settled. If you want to know the atomic number of gold, 79 is the answer. Anything's possible, but it's very unlikely that we're going to find evidence that, that's not the case.

Michael Weisberg:

I think even more importantly, though, is scientific methods are often taught as The Scientific Method, as a kind of five-step procedure. And I've spoken to many high school teachers about this, I think it's perfectly understandable that you need to give students something concrete to think about, some kind of procedure. But the problem is it makes it seem like it's a mechanical procedure. That first you do some research and then you come up with hypothesis and then you design an experiment. And that definitively tests the hypothesis and maybe you iterate, but that's it.

Michael Weisberg:

And in reality, sometimes that happens, but not that often. And some fields are very driven by testing hypotheses. Some fields are not at all. Some fields are really driven by doing really detailed field observations or making really precise measurements in the physical sciences. You often can spend a career just trying to add a decimal place to a measurement to make it more precise. And that involves building a more complex machine. Or in astronomy, the next generation of instrumentation or the next generation of telescopes lets you look deeper, but it's not really about hypothesis testing in the first instance.

Michael Weisberg:

There's many, many, many, many scientific methods. And again, this gets to what we were discussing before, that if you have fixed in your mind there's this five step procedure that science should follow. And then you look at how the discussions of COVID-19 have unfolded over the last few months. It doesn't look anything like those five steps.

Michael Weisberg:

When we look at areas of science that are highly polarized in this country, like climate change, the polarization happens along for Democrats accepting climate change and people who tend to vote for

Republicans, less accepting of climate change. Now, if you identify the subgroup of people who have a much deeper appreciation of scientific method, this is something that we've been measuring in our research group, most of that polarization disappears. So even very conservative people who have a appreciation for the real nature of scientific inquiry tend to not reject climate change. And the same is true of evolution. The same is true of vaccines.

Michael Weisberg:

So we suspect that some of what we're seeing in COVID-19 and the public's, at least some of the public's, resistance to it and resistance to wearing masks and other things could be explained by the same mechanism.

Alex Schein:

Weiseberg has thought about how the scientific community talks to the general public. And he says a different communication strategy could help bridge the gap.

Michael Weisberg:

Scientists might be tempted to just simply give the answer as they see it, or give the policy or the directive that they think is the right one. But I think it's extremely important to, even if it's in a simple way, talk about the "why we know what we know" and the "how we know what we know" and also the uncertainty. So I think if you were just only a little bit paying attention and you saw that the United States government went from telling people, "Don't worry about wearing a mask," to, "Yeah, maybe it's a good idea," to, "No, you need to wear a mask but you can wear whatever mask you want," to, "Well, we're not absolutely sure cloth masks are good enough. Make sure it's double layer if you're going to do cloth, but better that you should get paper mask," to then, whatever the next thing is.

Michael Weisberg:

I mean, it's probably completely justifiable why scientists said all of those things in the sequence that they said them, but I think we need to know more and more needs to be said. So if the answer is, "We didn't think before that the Coronavirus that causes COVID-19 could be in particles of a certain size, but now we do," I think just say that. I think it's very, very important to not allow all scientific discourse to fit into the smallest possible soundbite that TV wants it to be in. And for the scientific community to really push to at least have medium sized explanations and not just the "what" but the "how we know" explained all the time. So I think that's really important.

Alex Schein:

These days, scientists are on the news almost daily. Weisberg wants them to be loud and emphatic.

Michael Weisberg:

There's often a kind of debate, "Should the scientific community be political?" That's how it's often framed. And I think this is a really bad framing because, I don't think the scientific community should be partisan. So I don't think the scientific community should say vote for the Democrats. But I think the scientific community should say, "We have a core value and the core value is using empirical methods to find out what the world is like. And we believe in that so strongly that we think that you should guide your life by this. And here's why," that's the recommendation I'd make. Combine a political stance of reason and evidence with very specific recommendations tied to the reasons for those

recommendations. And fight for space, I mean the forces of darkness in this country know how to use the media to their advantage. So the scientific community needs to learn too.

Alex Schein:

That concludes the first episode in our six part series, In These Times. We'll be back with Episode 2: In Other Times, where we look at health crises of the past from the plague to the AIDS epidemic. We'll talk with historians and an English professor to see what we can learn if we take a look back.

Alex Schein:

The OMNIA Podcast is a production of Penn Arts & Sciences. Special thanks to professors David Roos, Courtney Boen, Regina Baker and Michael Weisberg. I'm Alex Schein, thanks for listening.

Alex Schein:

Be sure to subscribe to the OMNIA Podcast by Penn Arts & Sciences on Apple iTunes, or wherever you get your podcasts, to listen to all six episodes of In These Times.