TREND

Analysis of the Facts, Numbers, and Trends Shaping the World
THE PEW CHARITABLE TRUSTS

SCIENCE MATTERS

117 **Ts** *Trust*	15 **P** *Policy*	75 **Re** *Research*
110 **Ds** *Data*	52 **Te** *Technology*	53 **I** *Innovation*
2 **He** *Health*	16 **S** *Science*	99 **Es** *Evidence*

THE ELEMENTS OF SCIENCE EXTEND BEYOND THE LAB TO OUR EVERYDAY LIVES—AND THEY START WITH TRUST.

WINTER 2021 / 06

science

['sī-ən(t)s]

noun

1. the state of knowing : knowledge as distinguished from ignorance or misunderstanding
2. a system of knowledge covering general truths obtained and tested through scientific method
3. the determination of facts that lead to a better understanding of the world and ourselves, allowing us to find common ground and common purpose

CONTENTS

WINTER 2021 / 06

Read *Trend* online at pewtrusts.org/trend

TREND

WINTER 2021 / 06

One Commerce Square
2005 Market Street, Suite 2800
Philadelphia, PA 19103-7077

901 E Street NW, 10th Floor
Washington, DC 20004-2037

The Grove
248A Marylebone Road
London, NW1 6JZ

CONTRIBUTORS

MOLLY IRWIN is vice president for research and science at The Pew Charitable Trusts. *How Data Leads to Better Decisions*

RIMA JABADO is founder and lead scientist at the Elasmo Project and a Pew marine fellow. *Voices: How Has the Pandemic Changed Science?*

COURTNEY JOHNSON is a research associate, **CARY LYNNE THIGPEN** is a research assistant, and **CARY FUNK** directs science research at the Pew Research Center. *On the Intersection of Science and Religion*

ESTHER KROFAH is executive director of FasterCures, a center of the Milken Institute. *How to Make Science Work Quicker—and Better*

LAURA LINDENFELD is executive director of the Alan Alda Center for Communicating Science, dean of the journalism school, and vice provost for academic strategy and planning at Stony Brook University. *The Final Word: Scientists Need to be Better Communicators—and They Know It*

MARCIA MCNUTT is a geophysicist and the president of the National Academy of Sciences. A version of her essay first appeared in *Issues in Science and Technology*, a quarterly journal published by the National Academies of Sciences, Engineering, and Medicine and Arizona State University. *Delivering Science in a Crisis*

SUDIP PARIKH is chief executive officer of the American Association for the Advancement of Science and executive publisher of the *Science* family of journals. *Why We Must Rebuild Trust in Science*

CARLO ROVELLI is a theoretical physicist whose books include the bestselling *Seven Brief Lessons on Physics*. *Foreword: Acknowledging Our Limits Is the Strength of Science*

DAVID SATCHER is the founding director of the Satcher Health Leadership Institute and a professor at Morehouse School of Medicine. A former director of the Centers for Disease Control and Prevention, he was the 16th surgeon general of the United States. His essay is adapted from his book *My Quest for Health Equity*, published by Johns Hopkins University Press.

NOTES FROM THE PRESIDENT

SCIENCE MATTERS

COVID-19 has led to challenges the world has not confronted in more than a century: over 55 million cases and more than 1.3 million deaths; massive disruption to economies; state and local budgets in the U.S. at the breaking point; and lack of contact with loved ones, teachers, colleagues, and friends. And the pandemic has brought greater attention to the role of science in society. Vaccine development, therapeutics, and epidemiology are new topics of conversation in the public square. So in this issue of *Trend* we step back to explore public attitudes about science and how science can inform policy.

In the months leading up to the pandemic, the Pew Research Center measured the level of trust in science and scientists. The data revealed that large majorities around the globe support government investment in science. But when asked if they trust scientists to do what is right for the public, only 38% of Americans answered "a lot." So raising public confidence in science is a critical challenge.

Sudip Parikh, who leads the American Association for the Advancement of Science, writes that "a scientific endeavor that is not trusted by the public cannot adequately contribute to society." Parikh believes that the science community has work to do if it wants to increase trust among the American people. But he also believes that public skepticism about science can be reduced when scientists build strong relationships with the communities they serve—and offers strategies to do just that.

While the pandemic is disrupting the globe, Marcia McNutt, president of the National Academy of Sciences, says that the research community can respond in a meaningful way with a three-part framework learned from other calamities such as the Deepwater Horizon oil spill: *actionable science* given to decision-makers in the earliest days of a crisis; *strategic science* involving interdisciplinary teams working together to avoid a cascading series of disasters; and *irreplaceable science* that takes advantage of the unusual conditions existing during a crisis: for example, studying the effects of less human activity on marine life during the pandemic.

Effective COVID-19 vaccines and other measures are already addressing the pandemic's effects on public health and will eventually allow an economic recovery. But even when we put our masks away, science will continue to inform policy responses. Molly Irwin, who directs science and research at The Pew Charitable Trusts, writes that the federal government is building an infrastructure for collecting data needed to craft effective public policy. She notes that data-driven policymaking has evolved over decades and with each new challenge produces a body of evidence "that is adjusted, expanded, or reconsidered in subsequent versions" as scientists learn more about the problem they're trying to address.

Solving difficult challenges based on a foundation of rigorous science and public trust is the goal of all the authors in this issue of *Trend*. I hope their insights will help inform yours.

Susan K. Urahn, *President and CEO*

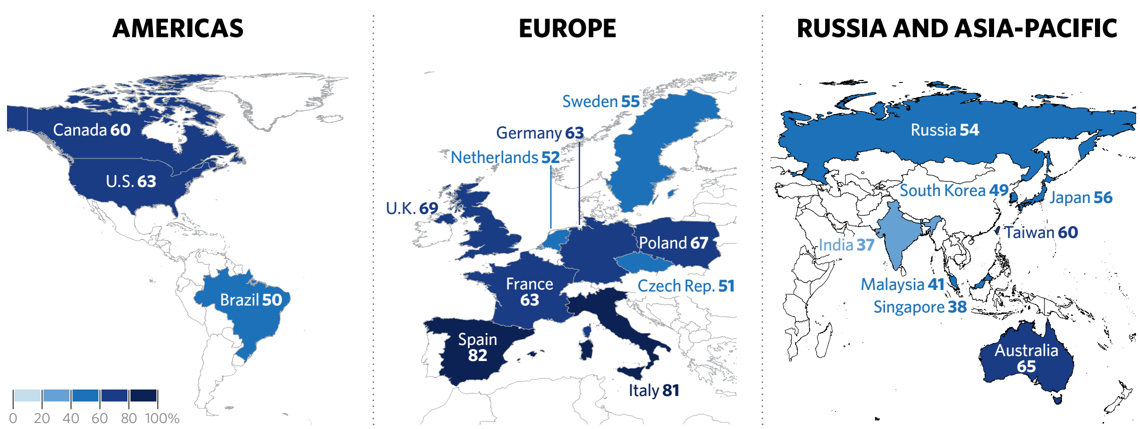
PLEASE SHARE YOUR THOUGHTS ON THIS ISSUE OF *TREND* BY WRITING US AT TREND@PEWTRUSTS.ORG, OR JOIN THE CONVERSATION ON TWITTER WITH #PEWTREND.

Science Held in High Esteem Across the Globe—but There's Ambivalence Too

Scientists and their research are widely viewed in a positive light in many places around the globe, and large majorities believe government investments in scientific research yield benefits for society, according to a Pew Research Center survey of people in 20 publics across Europe, Russia, the Americas, and the Asian-Pacific conducted from October 2019 to March 2020, just before the pandemic took hold in the world. Alongside the high trust for scientists, the survey also revealed ambivalence about some scientific developments such as artificial intelligence. Public concern about climate change and environmental degradation remain widespread.

IN MOST PUBLICS SURVEYED, HALF OR MORE SAY THERE IS A NEED FOR MORE GOVERNMENT ACTION ON CLIMATE

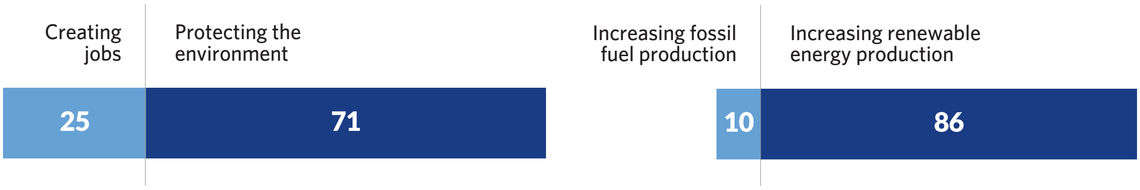
% who say their government is doing too little to reduce the effects of global climate change



MOST PRIORITIZE ENVIRONMENTAL PROTECTION, INCREASING RENEWABLE ENERGY

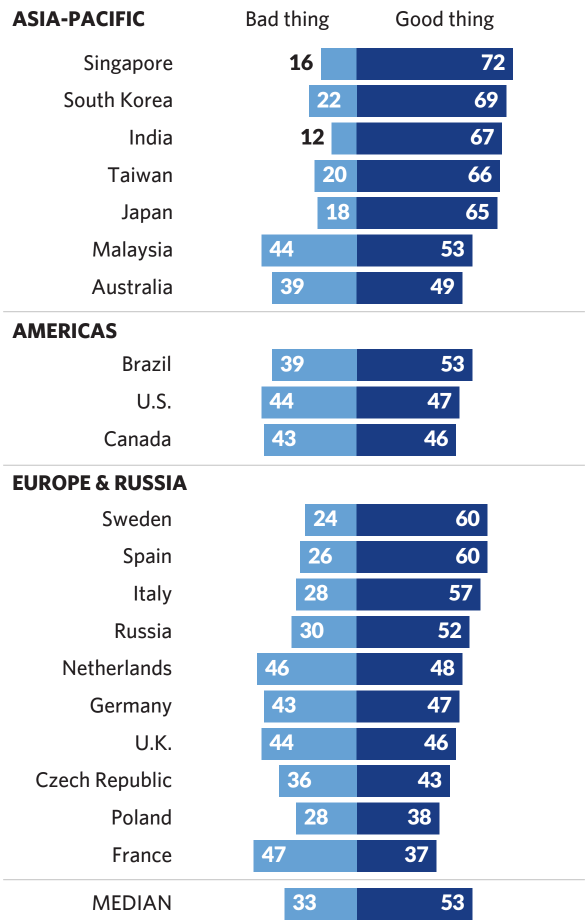
Median % who say ___ should be given priority

Median % who say ___ should be the more important priority for addressing energy supply



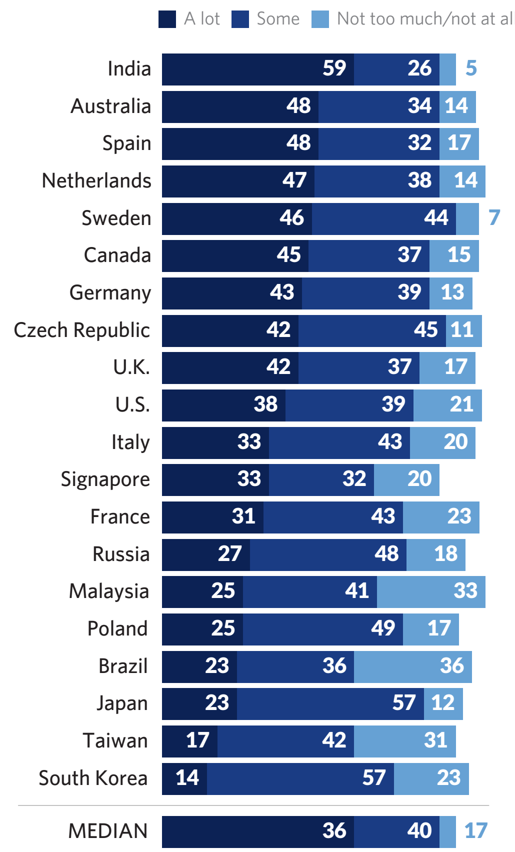
PUBLIC VIEWS OF AI'S IMPACT ON SOCIETY ARE OFTEN MIXED

% who say the development of artificial intelligence has mostly been a ___ for society



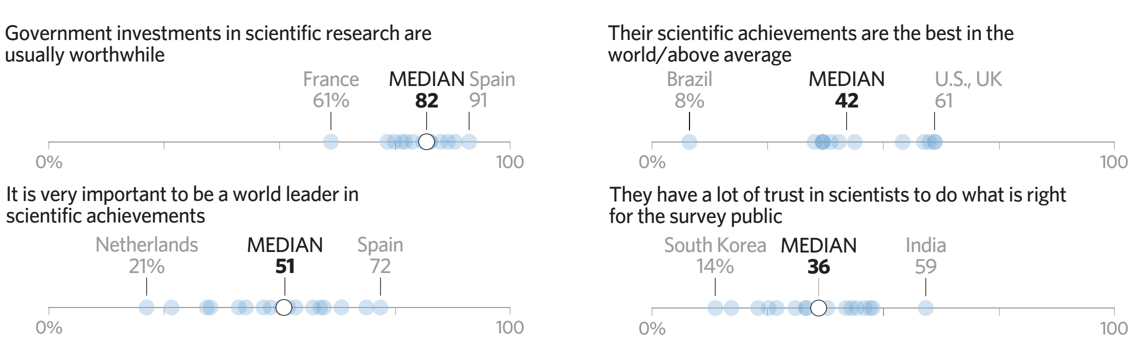
MAJORITIES HAVE AT LEAST SOME TRUST IN SCIENTISTS TO DO WHAT IS RIGHT

% who say they have ___ trust in scientists to do what is right for (survey public)



MOST VALUE GOVERNMENT INVESTMENT IN SCIENTIFIC RESEARCH, BEING A WORLD LEADER IN SCIENCE

% who say...



FOREWORD

ACKNOWLEDGING OUR LIMITS IS THE STRENGTH OF SCIENCE

BY CARLO ROVELLI

The coronavirus pandemic has exposed the fragility of our societies and the limits of our knowledge. We are less powerful than what we sometimes like to think. This virus has killed over a million human beings, has sickened many millions more, and has choked the economy of the planet. We have been groping in the dark.

At this time of fragility and confusion, government leaders and the public have turned to science for a solution, recognizing that science is the best defense we have. We have been anxiously waiting for science to give us a vaccine and a cure. And as we wait, people are still becoming sick and are still dying, promising vaccines will take time to reach everyone, and social distancing and other measures to stem the spread of the virus continue to divide people.

Scientists alone cannot decide on these measures, for science is only a tool— a tool with limits. The decisions that society faces must be made through a political process, negotiating between conflicting interests and conflicting values. To arbitrate between saving lives and protecting the economy, for instance, is to make decisions that cannot be made by science. Science is only the summary of the knowledge we currently have, and it does not have all the answers. It is often uncertain: Scientists often answer questions with "we don't know" or "maybe." They change their minds. Science itself grows via discussion, disagreements, trials and errors. It requires time.

And yet, science is the best tool we have and it should not be ignored. It has given us the modern world, with all its comfort and protections. It has raised life expectancy from 30 years to more than

70 and expanded our worldview. It has given us vaccines that have eradicated horrendous illnesses of the past, medications, tests, statistical analysis, and effective public health measures. Pandemics in prescientific times killed far more people than today, decimating populations of nations around the world. Science has given us years of a healthier, comfortable life that our forefathers did not even dream.

Science has achieved all this by recognizing the limits on our knowledge and continuing to move beyond them. For this is how we humans learn. By being humble, ready to accept that we have prejudices, and struggling to move past them. Listening to viewpoints unlike our own and taking them seriously. Acknowledging that the one who is right may be the person whose opinions differ from ours. Looking toward the boundless sea of our ignorance, rather than listening to the minuteness of our convictions. Looking at the world's innumerable questions, at the immense mystery that surrounds us, and replacing certainty of conviction with an openness to learn. This is science.

Science has taught us that we do not get rain by dancing, we do not heal by reciting formulas, we are not the center of the universe, we have common ancestors with all living beings on Earth. It has changed our worldview repeatedly. If we have a chance to come out from this pandemic, it will be thanks to science and by listening to science. If we have a chance to overcome the far more serious challenges that humankind has to face, such as climate change, it will be by listening to science.

And yet, what started and nourished scientific discovery has rarely been thinking about its momentous results and consequences. Science is born from curiosity. Even today for many scientists, the real motivation is nothing else than the desire to know more, to look a step further. It is the human sense of wonder that fires this wish to know. This human curiosity has taken us out of so many old prejudices. This quest has allowed humanity new vision, to see the world better and more deeply. It has been and continues to be the great adventure of getting to the boundary of what we know, and then looking in the dark and struggling to see a bit more. Because it is there, on the edge of what we know, in contact with the oceans of the unknown, that shines the mystery and the beauty of the world.

Why We Must Rebuild Trust in Science

ILLUSTRATIONS BY GABY BONILLA/
THE PEW CHARITABLE TRUSTS

A scientific endeavor that is not trusted by the public cannot adequately contribute to society.

BY SUDIP PARIKH

When the history of our current moment is written, science will be central to the story. In the crucible of 2020, did science rebuild the societal trust needed to defeat the coronavirus? Or did a break in trust lead to a lingering pandemic that foreshadowed future failures to solve the coming crises of climate change, food and water insecurity, and economic stagnation? Historians will consider what led to this pivotal moment in the relationship of science and society and how it was resolved. Scientists and society must work together to ensure that this time of uncertainty and upheaval leads to a new era of solutions that enrich the lives and well-being of us all.

We live in wondrous times: The pace of discovery and innovation has never been faster. We have seen for the first time the methane-covered mountains of Pluto, discovered gravitational ripples caused by colliding black holes, detailed extensive changes to our climate and environment, advanced quantum computing to the brink of broader utility, and harnessed gene editing to potentially cure sickle cell anemia and other diseases.

Despite failures in our public health response to the pandemic, the biomedical research enterprise has never worked more quickly than during its quest to understand and address COVID-19. While basic researchers work around-the-clock to answer fundamental questions about the coronavirus' structure, transmission, and impacts, clinicians and physician scientists are testing therapeutics and vaccines. The record-shattering number of submissions to the journal *Science* and other peer-reviewed publications for COVID-related research—from structural biology to epidemiology—speaks volumes about the speed and intensity with which researchers are responding to this crisis.

We also live in uncertain times: Multiple intersecting challenges have the potential to become global crises. The COVID-19 pandemic will not be the last time that science will be essential to society's triumph over existential threats. Addressing future public health concerns, such as climate change, food and water insecurity, and other challenges—some of which are yet to emerge—will require the long-term integration of science into policymaking in ways that have only been temporary in the past. The cadence of emerging crises and the pace of planet-changing discoveries necessitate permanent elevation of scientific advisers to the front ranks of policymaking as they have only sometimes been during national crises like world wars, and moments of global competition like the space race. At the same time, we need to more fully engage diverse communities with an intentional emphasis on those that have been ignored, marginalized, or harmed by scientific advancement.

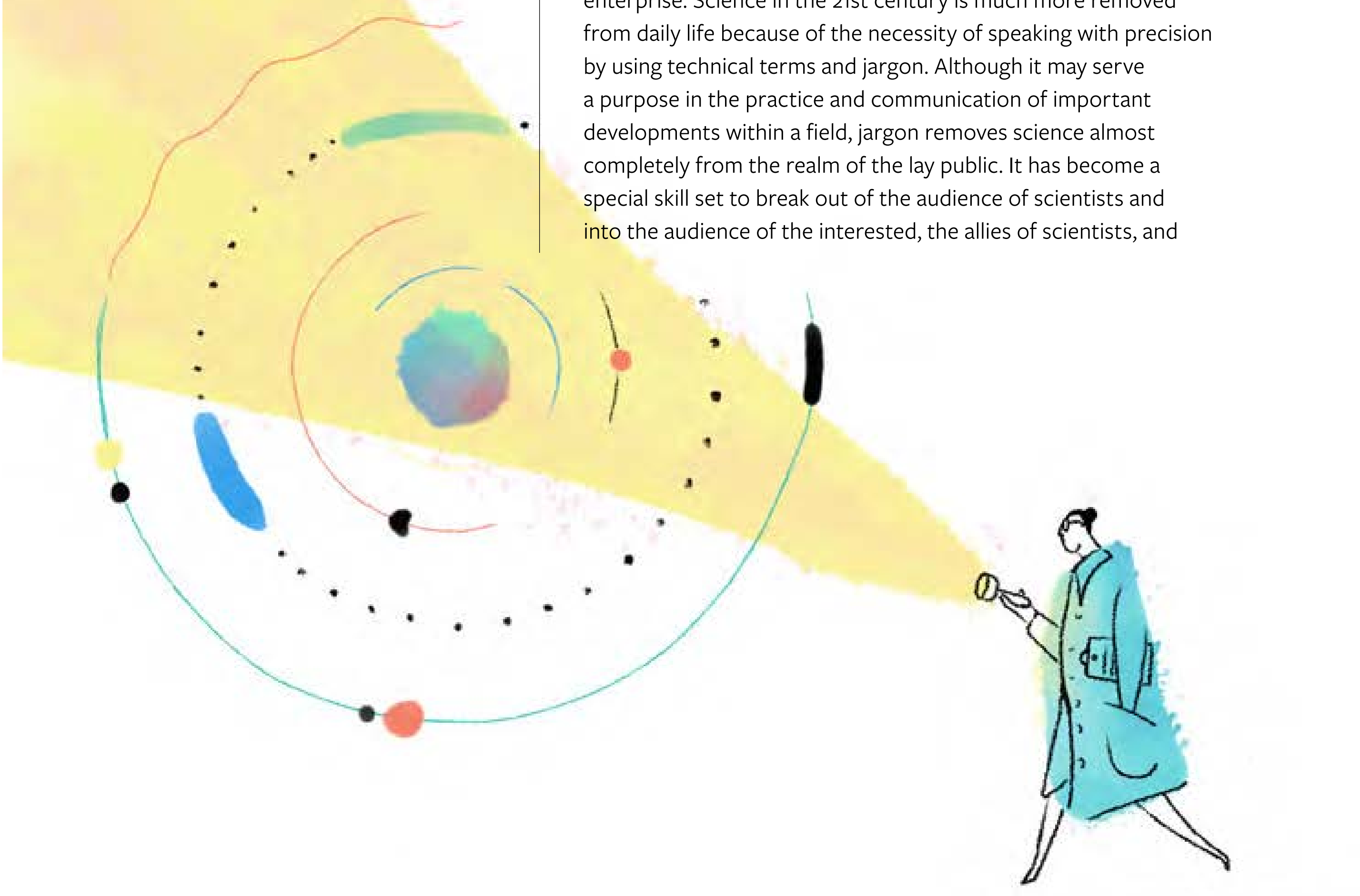
One element is absolutely critical to the success of our mission to improve the human condition: trust. It's a foundational element of any relationship, but for the mutual benefit of the scientific enterprise and the people who support it, trust is essential. Simply put, a scientific endeavor that is not trusted by the public cannot adequately contribute to society and will be diminished as a result.

The COVID-19 pandemic presents us with just such an example. Late last year two of the

THE COVID-19 PANDEMIC WILL NOT BE THE LAST TIME THAT SCIENCE WILL BE ESSENTIAL TO SOCIETY'S TRIUMPH OVER EXISTENTIAL THREATS.

vaccine candidates in clinical trials demonstrated safety and effectiveness in preventing infection of the virus that causes COVID-19. Although this was a remarkable accomplishment on its own, manufacturing and delivering these vaccines to the world's population will be an enormous challenge. To further complicate this situation, a public that is generally trusting of scientists and health professionals is receiving vastly different information, guidance, and recommendations based on its news consumption, political leaders, and geography. A September 2020 Pew Research Center survey found that Americans were evenly divided as to whether they would get a vaccine to prevent COVID-19 if one were available now. The science of vaccine development cannot be successful if it is not trusted enough that people will get vaccinated. Science will have accomplished nothing by producing a vaccine that sits unused in a warehouse. We cannot become resigned or complacent as we work to maintain trust in science during this critical moment.

Importantly, it is not enough to say the public should trust scientists because we know better or because we know more. Trust must be earned. Unfortunately, science and scientists have not consistently earned and nurtured this trust. In some respects, this is the result of the advancement of the scientific enterprise. Science in the 21st century is much more removed from daily life because of the necessity of speaking with precision by using technical terms and jargon. Although it may serve a purpose in the practice and communication of important developments within a field, jargon removes science almost completely from the realm of the lay public. It has become a special skill set to break out of the audience of scientists and into the audience of the interested, the allies of scientists, and



We must make sure that when historians look back at our time, they see how trust between science and society was actively strengthened and led to lasting benefits for the public good.

the public. The pace of discovery and knowledge, and the size and scope of the scientific enterprise, makes this especially difficult. It is incumbent on scientists to value and develop these skills.

The practice of science is messy. Hypotheses are put forward and tested. Understanding evolves and comes in fits and starts. The trial and error in research methodology and the repetitive testing in laboratories are often hidden behind the end products of scientific research—a new treatment, a new piece of technology, a new or revised piece of public health guidance—without the public seeing the puts and takes that are required along the way. When that process is then seen in real time, as we're all experiencing during the COVID-19 pandemic, the public has little context for updates in public health guidance, such as the change to recommending wearing face masks to limit and prevent infection.

More disturbingly, science has sometimes lost the trust of the public through researchers' own painful missteps and blatant violations of that trust. Science, engineering, and medicine are not immune to the discrimination, subjugation, and silencing of marginalized people and voices. We have too often been unwitting perpetuators of the status quo, and the reasons are deeply ingrained in the systems that govern our society. It's important to hold a mirror to the scientific community and recognize where we have made mistakes. We must look at the past and ask: What got us to where we are today? As just one example, the 40-year Tuskegee study of Black men with untreated syphilis that ended in 1972 was unethical and should never have happened. Unsurprisingly, Black Americans are more distrustful of medical experts than other demographic groups, an example of how trust can be lost. We must recognize and acknowledge the areas where science has fallen short so that we can listen, understand, and move forward.

Fortunately, we start from a solid foundation. Seventy-three percent of adults in the United States—like majorities around the world—agree that science and technology make our lives better, and they trust scientists and researchers to make important discoveries that help solve problems. In building on this foundation, scientists must remember that we have a responsibility not just to our research and our own careers but also to the public that we serve. The fruits of our labor are meant to be shared broadly with our communities, not left in labs. The only way to build trust is to show members of the public that we are of them and for them, not separate from them.

The differences in public opinion that we see on science-related issues often align with educational and ideological differences and exist primarily in applied science—that is, people's consideration of specific applications of science and technology that affect them directly—such as vaccines, genetically modified food, renewable energy, and artificial intelligence. Asking the public about their acceptance of applications provides a glimpse into what kind of world people want, what technologies they are comfortable with, and how solving existing problems with new technology might potentially create new questions and challenges.

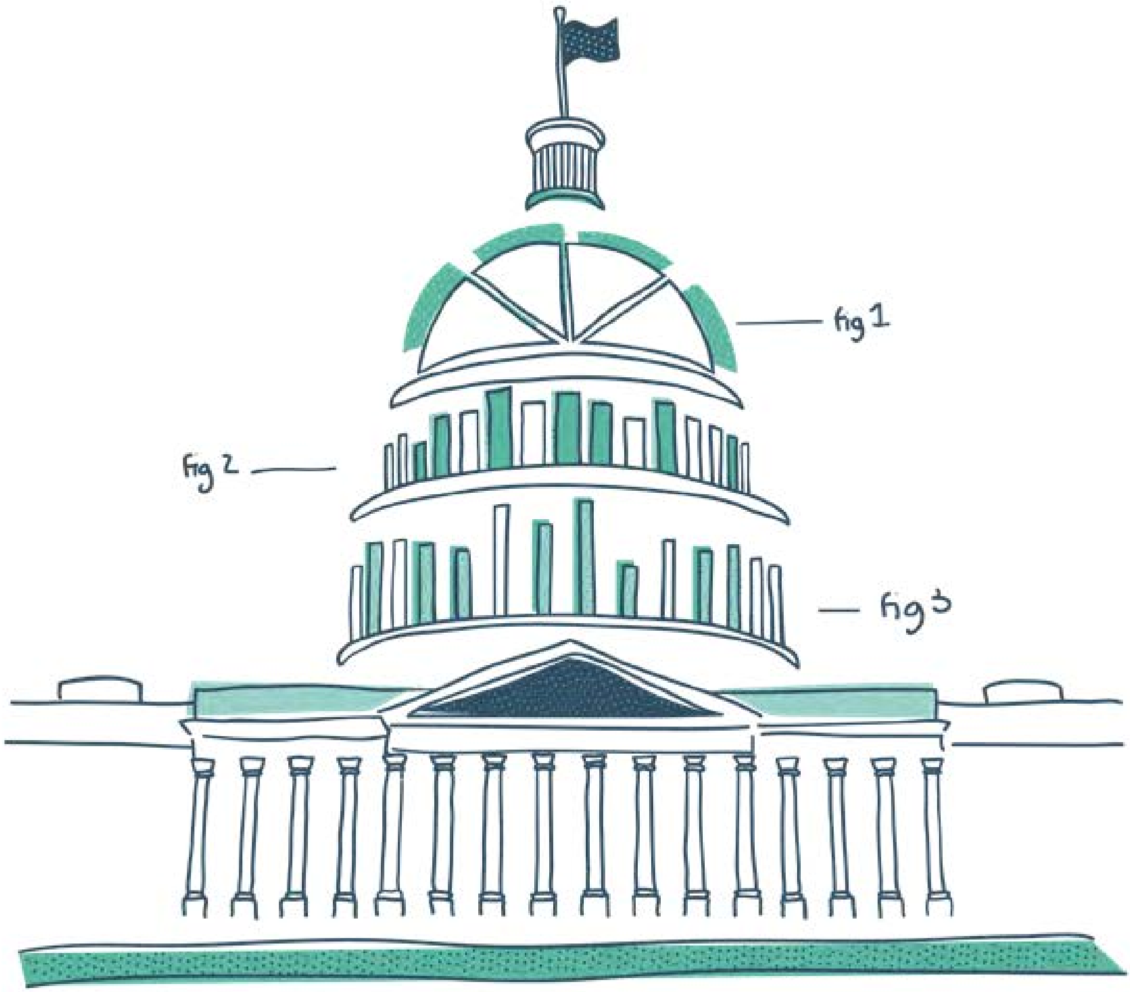
At the same time, increased political polarization and an outspoken faction of Americans who distrust experts, including scientists who develop evidence-based findings that may challenge closely held opinions, have also widened the gap between Americans' trust in science and scientists.

How do we consider the best path forward into an increasingly technology-oriented world—one that both faces these challenges head-on and works to address pressing societal issues? The time to build trust is before you need it. We need to build relationships in and across communities to become better informed and much more inclusive in how we define problems and find solutions. We must proactively and vigorously make connections and build trust between scientists and communities. At the American Association for the Advancement of Science, we create opportunities for scientists to listen to and share information with public audiences through conversations with diverse communities—from policymakers to reporters, from religious leaders to lawyers and judges. We place scientists as policy fellows within congressional and federal agency offices where they can learn from and directly influence policymakers. We connect journalists with vetted scientific experts to help reporters understand the science behind key issues. We help integrate science into the curricula of theologically diverse seminaries, showing that faith and science can be compatible. Perhaps most importantly, we help scientists build relationships in their communities before they are needed during a crisis.

Science is not just for the few. It is for everyone and can be used by anyone. We must find new and better ways to connect the practice and use of science to inform and shape our communities, our country, and our world. We must make sure that when historians look back at our time, they see how trust between science and society was actively strengthened and led to lasting benefits for the public good.

THE TAKEAWAY

Scientists and society must work together to ensure that this time of uncertainty and upheaval leads to a new era of solutions that enrich the lives and well-being of us all.



HOW DATA LEADS TO BETTER DECISIONS

BY MOLLY IRWIN

ILLUSTRATIONS BY ALLIE TRIPP/THE PEW CHARITABLE TRUSTS

Data and the scientific method aren't just for the laboratory; they inform social science that leads to better public policy.

In the movie "Apollo 13," when it is clear that the astronauts are in serious trouble, flight director Gene Kranz in Houston tells his team, "Let's work the problem, people. Let's not make things worse by guessing."

This warning about the dangers of guesswork puts into stark relief the importance of grounding critical—and sometimes lifesaving—decisions on facts and data. Congress got the message. In 2016, to help make sure that policymakers in the federal government act on the best available evidence, Congress created the Commission on Evidence-Based Policymaking to study and develop a strategy for strengthening the government's evidence-building and policymaking efforts. A year later, the commission submitted its report to the president, the speaker of the House, and the president of the Senate. The commission made numerous recommendations to strengthen federal evidence-building capacity—including developing learning agendas, or a set of research questions and strategic approach, to support building and using evidence to address policymakers' questions; improving the security and confidentiality of data; and aligning administrative processes with evidence-building activities.

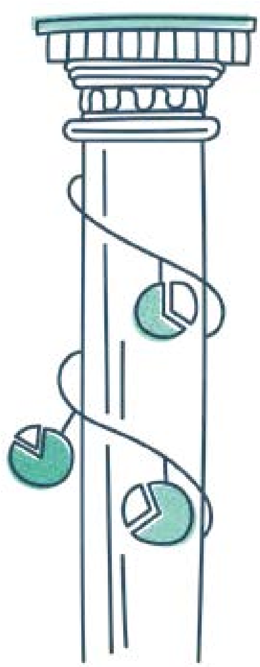
In response to the commission's report, Congress passed the Foundations for Evidence-Based Policymaking Act of 2018, which put into law many of the commission's recommendations. The law did not get a lot of press attention—or any awards for a clever title. Nevertheless, the act may have done more to change the way federal agencies collect and distribute data—and develop policies based on that data—than any other recent legislative action. And that is a significant accomplishment.

The act is essentially an infrastructure bill. But instead of building roads and bridges, it builds a federal system for collecting and accessing data that can be used to develop evidence-based policies. It requires agencies to submit annually to the Office of Management and Budget, and Congress, a systematic plan for identifying and addressing policy questions. The plan must include, among other things, the data that agencies intend to collect to facilitate policymaking; methods and analytical approaches that the agency will use to develop evidence; and any statutory or regulatory restrictions that limit access to the data. Each agency must designate senior officials to coordinate evidence-collecting activities. And to make government data widely available to the public, the act requires the General Services Administration to maintain an online catalog that the public can use as a single point of entry—or one-stop shop—when searching for data that federal agencies collect.

Creating an infrastructure for evidence building, and collecting, organizing, and distributing data was the necessary first step for improving decision-making. But the next step—the one the rest of this article explores—is how decision-makers at all levels of government use data and evidence to inform policy. That may sound like a topic suitable only for statisticians, political scientists, and other number crunchers. But what government chooses to do—and not do—affects every American. From education funding to protecting medical privacy, and from what goes on a food label to deciding where oil can be drilled for on public land—government policy on all levels affects and sometimes determines how we live, work, learn, and communicate. And perhaps most important, many of the policy choices that legislators and officials make today will determine the quality of life for future generations. Will they inherit a healthier, safer, better educated, and more economically productive nation? The answer to this and countless other policy questions depends on evidence and the willingness of decision-makers to follow that evidence wherever it leads.

> **AND PERHAPS MOST IMPORTANT, MANY OF THE POLICY CHOICES THAT LEGISLATORS AND OFFICIALS MAKE TODAY WILL DETERMINE THE QUALITY OF LIFE FOR FUTURE GENERATIONS.**

Fig 2



There is no perfect system for turning science and data into effective policies. But it is certainly accurate to say that decision-makers need the best available information relevant to the problem they're trying to solve—and that scientists can provide that information through rigorous research that is accessible and usable by policymakers. The act is an important step forward, but the history of policymakers—including at the state and local level—working with the science community did not begin with the federal legislation. The Pew Charitable Trusts, for example, has a long record of bringing scientists and decision-makers together to identify the relevant policy questions and then collecting data and doing research that states have used to make evidence-based policies about issues ranging from public safety to consumer finance and ocean conservation.

In addition to Pew's work, there are many real-world cases of science and data informing policy. Lawmakers wanted to reduce alcohol-related car accidents and death. Peer-reviewed research in the early 2000s across several states showed that decreasing the legal limit for drivers' blood alcohol concentration to 0.08% cut traffic fatalities by about 7%. Using this data, some states moved ahead and mandated that anyone operating an automobile above the limit of 0.08% could be charged with driving under the influence. Meanwhile, at the federal level, there was no corresponding national mandate for what constitutes drunken driving. But Congress did use the same data to come up with a new policy. Through legislation, it tied federal highway funds to a state's willingness to use the 0.08% benchmark. That incentive prompted all 50 states to adopt the limit.

Science does not always—or even primarily—inform policymaking with the mathematical precision that was available in the case of blood alcohol levels. Policy is usually made over much longer timelines, with a larger body of evidence, in an iterative process. That means developing a body of evidence—say, to improve a government service—that is adjusted, expanded, or reconsidered in subsequent versions as scientists continue their research and learn more about the problem they're trying to understand and solve. In doing so, the research community ends up with data that has accrued over many years, along with a better understanding of what works and what doesn't.

This may be especially true in the social sciences where research—in a step-by-step refinement of data—helps policymakers over time adjust programs and steadily improve outcomes. That's where social policy research has been for many years and remains today: developing evidence-informed policies often using the same methodology of randomized control trials that biomedical and other hard sciences are well known for.

For example, there's been a lot of research over the past 20 years trying to understand how best to train workers—with two goals in mind. First, to help workers gain employment, succeed in the workplace, and increase wages. And, second, to meet the needs of employers as the economy changes and becomes more global. To achieve these goals, there has been a significant change in the questions that social science research is trying to answer. Historically, the focus was on the worker—his or her skill set; ability to prepare a résumé and perform well in an interview; and how to succeed in the workplace. This was the supply side. Now attention is being paid to the demand side; that is, researching the optimal way to train workers so their skills and career track match the evolving needs of employers.

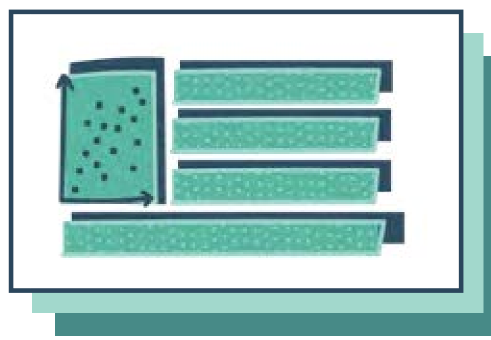
One approach to the demand side has been to connect the higher education system with the workforce training system and then develop a career path for specific sectors of the economy. This approach gives workers the technical training and experience they need—along with support such as child care—and the opportunity to earn an academic credential that puts them on a pathway to greater success. In the health care sector, a person can enter a training program to become a health care aide, join the workforce for on-the-job experience, and then enroll in higher education classes and earn an additional certificate or credential.

More than a decade of research, using randomized control trials—where some workers are in programs that connect academic training, work experience, and services, and others are not—has shown that this comprehensive approach can lead to better outcomes for workers because they're more likely to get employed, stay employed, and earn higher wages. But just as important, they're developing a base of knowledge that the national economy needs and that employers can rely on over the long term.

This research is changing the workforce training policies of state and local governments. But it is also informing federal policy. In 2014, Congress reauthorized the Workforce Innovation and Opportunity Act, which now requires workforce centers throughout the United States to collaborate with adult education and postsecondary education partners to build a career pathway for workers—not just teach a discrete skill.

In addition to workforce training, the federal government and some state governments are using financial incentives to move states toward evidence-based policymaking in several other programmatic areas, including education, home visiting, and teen pregnancy. One example is tiered-evidence grants, a funding

THAT'S WHERE SOCIAL POLICY RESEARCH HAS BEEN FOR MANY YEARS AND REMAINS TODAY: DEVELOPING EVIDENCE-INFORMED POLICIES OFTEN USING THE SAME METHODOLOGY OF RANDOMIZED CONTROL TRIALS THAT BIOMEDICAL AND OTHER HARD SCIENCES ARE WELL KNOWN FOR.



— fig3

mechanism that incentivizes the use of evidence-backed practices by tying the majority of funding to programs already backed by science. But the officials implementing these programs are also given the opportunity to innovate because the goal is to use the best current evidence while leaving room to experiment and build new evidence. Examples of tiered-evidence grant programs include the Department of Education's Education Innovation and Research program; the Department of Health and Human Services' Teen Pregnancy Prevention program and Maternal, Infant, and Early Childhood Home Visiting program; and the Department of Labor's Workforce Innovation Fund.

The iterative process of building a large body of evidence through innovation, experimentation, reconsideration, and peer review that decision-makers use to create effective policies often takes years. However, there are times when the need for speed and innovation competes with the equally important priority of adhering to a methodical research process that ensures rigor and certainty. That's what we're facing with COVID-19. Today, scientists around the globe are sharing data and information as they race to learn about COVID-19 and possible treatment approaches. The science is progressing at a rare—and possibly unprecedented—speed. But this rapid pace of discovery highlights the challenge of balancing the urgency to develop treatments and a vaccine against the typically long timeline of rigorous research, which usually calls for coming up with a hypothesis, testing that hypothesis, vetting discoveries through a process of peer review, and carefully communicating what's known and unknown to the public.

In the months since the COVID-19 outbreak was identified as a pandemic, the biomedical science community has been learning how to achieve that balance. In doing so, scientists are able to give policymakers the data they need to protect public health. And again, because this is an iterative process, as more data comes in, decisions about masks, testing, social distancing, community spread, immunity, antibodies, vaccines, and more can be refined. As for the need for urgency, that challenge is being addressed by increased collaboration among scientists, data sharing, and having multiple people from different fields working on the same problem.

Science informing public policy did not begin with federal legislation or the COVID-19 pandemic. It is a process that's been evolving and growing for several decades in both the natural sciences and social sciences. So where does evidence-based policymaking stand now? There is certainly more data being collected and more ability to share and access that data. And coupled with this change is a bigger one: the ability to harness data through artificial intelligence, machine learning, and big computing. These trends and patterns began before COVID-19, but the pandemic has certainly made them easier to see. And here is another trend that is a very positive development for decisions informed by science: greater public interest in—and understanding about—how scientists conduct and ensure the validity of their research, and the impact that research has on the lives of our citizens and communities.

As in "Apollo 13," policymaking cannot be based on guesswork. It is with relevant, rigorous research that is continuously refreshed as more data comes in, and then shared around the world, that we will find the best answers to our greatest challenges and build a safer and healthier future for generations to come.

THE TAKEAWAY

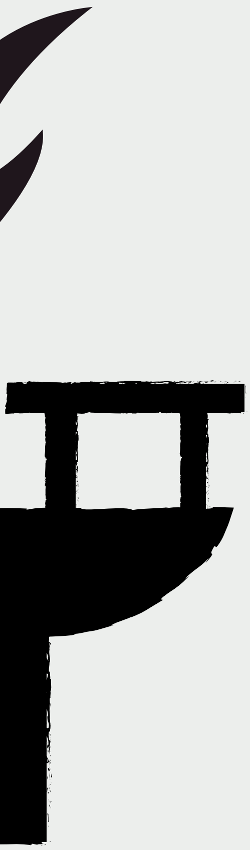
Good public policy depends on data and evidence, and on the willingness of decision-makers to follow them wherever they lead.

Delivering Science in a Crisis

Lessons from science's role in the response to the Deepwater Horizon disaster can guide research during the pandemic.

BY MARCIA MCNUTT

ILLUSTRATIONS BY CARA BAHNIUK/
THE PEW CHARITABLE TRUSTS



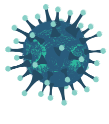
The COVID-19 pandemic has taken a heavy human toll all over the world; at this writing, more than 1 million people have died, and more than 40 million have been infected. As winter approaches in the Northern Hemisphere, cases are alarmingly on the rise again in the U.S. and Europe. The virus has disproportionately affected racial and ethnic minorities in the U.S. and other countries, exposing long-standing economic disparities and inequities in health care. The U.S. is experiencing extreme unemployment. Researchers have mobilized as never before to develop COVID-19 vaccines and treatments. But it could be many more months before effective vaccines are widely available. In the meantime, students and teachers have returned to school, either virtually, in person, or a mix of both, and national, state, and local decision-makers are making difficult choices about how to balance the protection of public health and safety with the restoration of critical societal functions. Society is depending on science to deliver us from this health, social, and economic crisis.

An obvious role for science is to develop novel vaccines and effective therapies, and in that pursuit, biomedical research has retooled diverse laboratories toward this singular problem. But there is a broader array of answers we need from science to see our way forward—for example, how to mitigate the spread of the virus, prevent a recurrence, and design a more resilient future for humanity. To effectively provide these answers, we must recognize that science in crisis is special. There is an urgency to act, because faster action will save lives. But science in crisis is also science in a crucible, its results tested by fire—not in a lab, but with the world watching. Here I offer a framework for providing answers based on experience developed with my colleague Gary Machlis during the Deepwater Horizon oil spill in 2010. (I was director of the U.S. Geological Survey at the time; Machlis was science adviser to the director of the National Park Service.) At the National Academies of Sciences, Engineering, and Medicine, we are now embracing this framework to address the COVID-19 pandemic.

In the early days of the crisis, national leaders needed to make informed decisions on short notice. They needed actionable science, defined as science delivered to a decision-maker that is timely, understood by the nonscientist, provided in the context of the decision at hand, of the highest standards that timeliness allows, and meaningful—in terms of safety, economics, health, welfare, security, or any other values that matter to society. At the National Academies, our standing committee on emerging infectious diseases has provided actionable science to the U.S. government on topics such as the effectiveness of homemade face masks, the costs and benefits of social distancing, crisis standards of care, and the seasonality of the virus.

And because the pandemic has an immediate impact on almost all aspects of daily life, we partnered with the National Science Foundation to launch a network that has brought the full range of scientific expertise across the social, natural, and biomedical sciences, providing actionable science on issues such as testing strategies on college campuses, how COVID-19 data points should be used in decision-making, and how to encourage cooperation with contract tracing and protective behaviors such as wearing masks.

The guidance, intended for decision-makers at the federal, state, and local levels, draws on research from communications, social psychology, and behavioral economics as well as lessons learned from successful public health campaigns such as tobacco prevention and seatbelt use. The network is poised to address these and other questions that are being raised by mayors, governors, local representatives, and other leaders.

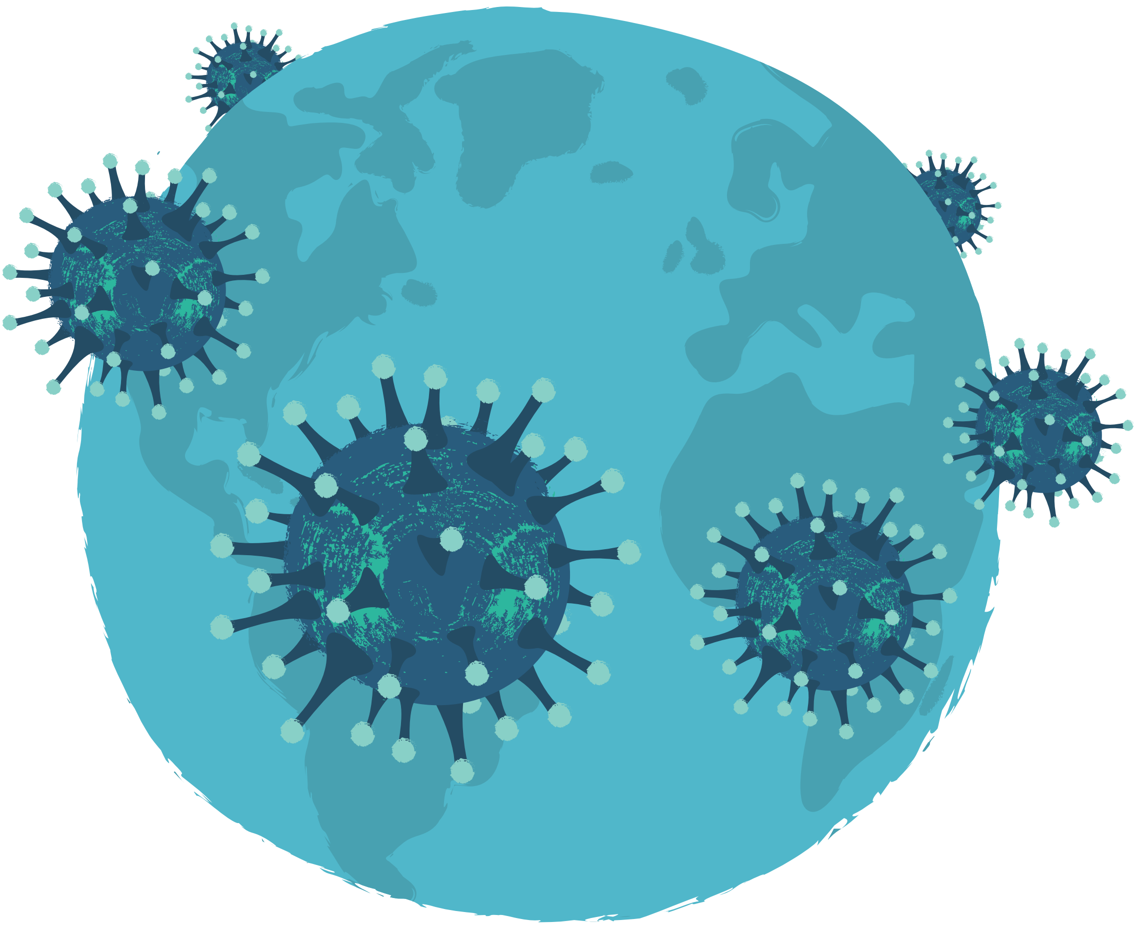


Although much focus in the early days of a crisis is by necessity on actionable science, it is also important to plan for the longer term. Whereas it took mere weeks for the coronavirus to upend almost every sector of society, it is looking increasingly likely that a full recovery could take years. For the foreseeable future, policymakers and communities will struggle to make decisions now that position them well for an uncertain future: Even with vaccines available, will COVID-19 be with us for the long term, like the seasonal flu or the measles? For this type of longer-term planning, strategic science involves interdisciplinary teams of scientists, engineers, and medical professionals planning for a range of possible future scenarios, along with estimating their uncertainties and considering their potential consequences for health, the environment, the economy, and infrastructure. The scenarios allow decision-makers to invest resources to prevent a long-term legacy of problems that cascade, in this case, from the virus, to people's health, to society, to national economies, and even to global political stability.

The National Academies as an organization is well positioned to provide strategic science, and we have launched a major initiative in this area. We have the capacity to convene experts across the full range of natural, life, environmental, and social sciences; engineering; and medicine. And those experts, in turn, can reach out to more colleagues to provide additional expertise as scenarios develop. The beneficiaries of scenario planning could be federal agencies; national, state, and local governments; nongovernmental institutions; and even private industry.

One of our new initiative's first topics is to examine how the pandemic could affect rental property evictions and the impact on low- and middle-income communities and disadvantaged groups. Other topics for analysis include the cognitive development and educational attainment of K-12 students who are low-income or have special needs and an examination of the nation's food supply chain. Or, as the pandemic wears on, strategic science could be used to weigh a range of scenarios that could ensure that the capacity of research universities—major stimulators of innovation, ingenuity, and economic growth—is maintained in an era of severe financial challenges and fiscal constraints.

As we fight this worldwide emergency, employing actionable, strategic, and irreplaceable science can help society recover from this crisis and also emerge better positioned to respond to inevitable future challenges for many generations to come.



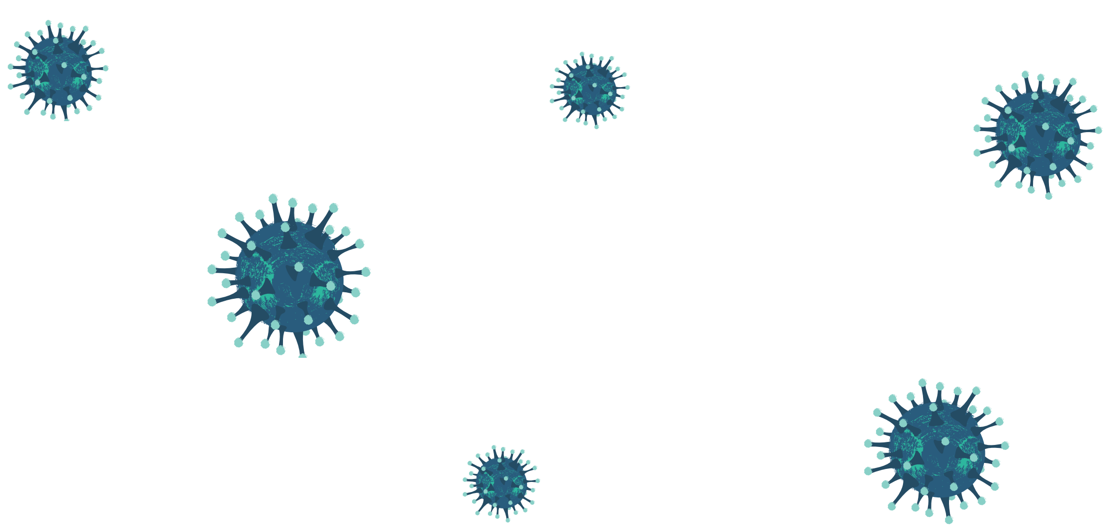
Although no one would wish a pandemic on a society—or a major oil spill for that matter—crises provide an opportunity to conduct irreplaceable science. This is a special type of research that takes advantage of the unusual conditions existing during a crisis, requires rapid response by funders and researchers, is constrained by a requirement not to interfere with response efforts or actionable science, and poses challenges for scientific reproducibility. The results might, or might not, be directly relevant to the solutions to the crisis at hand.

For example, no scientist would be able to devise an experiment in which a large fraction of the global population is asked to socially distance for months, but now that it has happened, it is important to understand the impacts on mental health, family relationships, and the social fabric of society. Such knowledge will be valuable in understanding how best to respond to a second wave of COVID-19 or another pandemic.

In another example, ocean scientists have been hoping to organize a "quiet day" for the ocean—a 24-hour period of relative silence from the cultural noise of human disturbance. Instead, thanks to the pandemic, they got months of relative quiet to observe the impact on marine life of turning down the noise level in the ocean. Although most irreplaceable science will be done by researchers at universities and other labs, I see a role for the National Academies in helping to identify important opportunities for irreplaceable science and in integrating the results where appropriate into actionable and strategic science.

The COVID-19 pandemic is the classic example of a problem that we will not solve anywhere until we solve it everywhere. This framework of actionable, strategic, and irreplaceable science (and with that I include engineering and medicine) will bring much-needed focus and cohesion to public- and private-sector research efforts related to the pandemic and encourage collaboration and cooperation in the United States and around the world. We've already seen many examples of scientists teaming up across borders in new ways to work on developing vaccines and treatments. During an era of growing nationalization, researchers must resist that constriction and continue to share knowledge so that lessons learned in one country can inform response and recovery in other nations.

Our national and global research enterprise houses the expertise to conquer the pandemic and at the same time help shape a stronger, better prepared nation and world. As we fight this worldwide emergency, employing actionable, strategic, and irreplaceable science can help society recover from this crisis and also emerge better positioned to respond to inevitable future challenges for many generations to come.



THE TAKEAWAY

Although much focus early in a crisis is by necessity on actionable science, it is also important to plan for the longer term.

HOW TO MAKE SCIENCE WORK QUICKER—AND BETTER

We are in a golden age of innovation in biomedical science, but there is so much else that could be accomplished for patients.

BY ESTHER KROFAH

ILLUSTRATIONS BY ALLIE TRIPP/
THE PEW CHARITABLE TRUSTS

By any measure, this is an exciting time in biomedical science, and we are entering a golden age of discovery. Among the major advances in recent years, the sequencing of the human genome has opened up possibilities that are breathtaking, and we are learning to target specific biomarkers in patients to protect them against specific kinds of disease. Science today was science fiction in what seems like just yesterday.

The hard fact, however, is that we could be moving faster. For all of our successes, the pace of biomedical advancement is too slow for too many patients. In many cases, it takes decades—30 years or more—to move a new idea from the lab bench to the bedside. What should be an efficient system of drug development is fragmented.

New therapies and even cures could be accelerated if all of the stakeholders—academic researchers, pharmaceutical companies, government regulators, and patient advocacy groups—established better policies and procedures for working cooperatively.

The problem is not innovation; we have never had so many talented scientists doing so many amazing things. The problem is the many hurdles that innovation must cross to reach the marketplace and help the patients who need treatment.

At Faster Cures, the Milken Institute project I direct, we see three major areas where improvement is needed—and where progress can be achieved. The first need is to listen to what patients can teach the scientific and medical community. We call this elevating the patient's voice. It used to be thought that if you asked patients what they wanted and needed in treatment, it would slow things down. We think it will move things faster.

We need to create a more permanent place at the decision-making table for disease foundations and patient advocacy groups—such as the Juvenile Diabetes Research Foundation, Parent Project Muscular Dystrophy, or the Michael J. Fox Foundation for Parkinson's Research—that may know better than laboratory scientists what disease sufferers are dealing with and what will help them. The CEOs of such nonprofit organizations should join the national dialogue for speeding up treatments and improving health.

Some groups, notably the Cystic Fibrosis Foundation, have successfully helped produce treatments by funding research that no one else in the drug development pipeline would tackle. Even more could be achieved with cooperation across the system. We have seen the real results of this type of cooperation in the development of COVID-19 vaccines.

Patients, for instance, want to take part in trial studies for potential new drug therapies. But they often can't find them. Pharmaceutical companies, in turn, need patients to participate in trials.

But they often can't find them easily. Closer relationships and community partnerships would help connect them.

A second area that needs to be addressed is creation of greater incentives for the pharmaceutical industry to invest in promising drugs that may not have potential for big profits—that won't ever become blockbuster drugs, in the parlance of Wall Street. Some of these may be treatments for rare diseases with relatively small patient populations. A cancer therapy that could benefit millions of people will always get funded; a treatment for a disease with a few thousand patients might not.

In some cases, potentially helpful drugs with low profit potential end up sitting on the shelf and are never pushed to market. The insider jargon for these innovations is deprioritized assets. But what if the government could provide incentives for companies to move these ideas forward? What if a government lab or a government-funded research partnership took them on? How much funding should Congress give to the National Institutes of Health to incentivize research collaborations? What does the Food and Drug Administration need to support such efforts?

A CANCER THERAPY THAT COULD BENEFIT MILLIONS OF PEOPLE WILL ALWAYS GET FUNDED; A TREATMENT FOR A DISEASE WITH A FEW THOUSAND PATIENTS MIGHT NOT.

The Milken Institute has begun to innovate in this area with the Bridge Initiative, which seeks to bring together companies that have deprioritized assets with new partners in order to move shelved ideas to the marketplace.

And then there is the issue of information sharing. How can we incentivize sharing among lab scientists, drug companies, and others who may be working separately but simultaneously on the same problem? Can we start by creating data-sharing platforms where stakeholders may learn about and build on the efforts of others?

All of this is being thought out and worked on, but the effort needs to quicken.

The third area that has the potential to speed up treatments and cures is better use of technology—not only what we may develop in the future, but what we already have.

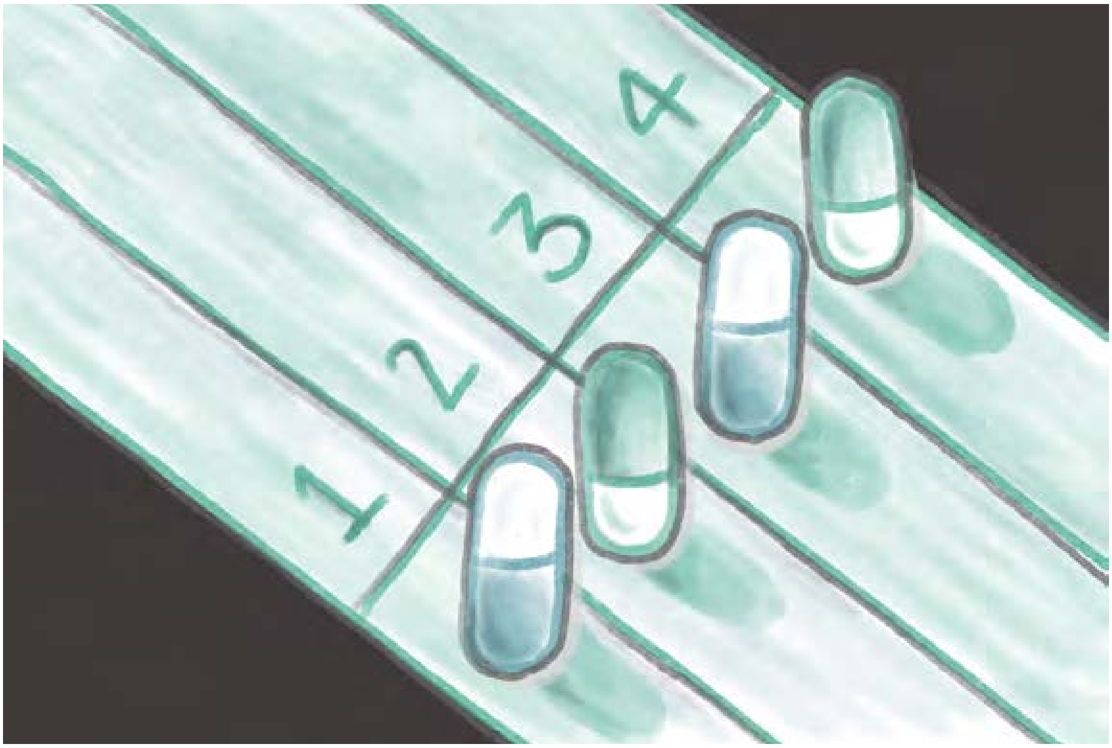
We have seen in recent years what the digitization of medical records can do. A top specialist at a university hospital in Philadelphia, let's say, can now easily look at the MRI ordered by a physician at a community hospital in small-town Pennsylvania and quickly collaborate on a patient's care.

The coronavirus crisis, while restricting in-person patient visits, has shown us the benefits of video appointments and telemedicine. Following the example of the Centers for Medicare & Medicaid Services, which changed its policies to better cover telemedicine, private insurers are now fairly reimbursing doctors for this kind of patient care.

Electronic health data is also helping rural and small-town patients participate in those clinical trials heretofore available only to patients near university hospitals. Not only can this help patients, but it can expand researchers' knowledge by giving them a greater diversity of people in many situations to look at. These efforts unfortunately are too limited and not scaled across the country.

Remote participation technology, of course, is not the only area where we can capitalize on tech advances. We can point to innovative cell and gene therapies that use viral vectors to enable scientists to edit a gene and then put it back into a patient to correct for illness. Children suffering from spinal muscular atrophy who lose motor function over time, for example, now have the potential for a cure through new gene therapy that targets the underlying genetic root cause. That's incredible, and there is so much more that we can speed to development for diseases once thought incurable.

The response to the coronavirus pandemic may become a model for what could occur in the future in many areas of biomedical science, because so much of what is happening addresses many of the issues I've been describing. For example, Operation



Warp Speed, the federal government's step-up-the-pace plan to produce hundreds of millions of doses of COVID-19 vaccine by early 2021, provides incentives and mandates for collaboration among stakeholders. Researchers have been sharing information among themselves. And scientists and companies are sharing their data in real time with FDA, so they can align on the design for clinical trials.

Speed, of course, needs to be accompanied by caution and ethical considerations. The overwhelming pressure for the biomedical science community to produce vaccines in the shortest possible time has made the effort seem like a race, prompting fears that shortcuts are being taken. Polls suggest that one-quarter of Americans may be leery of taking a vaccine, at least in the early stages of distribution. Trust is particularly low for many in the African American population because of many decades of neglect in health care.

The big question is, how do we ensure trust in a vaccine? How do we engender confidence that FDA is making decisions not for reasons of politics or haste, but for safety and efficacy?

Someday—we think, we hope—the coronavirus crisis will be behind us. Then the challenge will be applying the lessons we have learned about collaboration and breaking down barriers to other urgent needs in biomedicine. From Congress to regulatory agencies, to academic researchers, and among private industry, we will need to capitalize on this opportunity to change the structures that put up barriers to biomedical advances.

For despite our incredible discoveries, there is still so much to be done. The hunt for a new generation of antibiotics to fight infections is a prime example of where new thinking is required.

Because of the overuse of prescription antibiotics, dangerous microbes are becoming more and more resistant to the antibiotics on which we have long relied. We are depending on drugs developed decades ago, with few new alternatives being brought to market. Yet we also are seeing projections that superbugs, immune to antibiotics, could evolve and kill millions worldwide if we don't create new defenses. Sadly, 700,000 people a year globally are already dying as a result.

We need greater incentives to promote the development and manufacturing of a whole new class of antibiotics. There are any number of small biotech companies that have invested in new antibiotics, and there are large companies that would be ready to do so if they saw good profit potential.

Ironically, one major hurdle is that our old reliable antibiotics are so cheap. Anyone with an ear infection or bronchitis knows these drugs are among the most affordable medications, often selling for cents on the dollar compared with what they used to cost.

When there is a new class of antibiotics, the cost of treatment could be exorbitant by comparison—in the many thousands of dollars, at first. Insurers won't want doctors or hospitals to prescribe them except as a last resort. That may be understandable from a financial standpoint, but it's also an example of a broken market.

Antibiotic resistance, it should also be noted, is a key area where we need to listen to the experiences of patients. Some patients already are dealing with drug resistance. Cystic fibrosis sufferers, for example, regularly get infections, and they especially would benefit from new, more effective medications.

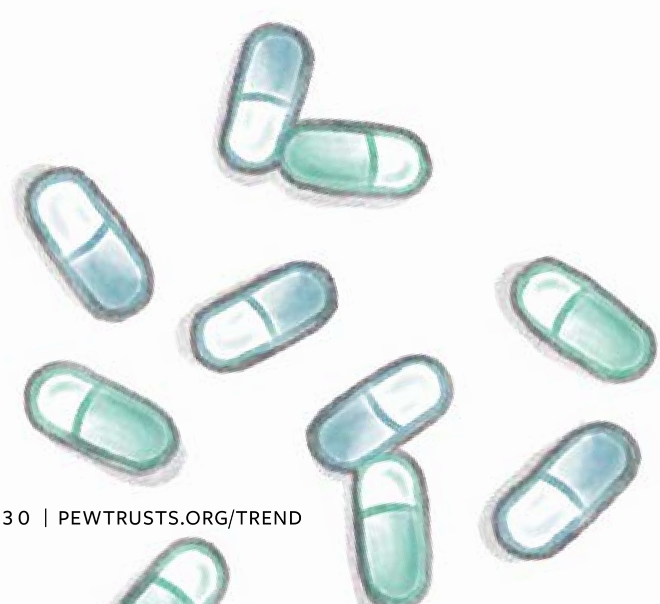
None of what I'm describing will be easy to accomplish. But few important advances are easy—they require work and creativity and cooperation. We are witnessing those requirements now as we navigate our way through the pandemic.

WE NEED GREATER INCENTIVES TO PROMOTE THE DEVELOPMENT AND MANUFACTURING OF A WHOLE NEW CLASS OF ANTIBIOTICS.

The experience garnered from this difficult time as well as the obvious benefits that would result from the changes we should seek make me an optimist. I do think we are going to fundamentally change the way we approach medical research in the future.

But I am also a realist. What happens when the urgency of the COVID-19 emergency is over? That is when we will need to make permanent some of these temporary collaborations.

Will we go back to the old way of doing things when COVID-19 is gone? Or will we learn from it? Now is the time to turn the lessons of today into the practices of tomorrow. We must do this for the long-term benefit of humankind.



THE TAKEAWAY

To speed cures, we must listen to patients, incentivize development of drugs without high-profit potential, and improve technology for remote treatment.

From Science to Policy to Practice

Science can and should influence policies that make our lives healthier—but it can require patience along the way.

BY DAVID SATCHER

ILLUSTRATIONS BY CARA BAHNIUK/THE PEW CHARITABLE TRUSTS

Science, at its best, leads to changes in policy that make everyone's life better. But science alone cannot shape policy; policy is also influenced by politics, opinions, deeply held beliefs, and advocacy.

As surgeon general, I based all of my reports on the best available public health science, but they did not always lead to a change in policy. Sometimes that takes years. We know, for example, that even after 1964's "Smoking and Health: Report of the Advisory Committee of the Surgeon General of the Public Health Service" documented concerns about cigarettes, it was not until 1972 that tobacco advertising was prohibited, and it was another 22 years before California became the first state to prohibit smoking in public places; as of March 2019, 28 states have such laws.

This dynamic interaction among science, policy, and practice is basic to progress in lifestyle and healthy living. In the area of smoking and health, we have perhaps had the most experience and made the most progress, but there are many other examples. It is because of science that we have vaccines that have eliminated and even eradicated diseases. It is because of science that we have reduced deaths from cardiovascular disease and cancer and diabetes. It is because of science that we can help people with "unquiet" minds, such as those with bipolar disease, lead productive lives.

What those experiences have taught us is that in the face of political or ideological influences, it is important to continue to mount the scientific data and arguments in pursuit of policy change. But understanding where science can have the most impact is equally critical. In 2009, the World Health Organization's Commission on Social Determinants of Health, on which I served, reported after a worldwide study that social determinants of health—the conditions into which people are born, live, grow, learn, work, age, and die—had a much greater effect on health outcomes than did health care.

For example, predominantly White neighborhoods have four times more supermarkets than predominantly Black neighborhoods, and we know that people who live in communities with poor access to affordable fruits and vegetables are more likely to suffer from obesity, diabetes, and other diet-related problems than those who live where healthy and nutritious food is readily available. Yet such conditions are controlled by money, power, and influence and can be changed only when policies that affect them are changed.

It is perhaps in regard to social determinants of health that science, especially when wielded by effective leadership, can be most instrumental in driving new policy and improving lives. Leadership can intervene to improve the health of individuals and communities at three key points: downstream, midstream, and upstream. Downstream is the level of individual health that can be improved through education, science, and medicine. Midstream is the community level and involves mitigating environmental threats, such as lead and other toxins; providing safe places for physical activity; and ensuring that institutions, such as schools and workplaces, promote the health of those who use them. Upstream is where policies are made that affect what happens midstream and downstream.

I always emphasize that these are not places, but functions. Policies are often made in the home or school, not just in the houses of government. And the arrow goes both ways: What happens downstream, whether science, practice, health care, or education, can lead to enhancements in policies from upstream. For instance, the Quality Parenting Program at the Satcher Health Leadership Institute at the Morehouse School of Medicine evaluates its impact on participants in the hope that the findings will influence policy and lead to investments to improve children's well-being, development, and school readiness. And indeed, the National Institutes of Health has already responded to outcome data showing a reduction in depression among participating Black mothers by supporting the program's replication in 12 states. Thus, a practice downstream, when properly documented, can improve policies upstream.

In particular, public health and public health science are especially important to this process of improving the health of individuals and communities and the policies that affect them. In 1988, the Institute of Medicine, now the National Academy of Medicine, defined public health as "the collective efforts of a society to create the conditions in which people can be healthy." I have come to embrace this definition, with the understanding that "the conditions" rely on the right policies being in place. And with the newfound appreciation for the importance of social determinants of health, the definition takes on new significance. In 2005, colleagues and I published an article titled "What If We Were Equal?" in the journal *Health Affairs*. In it, we attempted to define the magnitude of health disparities in the United States by comparing the mortality rates of African Americans with those of White people, and we were able to show that if those rates had been equal in the 20th century, 83,500 fewer African Americans would have died in the year 2000 alone. In light of the WHO commission's report on social determinants of health, those findings are given new focus, most notably that relative physical inactivity is virtually predetermined in communities that lack safe places to be physically active, just as the absence of grocery stores limits access to fresh fruits and vegetables.

This same broadening understanding of social determinants of health has informed significant policy agendas. Each decade, the U.S. Department of Health and Human Services releases its Healthy People goals, which outline the nation's public health objectives and tools for measuring progress. The major difference between the goals of Healthy People 2010 and Healthy People 2020 is that the 2020 document incorporated social determinants of health in terms of problems and solutions. Similarly, WHO set the goal of "global health equity" and began working toward it. The evolution of the Healthy People initiative and of WHO's efforts shows that, although science is not definitive and does not have the final word in policy debates, we still must continue to do the science and repeat studies. When people come together to listen to and hear each other and try to arrive at reasonable decisions, make important decisions, or invest significant resources that promote societal health, they generally want to know what the science shows.

Science is rigorous and begins by defining critical questions for pursuit. And it never ends; one set of questions generally leads to the proposition of another set of questions. Since the surgeon general's report of 1964 showed that smoking was associated with lung cancer and heart disease, we have continued to learn more about the harmful effects of smoking, and scientific research has informed new policies and practices. In 1970, President Richard Nixon signed a law banning the advertisement of tobacco on television and radio. In 1995, California outlawed smoking in public places. Later, science determined that almost 90% of adult smokers became addicted by age 18, which eventually led to a policy forbidding the sale of

IT IS IMPORTANT TO CONTINUE TO MOUNT THE SCIENTIFIC DATA AND ARGUMENTS IN PURSUIT OF POLICY CHANGE. BUT UNDERSTANDING WHERE SCIENCE CAN HAVE THE MOST IMPACT IS EQUALLY CRITICAL.

tobacco to children. And between 2000, when I released the surgeon general's report on women and smoking, and 2014, when the 50th anniversary surgeon general's report came out, at least six new health defects associated with smoking had been reported.

And though the science never ends in any public health arena, there comes a point when the evidence is strong enough where we must insist that our practices adapt to our current science. Surgeon General Luther L. Terry did this in 1964 when he declared that the evidence of a link between smoking and lung cancer and cardiovascular disease was overwhelming. That declaration led to new policies and practices, and as a result smoking in the United States declined from 42% in 1965 to 14% in 2017.

Today, the decline continues, not only in our country, but globally. In 2003, the WHO Framework Convention on Tobacco Control, a global tobacco control treaty, led to a worldwide policy related to exposure of children to smoking. Now, even in developing countries, smoking is declining and lives are being saved because over the years science builds on science.

Nevertheless, I am certain that there are still people who don't agree that smoking is harmful to health. They are influenced by deeply held beliefs, by money, and certainly by the political process. The practice of smoking has not been easy to influence, despite the science. Similarly, my Surgeon General's Prescription in 2000 was an attempt to inform Americans and urge them to be more physically active, consume more fruits and vegetables and fewer fats and sweets, and avoid toxins such as tobacco and illicit drugs. But it is clear to me now that, rather than focusing mainly on the upstream policy, the best way to deal with these behaviors is to use science to drive changes in the social determinants that directly affect decisions made downstream and midstream—to remove barriers to healthy choices; provide incentives for physical activity, good nutrition, and smoking cessation; and ensure that communities are safe and provide the facilities that individuals need to live healthy lives.

This is, appropriately, a circular process of new science, new policy, better practices, and new questions arising from observation and practice. Yet the question that gives rise to that science may begin with a practice as the basis of concern, or it may be a policy, and those concerns and questions often lead to new science. The dramatic decline in physical education in schools between 1980 and 2000 was thought to be good for academic rigor and performance. Upon closer examination, however, a commensurate increase in obesity was taking place, including a tripling among children. The science also revealed that children who were physically active and ate a good breakfast performed better academically. Thus, examination of practice and the policies behind them revealed that they were out of step with good science. In this way, the science-policy-practice cycle, though sometimes slow and rarely smooth, continues to build our knowledge and help us thrive.

Medicine is a science in the sense that we are committed to practice that which is consistent with the state of science. We never stop asking questions, and over time our practice improves. Today, we do not diagnose or treat diabetes and hypertension the way we did when I was a student. We have developed new science, and it has reshaped our practice.

One of the beauties of science is that it always welcomes new questions, debates, and challenges. The scientific process must always be open and be opening new horizons in our minds, our lives, and our environments.

THE TAKEAWAY

The dynamic interaction between science, policy, and practice is basic to progress in healthy living.

On the Intersection of Science and Religion

The relationship between science and religion is often viewed in a Western context and through a Christian perspective. We turned to Muslims, Hindus, and Buddhists for a different view.

BY COURTNEY JOHNSON, CARY LYNNE THIGPEN, AND CARY FUNK

ILLUSTRATIONS BY GABY BONILLA/THE PEW CHARITABLE TRUSTS

Over the centuries, the relationship between science and religion has ranged from conflict and hostility to harmony and collaboration, while various thinkers have argued that the two concepts are inherently at odds and entirely separate.

Pew Research Center surveys have documented those trends over more than a decade in the United States. We found that 56% of Americans say there generally is conflict between science and religion but that this sense of tension is more common among the religiously unaffiliated— those who describe their religion as atheist, agnostic, or "nothing in particular." The survey showed that just 16% of Christians in the U.S. say their religious beliefs "often" conflict with science; another 3 in 10 say such conflict sometimes occurs.

We've also examined views on a range of issues in which science and religion might be flashpoints. On evolution, for example, we found that a majority of Catholics believe humans evolved over time, as do a similar number of White mainline Protestants, but far fewer Black Protestants and White evangelicals hold this view.

Our research and much like it from other sources has taken place in a Western context, primarily through a Christian lens. More recently, we sought to better understand the ways in which science relates to religion around the world and engaged a small group of Muslims, Hindus, and Buddhists in Southeast Asia to talk about their perspectives.

The discussions reinforced the conclusion that there is no single, universally held view of the relationship between science and religion among the three religious groups, but they also identified common patterns and themes within each one. For example, many Muslims expressed the view that Islam and science are basically compatible, though they acknowledged some areas of friction, such as the theory of evolution conflicting with religious beliefs about the origins and development of human life on Earth.

Hindu interviewees generally took a different tack, describing science and religion as overlapping spheres. Many Hindus maintained that their religion contains elements of science, and that Hinduism long ago identified concepts that were later illuminated by science. Buddhist interviewees generally described religion and science as two separate and unrelated spheres. Several talked about their religion as offering guidance on how to live a moral life while describing science as observable phenomena. Often, they could not name any areas of scientific research that concerned them for religious reasons.

Some members of all three religious groups, however, did express religious concerns when asked to consider specific kinds of biotechnology research, such as gene editing to change a baby's genetic characteristics and efforts to clone animals. For example, Muslim interviewees said cloning would tamper with the power of God, and some Hindus and Buddhists voiced concern that these scientific developments might interfere with karma or reincarnation.

These are some of the key findings from a qualitative analysis of 72 individual interviews with Muslims, Hindus, and Buddhists conducted in Malaysia and Singapore—two nations that have made sizable investments in scientific research and development in recent years and are home to religiously diverse populations—between June 17 and Aug. 8, 2019. The study included 24 people in each of the three religious groups, with an equal number in each country. All interviewees said their religion was "very" or "somewhat" important to their lives, but they otherwise varied in terms of age, gender, profession, and education level.

These interviews are not representative of religious groups either in their country or globally, but they do provide insight into how individuals describe their beliefs, in their own words, and the connections they see (or don't see) with science. We coded the responses into themes to avoid putting too much weight on any single individual's comments.

Muslims frequently described science and their religion as related rather than separate concepts and often said the Quran contains many elements of science. One 24-year-old Muslim man in Malaysia said both science and his religion explain the same things, just from different perspectives: "I think there is not any conflict between them. ... I still believe that it happens because of God, just that the science will help to explain the details about why it is happening."

Still others described the relationship as conflicted. "I feel like sometimes, or most of the time, they are against each other. ... Science is about experimenting, researching, finding new things, or exploring different possibilities. But then, religion is very fixed, to me," said a 20-year-old Muslim woman in Singapore.

When asked, many of the Muslims who were interviewed identified specific areas of scientific research that bothered them on religious grounds. Multiple interviewees mentioned research that uses non-halal substances (such as marijuana, alcohol, or pigs), some pregnancy technologies that they considered unnatural (such as procedures that use genetic material not taken from a husband and wife), or cloning.

Representative surveys of Muslims in countries around the world also have found variation in the share of Muslims who see any conflict between science and religion, although this share is less than half in most countries surveyed.

A Pew Research Center survey conducted in 2011 and 2012 that examined the views of Muslims found that, in most regions, half or more said there was no conflict between religion and science, including 54% in Malaysia. (Muslims in Singapore were not surveyed.)

The predominant view among Hindus who were interviewed is that science and Hinduism are related and compatible. Many of them offered—without prompting—the assertion that their religion contains many ancient insights that have been upheld by modern science, such as the use of turmeric in cleansing solutions, or the use of copper in drinking mugs. They said that Hindus have known for thousands of years that these materials provide health benefits but that scientists have confirmed only relatively recently that it's because turmeric and copper have antimicrobial properties. "When you question certain rituals or rites in Hinduism, there's also a relatively scientific explanation to it," said a 29-year-old Hindu woman in Singapore.

Still, many Hindu interviewees said science and religion are separate realms. "Religion doesn't really govern science, and it shouldn't. Science should just be science," said a 42-year-old Hindu man in Singapore.

Asked what scientific research might raise concerns or should not be pursued for religious reasons, Hindu interviewees generally came up blank.

The sense that Hindus generally see little conflict with science aligns with survey findings. In three of the four countries in the 2018 Wellcome Global Monitor with large enough samples of Hindus for analysis, majorities said science had "never disagreed" with the teachings of their religion, including two-thirds of Hindus in India, which is home to the vast majority of the world's Hindus.

Buddhist interviewees described science and religion in distinctly different ways from Muslims or Hindus. For the most part, they said science and religion are unrelated. Some have long held that Buddhism and its practice are aligned with the empirically driven observations in the scientific method; connections between Buddhism and science have been bolstered by neuroscience research into the effects of Buddhist meditation at the core of the mindfulness movement.

One 39-year-old Buddhist woman in Malaysia said science is something that relates to "facts and figures," while religion helps her live a good and moral life. A 26-year-old Singaporean Buddhist woman explained: "Science to me is statistics, numbers, texts—something you can see, you can touch, you can hear. Religion is more of something you cannot see, you cannot touch, you cannot hear."

To many of the Buddhist interviewees, this means that science and religion cannot be in conflict and have a compatible relationship.

Even when prompted to think about potential areas of scientific research that could raise religious concerns, relatively few Buddhists mentioned any. Among those who did, a common response involved animal testing, with the interviewees talking about the importance of not killing living things in the practice of their religion. The tenor of these comments is consistent with survey findings from the 2018 Wellcome Global Monitor. Majorities of Buddhists in all 10 countries with large enough samples for analysis said science has "never disagreed" with the teachings of their religion.

In the interviews, we asked about a number of subjects that have sometimes been seen as in conflict for some people in other religions. These included evolution, reproductive technologies such as in vitro fertilization, gene editing, and cloning.

Evolution raised areas of disagreement for many Muslim interviewees, who often said it is incompatible with the Islamic tenet that humans were created by Allah.

"This is one of the conflicts between religion and Western theory. Based on Western theory, they said we came from monkeys. For me, if we evolved from monkeys, where could we get the stories of [the prophet] Nabi? Was Nabi Muhammad like a monkey in the past? For me, he was human. Allah had created perfect humans, not from monkey to human," said a 21-year-old Muslim man in Malaysia.

A Pew Research Center survey of Muslims worldwide conducted in 2011 and 2012 found that a 22-public median of 53% said they believed humans and other living things evolved over time. However, levels of acceptance of evolution varied by region and country, with Muslims in South and Southeast Asian countries reporting lower levels of belief in evolution by this measure than Muslims in other regions. In Malaysia, for instance, 37% of Muslim adults said they believed humans and other living things evolved over time. Evolution posed no conflict for the Hindus interviewed, who said the concept of evolution was encompassed in their religious teachings. "In Hinduism we have something like this as well, that tells us we originated from different species, which is why we also believe in reincarnation, and how certain deities take different forms. This is why certain animals are seen as sacred animals, because it's one of the forms that this particular deity had taken," said a 29-year-old Hindu woman in Singapore.

The Buddhists interviewed also tended to say that there was no conflict between their religion and evolution and that they personally believed in the theory. Some added that they didn't think their religion addressed humans' origins at all.

There is limited global survey data on this issue. However, the Pew Research Center's 2014 Religious Landscape Study found that 86% of Buddhists and 80% of Hindus in the U.S. said humans and other living things have evolved over time, with majorities also saying this was due to natural processes.

In discussing scientific research using gene editing, cloning, and reproductive technologies such as in vitro fertilization, Muslim, Hindu, and Buddhist interviewees raised the idea that such practices may go against

MEMBERS OF ALL THREE GROUPS EXPRESSED RELIGIOUS CONCERNS WHEN ASKED TO CONSIDER SPECIFIC KINDS OF BIOTECHNOLOGY RESEARCH, SUCH AS GENE EDITING.

A COMMON THREAD IN THESE CONVERSATIONS POINTED TO THE IMPORTANCE OF NATURE AND RESPECT FOR LIVING THINGS.

the natural order or interfere with nature. As one 64-year-old Buddhist man in Singapore put it: "If you have anything that interferes with the law of nature, you will have conflict. If you leave nature alone, you will have no conflict." Similarly, a 20-year-old Muslim woman in Singapore said "anything that disrupts or changes the natural state" goes against religious beliefs.

Interviewees were asked to talk about their awareness and views of three specific research areas in biotechnology: new technologies to help women get pregnant, gene editing for babies, and animal cloning. People had generally positive views of pregnancy technology such as in vitro fertilization, although Muslim interviewees pointed out potential objections depending on how these techniques are used. Views of gene editing and cloning were more wide-ranging, with no particular patterns associated with the religious affiliation of the interviewees.

Individuals from all three religions generally approved of pregnancy technology and in vitro fertilization.

Some Muslim interviewees emphasized that they would be OK with these technologies only if certain criteria were met—specifically, if the technologies were used by married couples, and with the couples' own genetic material.

Some Hindus and Buddhists noted that they were comfortable with pregnancy technologies themselves. "I feel it is fine. It's still trying to get the balance of being a believer of a religion versus overly superstitious or believing too much in that religion that you forgo the reality of life going on," said a 37-year-old Buddhist man in Singapore.

Interviewees, regardless of their religion, said the idea of curing a baby of disease before birth or preventing a disease that a child could develop later in life would be a helpful, acceptable use of gene editing. But they often viewed gene editing for cosmetic reasons much more negatively.

Several interviewees brought up the idea of not agreeing with gene editing out of fear that people might want to Westernize their children. For example, some expressed the concern that gene editing would be used to create babies with blond hair and blue eyes.

Views of cloning were similarly conditional. Individuals from all three religions spoke of their disapproval of cloning for humans, with Muslims saying that cloning could interfere with the power of God, who should be the only one to create. But interviewees generally found animal cloning to be more acceptable. Many people interviewed envisioned useful outcomes for society from animal cloning, such as providing meat to feed more people, or helping to preserve nearly extinct animals.

When Hindus and Buddhists did express religious concerns pertaining to gene editing and cloning, it was because these scientific methods might interfere with karma or reincarnation. "Sometimes the person is born with sufferings, and it is because maybe previously he had been doing some evil things," said a 45-year-old Buddhist woman in Singapore.

Pew Research Center surveys in the U.S. find a strong relationship between levels of religious commitment and views on biotechnology developments, including gene editing. In a 2018 survey, majorities of U.S. Christians, including white evangelicals and other Protestants as well as Catholics, said that if the development of gene editing for babies entailed embryonic testing, it would be taking the technology too far. A common finding in Center surveys of Americans on emerging biotechnology issues such as gene editing for babies and animal genetic engineering is that public opinion depends on the use and effects of emergent technologies for society.

Conversations with Muslims, Hindus, and Buddhists enrich our understanding of the intersection of religion and science. Some Muslims saw evolutionary theory as being at odds with their beliefs about how Allah created human life, but Hindus and Buddhists saw no such tension with their religious beliefs. No area of scientific research was universally seen as off-limits, and most interviewees saw potential benefits from emerging developments in biotechnology such as gene editing and animal cloning. But a common thread in these conversations pointed to the importance of nature and respect for living things. People in all three religions raised concerns about scientific developments that could be seen as altering natural processes or used in ways that violate moral principles of their religion.

THE TAKEAWAY

There is no single, universal perspective on the relationship between science and religion. Science is often embraced by Muslims, Hindus, and Buddhists, though some raise concerns over how scientific developments could be used.

HOW HAS THE PANDEMIC CHANGED SCIENCE?

MANY SPECIES MAY DISAPPEAR BEFORE WE CAN LEARN ABOUT THEM

By Rima Jabado

As a marine scientist, I have been working to investigate guitarfishes and wedgefishes, which are among the little-understood species threatened with extinction.

These fish are fascinating. They are beautiful and gentle. They look like sharks, but they are actually rays. I consider them charismatic megafauna—large species that capture the imagination—but they haven't gained the wide attention that whales or dolphins have. We should know more about them, and we don't. They are disappearing quickly, and we have little time to act. That is why I have chosen to study them.

For 2020, I had big plans. I am a Canadian, but based in Dubai on the Arabian/Persian Gulf. I was planning to do field work in the United Arab Emirates and travel to India, Sri Lanka, and several countries across West Africa to work with government agencies, train field researchers, and talk with fishers. Fishers can be our allies in species conservation, if for no other reason than to protect their own livelihood. My team and I were building such a good relationship with many of them that they were contacting us about rare species they were catching.

But then COVID-19 happened.

The coronavirus pandemic shut down almost everything. I have mostly been unable to travel, unable to do training sessions for my research teams, unable even to go to the docks. As a result, we are going to see gaps in the data that we were collecting. We've lost so much time on so many things. Some of it can be regained; some of it cannot.

In 2019, we made major progress. The Convention on International Trade in Endangered Species of Wild Fauna and Flora regulated the trade of an additional 18 species of sharks and rays whose populations are quickly declining. Included were 10 species of wedgefish and six species of giant guitarfish.

We were helping governments implement these new controls. But now, amid the pandemic, we don't know what's happening. We don't have eyes on the ground. Fishers are still going out fishing, but there is no one there to enforce protections and monitor the trade. We don't know what is actually happening. In terms of the impact on species that are already threatened or are disappearing, we have lost all control in the countries I work in.

Fishers are still going out fishing, but there is no one there to enforce protections and monitor the trade.

The fins of guitarfish and wedgefish are extremely valuable and are used in shark fin soup. We have anecdotal information that traders are coming in and paying fishers to target these species, and they are stockpiling the fins so that, as soon as the markets reopen, they can sell them at very high prices.

Mauritania, the West African nation where I was able to make my one and only trip since the pandemic in March, has a marine protected area. We're pretty sure that fishers in this area are targeting these species, despite a ban on fishing. Obviously, if this continues much longer, we will have lost critical time in preserving species.

Starting up again will take time. There are regulators, customs officials, and researchers who have had to leave their positions. So we'll need to do hiring and new training. In a way, if this continues for much longer, we'll be going back to zero.

In addition to affecting how science is practiced, the pandemic is hitting scientists themselves very hard. Stuck at home, unable to be in their labs or do field research, many scientists are finding it difficult to complete their projects in the time allotted by funding agreements. Funders typically award grants for a set period of time. When that time ends, so does the funding.

Some of my colleagues are concerned they won't have income. If they lose their salary, they cannot continue being scientists. They are going to have to do something else. They may have to shift careers, especially if they are early-career scientists.

A lot of the Ph.D. students who were hoping to get funding and start projects haven't been able to do that. But they still have to pay their bills. So they may need to find somewhere else to work. We could lose part of a generation of scientists.

In some developing countries, governments themselves depend on the funding that we bring in as external researchers. And without our work—without up-to-date data on what is actually happening to species in their territory—they may lack political ammunition to impose hard but necessary restrictions.

Am I discouraged? I'm trying not to be. A lot of people are very depressed about what is happening. But we are going to be able to get back out there and collect information. We are going to be able to continue with conservation. It's important to think like that and have that hope.

Dr. Anthony Fauci: Science is Essential to Public Policy

Dr. Anthony Fauci was appointed director of the National Institute of Allergy and Infectious Diseases in 1984. He oversees an extensive portfolio of basic and applied research to prevent, diagnose, and treat established infectious diseases such as HIV/AIDS, respiratory infections, diarrheal diseases, tuberculosis, and malaria, as well as emerging diseases such as Ebola, Zika, and COVID-19.

WHY DID YOU FIRST GET INTO SCIENCE AND BECOME A DOCTOR?

I come from a family that was very interested in public service, and I attended Regis High School, a Jesuit high school, in New York City, where the theme is service for others. I got very keenly interested in humanitarian issues—the interaction of various civilizations with each other, philosophy, and all the things that go along with a classical education—Greek, Latin, and romance languages. I also liked science, chemistry, and particularly biology. When I looked for a career to combine my affinity for wanting to be with people and my aptitude for science, I decided to be a physician. I spent three years in an infectious disease immunology fellowship at the National Institutes of Health, and I found I liked the science of human issues, human disease, human pathogenic mechanisms, and that led me to where I am right now. Everyone should get at least an exposure to science—it satisfies your curiosity to explore the unknown. And when you like it, you fall in love with it.

WHAT DO YOU WISH PEOPLE BETTER UNDERSTOOD ABOUT SCIENCE AND THE PRACTICE OF SCIENCE?

Particularly now as we're in the profound situation of living with COVID-19—the most important pandemic in 102 years—people need to understand that science is something that is self-correcting and exploratory. When you're dealing with a static situation, the scientific facts don't change, and your policy and your interpretation generally don't change. But when you're dealing with an evolving situation like this one, I wish the public could understand that science collects data and evidence at any given moment and makes decisions out of necessity that you have to make. You have to be humble enough, open-minded enough, and flexible enough to know that as things evolve and the data evolve and you get more evidence, that you are likely to change a recommendation or to change a policy. That's not a mistake. That's science helping you to adjust to the evolving situation.

PEW RESEARCH CENTER SURVEYS SHOW THAT ONLY ABOUT A THIRD OF AMERICANS ARE CONFIDENT THAT SCIENTISTS ACT IN THE PUBLIC INTEREST. HOW CAN THAT BE IMPROVED?

What we're living through now is an opportunity for that. There are many complex reasons why people might have a lower level of esteem for science than you would like them to have. First, there's almost an anti-authority mode in the country because of the political divisiveness. Scientists, because we deal with facts and talk about facts and try to preach facts, are often looked upon as authority figures. So any kind of a negative feedback on authority might tend to brush off on scientists. Another thing is that sometimes scientists tell people things they don't want to hear. And also, scientists are human. They have foibles and inadequacies and make mistakes. Since they're supposedly the people who are trumpeting the truth, when some of them step out of line and distort data or distort facts, which happens unfortunately, that casts a negative reflection on all scientists. But in general, I think scientists, if you take away the divisiveness that we're going through now, are generally well thought of. They're people of good faith who want to get the truth out.

IS PART OF THE PROBLEM THE ABILITY OF SCIENTISTS TO COMMUNICATE EFFECTIVELY AND FOR THEM TO REACH NEW AND BROADER AUDIENCES?

You want to get information that's important for the health of the people to a variety of different segments of society. Not everybody listens to podcasts, not everybody looks at TV news. That's the reason why during the pandemic I do Instagram interviews. I also do interviews with rap artists and entertainers, because you do an Instagram with one of them, and you get to a group of people that you never would get to otherwise. Some scientists, for one reason or another, either talk down dramatically to an audience to whom they should not be talking down, or they feel they have to appear, if they're on national TV, to be really, really smart. My formula is when you're trying to explain something, it is not important for you to appear smart. It is important for you to be understood. Because if you're not understood, it doesn't matter how smart you are, you have failed in your communication. So you've got to walk a delicate balance of saying things in a clear way and in a way that doesn't talk down to people. I use the motto that I learned through my eight years of Jesuit education: precision of thought and economy of expression. Know precisely the message that you want to convey and say it in absolutely as few words as possible.

POLICY SHOULD NOT BE MADE IN A DATA-FREE ZONE

HOW WOULD YOU LIKE TO SEE SCIENCE INFORM POLICYMAKING?

I think science is totally essential to public policy. Policy should not be made in a data-free zone. Policy needs to be made based on the best possible information. The scientific process provides policymakers with that. That's the situation that we're in right now, which is not that easy, as you might imagine. But when you're talking about policy around sensitive issues that involve the economy, schools, employment, all kinds of things—in the best possible world the information that the scientists give you would inform policy. But remember—policymakers get more than just scientific information. They get other information that relates to the economy, information that relates to other aspects of society. So the input that I give as a scientist is part of a multifaceted process of policymaking. You just hope that it's dominant when you're dealing with a public health issue.

THE FINAL WORD

Scientists Need to be Better Communicators—and They Know It

By Laura Lindenfeld

Science and technology permeate our daily lives. We depend on scientific discovery and technological advancement for food, water, energy, travel, communication, health, and other essential needs. The structured, systematic approach science uses to produce new knowledge enables us to reduce doubt, implement new solutions, and improve decision-making to benefit society and our planet.

Yet, what Carl Sagan wrote in the *Skeptical Inquirer* three decades ago is still true today: "We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology." That knowledge gap is compounded by a growing distrust and denial of science, which fundamentally threatens support for the scientific enterprise. Reduced funding for science undermines scientific progress. The rejection of sound evidence in public health literally costs lives. A disregard for the findings of climate science erodes our capacity to act in a timely fashion. These are but a few critical examples that require different, more engaged approaches to communicating science to address some of the most pressing challenges of the 21st century.

Fortunately, there also is a growing recognition of the power of communication and need for engagement around science. Scientists have come to understand that strong communication is an essential part of what it means to be a scientist rather than a burdensome add-on. As part of this shift, many new training programs have emerged to prepare scientists to communicate and engage with different audiences. The type of communication training scientists receive matters greatly. Social science research has helped us to understand that simply sharing facts and information with someone doesn't mean they will grasp an issue. This is the so-called "deficit model of communication," and it doesn't work. Understanding doesn't come from facts alone, and that approach can actually backfire and reinforce disbelief—we've seen it happen when some doctors try to encourage people who adamantly oppose vaccinations to immunize their children. In these cases, parents often become even more opposed to vaccination.

Instead of forcing facts and figures on others, scientists communicate successfully when they work to foster genuine connections and build trust with others.

The Alan Alda Center for Communicating Science at Stony Brook University in New York represents one of the major training programs in the U.S. The Alda Center aims to foster empathy and connection through communication training as a way to build trust and strengthen relationships between society and science. For more than a decade, actor Alan Alda hosted the PBS series “Scientific American Frontiers,” interviewing hundreds of scientists. With this experience, Alda recognized how effective a conversational approach is for conveying complex information. He concluded that scientists could be more dynamic, engaged communicators if they learned to pay close attention to their audience and sought to connect with them in a personal way.

So Alda turned to the improvisational techniques he learned as an actor and decided to share that approach with scientists. In improvisation, actors work together to create a scene, building on each other’s ideas and reactions to tell a story or find meaning. Improv doesn’t work without empathy, and without an active willingness to take others’ needs, concerns, and ideas seriously, even during disagreements. Alda hypothesized that those skills would help scientists to talk about their work in ways that invite collaboration and build real understanding. Starting in 2009, he and our team at the Alda Center developed and honed this idea to build an improv-based science communication training program that aims to foster connections between scientists and those they seek to engage. Together, we devised and refined what has come to be called the Alda Method and more than 15,000 scientists and medical professionals have gone through our workshops.

These online and in-person training programs have become regular features at hundreds of the leading scientific organizations in the country, including the American Psychological Association, Stanford University, Johns Hopkins University, and various government agencies. Program participants tell us that the experience opens their eyes to the importance of communication and provides techniques they continue to use to engage others about their work.

At face value, we may think communication is about the words we say or write. But it is so much more. Effective science communication builds on that bond to share mutual

SCIENTISTS HAVE COME TO UNDERSTAND THAT STRONG COMMUNICATION IS AN ESSENTIAL PART OF WHAT IT MEANS TO BE A SCIENTIST.

understanding, find common meaning, and make the best possible decisions together, as a community of experts and nonexperts.

Faced with a pandemic and concerns about vaccine efficacy, rising sea levels threatening cities and entire nations, wildfires burning hundreds of square miles, and increasing numbers of threatened and endangered species, we have never so desperately needed to embrace science and evidence-based decision-making.

We face difficult decisions and divisive times. Effective communication does not mean we must agree with each other. It means that we seek to understand each other and work together to find a productive path forward. By empowering and encouraging scientists to build trust through empathy and compassion as they share their vast knowledge, we create spaces where we can come together to discuss ideas and implement community-driven and community-supported solutions. Together, we can build the stronger, brighter future based on mutual respect that we want for ourselves, for our families, and for each other.

A THOUSAND WORDS

Rawpixel.com/Shutterstock

THE PEW CHARITABLE TRUSTS

One Commerce Square
2005 Market Street, Suite 2800
Philadelphia, PA 19103-7077

NONPROFIT ORG
U.S. POSTAGE PAID
CINNAMINSON, NJ
PERMIT NO. 579

PEWTRUSTS.ORG/TREND

POST-CONSUMER RECYCLED

ECO-INKS

MIX
Paper from responsible sources
FSC
www.fsc.org
FSC® C012856