

Leading Through Creativity and Innovation: The 2020 Nobel Laureates, MacArthur and Schmidt Science Fellows, and Immigrant Scientists in Search of a COVID-19 Vaccine

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Key Findings

1. In 2020, none of the Nobel Prize winners from the United States are foreign-born individuals.* However, four of this year's 12 Laureates are foreign born and have been associated with U.S. research institutions or universities at some point in their careers. They are Emmanuelle Charpentier (Chemistry), Michael Houghton (Physiology or Medicine), Reinhard Genzel (Physics), and Roger Penrose (Physics). Since 2010, there have been 23 foreign Nobel winners who were not in the United States when they won the Nobel Prize but spent significant time working at U.S. institutions.
2. Throughout the history of the Nobel Prize, 143 immigrants to the United States have won a Nobel Prize. These 143 individuals account for 15 percent of all Nobel Laureates since 1901 and 34 percent of all U.S. winners.¹
3. The top three countries of origin of foreign-born U.S. Nobel Prize winners between 1901 and 2020 are Germany, the United Kingdom, and Canada. However, the number of winners from Asia and Africa has increased since 1979 and in the twenty-first century.
4. Immigrants, and children of immigrants, are prominent recipients of other prestigious awards as well. For example, in 2020, four of the 21 MacArthur Fellows and at least four of the 22 Schmidt Science Fellows are foreign born and living in the United States. Since 1981, 230 of 1,061 total MacArthur Fellows, or 22 percent, were born outside of the United States. Since its inception in 2018, there have been 56 Schmidt Science Fellows, and at least 19 of them, or 34 percent, have been foreign-born individuals affiliated with U.S. institutions.
5. Immigrant scientists are among those working tirelessly on finding a COVID-19 vaccine. Immigrants make up 19 percent of all workers in the Medical Equipment and Supplies Manufacturing, Pharmacies and Drug Stores (Retail), and Pharmaceutical and Medicine Manufacturing sectors of the biomedical industry. Many of these immigrant workers have lived in the United States for decades, are naturalized U.S. citizens, and are highly educated.

* Please note that the terms "immigrant" and "foreign-born" are used interchangeably throughout this report. Foreign-born refers to individuals who are not a U.S. citizen at birth or who were born outside the U.S., Puerto Rico or other U.S. territories and whose parents are not U.S. citizens. The foreign-born may include naturalized U.S. citizens, Legal Permanent Residents, temporary residents, refugees and asylees, and others. Native born includes those who are U.S. citizens at birth, those born in the United States, Puerto Rico, or other U.S. territories, and those born abroad to a parent who is a U.S. citizen.

Introduction

This year, scientific research is in the headlines and at the top of many people's minds like never before. As the global novel coronavirus pandemic rages and hopeful signs of a successful vaccine dominate the news, doctors, scientists, and researchers around the world are working together to bring an end to COVID-19. Immigrants in the United States and elsewhere are at the forefront of many emerging scientific and medical discoveries with the potential to end the pandemic once and for all.

The 2020 Nobel Prize winners in Physics, Physiology or Medicine, Chemistry, Peace, Economic Sciences, and Literature were announced in October, and the prizes will be awarded via a virtual ceremony in December. The Nobel Prize, first awarded in 1901, was established by Alfred Nobel to be given to outstanding individuals who accomplish work "for the greatest benefit to humankind" within their lifetimes.² Since 1901, 143 Nobel Laureates have been foreign-born individuals who immigrated permanently to the United States or were at a U.S. institution of higher learning at the time they received the award. These 143 individuals account for 15 percent of all Nobel Laureates since 1901 and 34 percent of all U.S. winners.³

In this report, Nobel Laureates are identified by the country of residence and university or research institution with which they were affiliated at the time of the Nobel Prize announcement, not by country of citizenship. Therefore, we categorize a foreign-born individual working at a U.S. university or living in the United States at the time of the award as a U.S. winner. We distinguish between native-born U.S. winners and foreign-born U.S. winners, based on the biographical information provided by the Nobel Prize administrators or official university biographies. The foreign-born winners may be naturalized U.S. citizens, Legal Permanent Residents, or temporary residents.

In 2020, there were no immigrant Nobel Laureates from the United States. However, four of the winners are foreign born and spent significant time living, researching, and working in the United States. They are Emmanuelle Charpentier (Chemistry), Michael Houghton (Physiology or Medicine), Reinhard Genzel (Physics), and Roger Penrose (Physics). In addition to the 143 foreign-born U.S. Nobel Laureates, since 2010, there have been 23 foreign Nobel Prize winners who spent significant time at U.S. research institutions and universities.

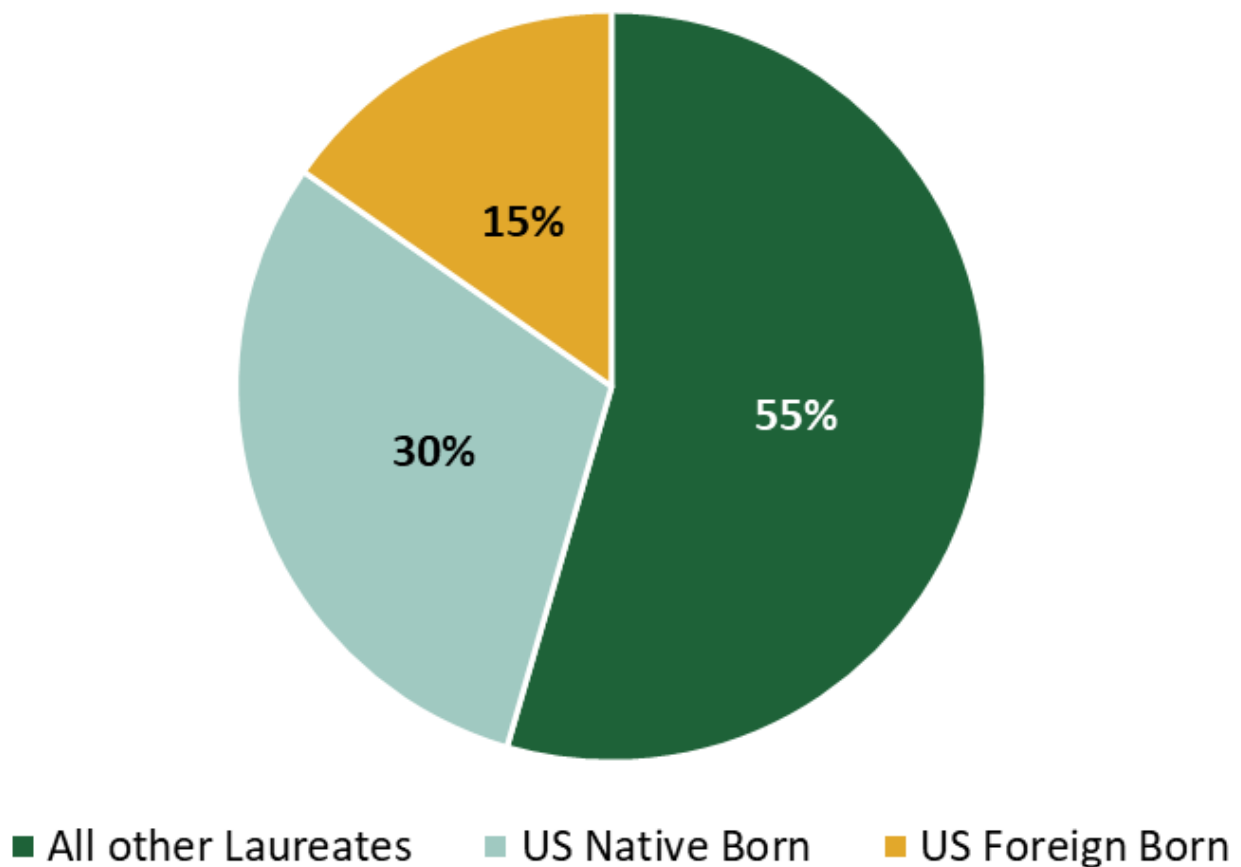
International collaboration is an important element of scientific discovery, and this year's Nobel Laureates have worked with each other, across international boundaries, to make vital discoveries. For example, Drs. Emmanuelle Charpentier of France and Jennifer Doudna of the United States were co-awarded the 2020 Nobel Prize in Chemistry for their work on the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR-Cas9) genetic engineering technology. Michael Houghton of Great Britain collaborated with his American counterparts, Charles M. Rice and Harvey J. Alter, and they won the 2020 Nobel Prize in Physiology or Medicine for their groundbreaking research on the hepatitis C virus.

Continued international collaboration will be necessary to face current and emerging global threats. For example, in 2020, the world is facing a global COVID-19 pandemic, and scientists and researchers around the world are working to produce a COVID-19 vaccine. Many of these top scientists in the United States are immigrants who came to this country to continue their education and pursue their dreams. Perhaps these researchers will become future Nobel Laureates and receive well-deserved recognition for their current work.

Immigrant Nobel Prize Winners Throughout the Years

Since the beginning of the twentieth century, the Nobel Foundation has awarded 934 Nobel Prizes to individuals.⁴ Notably, the United States has been home to almost half (45 percent) of all Nobel Laureates, 15 percent of whom were foreign-born U.S. winners, while over a quarter (30 percent) of them were U.S. born individuals (Figure 1). Overall, there have been 143 foreign-born U.S. Nobel Laureates from 1901 to 2020, averaging about one foreign-born U.S. winner per year.⁵

Figure 1. Nobel Laureates, 1901-2020



Source: IIR Analysis of all Nobel Prize winners Accessed October 26, 2020. <https://www.nobelprize.org/prizes/lists/all-nobel-prizes/>

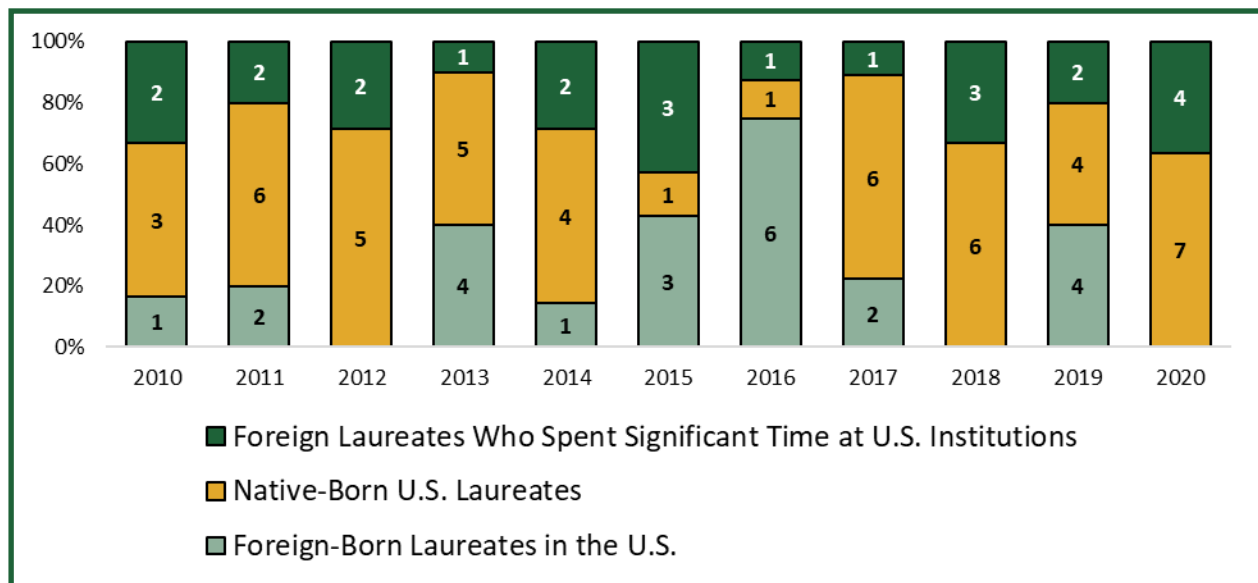
There have been 23 foreign-born U.S. Nobel Laureates since 2010. While the number of immigrant winners has fluctuated over the past 10 years, 2016 set the record for the highest number (6) of immigrant winners in a single-year (Figure 2).

While there were no foreign-born U.S. winners in 2020, there were four foreign-born Nobel Laureates who spent significant time studying or working at American research institutions or universities -- Emmanuelle Charpentier (Chemistry), Michael Houghton (Physiology or Medicine), Reinhard Genzel (Physics), and Roger Penrose (Physics).

Since 2010, there have been 23 foreign Nobel Laureates, who resided outside of the United States at the time of the award, but spent significant time studying or working at U.S. institutions at some point during their career (Figure 2).

Additionally, in 2020 there were seven native-born U.S. Nobel Laureates who were recognized for their innovative work in Economic Sciences (2), Chemistry (1), Literature (1), Physiology or Medicine (2), and Physics (1).

Figure 2. Native-Born, Immigrant, and Foreign-Born Laureates Who Worked at U.S. Institutions 2010-2020



Source: IIR Analysis of all Nobel Prize winners. Accessed October 15, 2020. <https://www.nobelprize.org/prizes/lists/all-nobel-prizes/>

The national origins of foreign-born U.S. Nobel Prize winners did not significantly diversify until after 1979. Prior to 1979, only seven winners originated from countries outside of Europe; these Nobel Laureates came from China (3), Japan (2), India (1), and South Africa (1). Since 1979, 19 immigrant winners have originated from countries outside of Europe; these winners came from Japan (4), South Africa (3), India (1), Pakistan (1), Venezuela (1), Taiwan (1), Korea (1), China (3), Mexico (1), Egypt (1), Israel (1), and Turkey (1).

The 2020 Nobel Laureates

In 2020, there are four foreign-born winners who spent significant time studying or working at U.S. research institutions or universities.

Nobel Prize in Chemistry



Photo courtesy of Hallbauer & Fioretti

Emmanuelle Charpentier is a French microbiologist, geneticist, and biochemist and the co-winner of the 2020 Nobel Prize in Chemistry.⁶ Charpentier was awarded for co-inventing Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR-Cas9), a novel gene-editing technology that is advancing biomedical researchers' ability to examine and manipulate genes.⁷ Charpentier spent about five years working at U.S. institutions where she developed her research expertise and skills, which contributed to the materialization of her award-winning work.⁸ Charpentier was born on December 11, 1968 in Juvisy-sur-Orge, a small civil township close to Paris.⁹ She obtained her BS degree from the former Pierre and Marie Curie University (now Sorbonne University since 2018).¹⁰ In 1995, Charpentier attained her PhD in Microbiology from the Pasteur Institute and stayed on for a year to work as a Postdoctoral Fellow.¹¹ However, in order to fulfill her goal of leading a research lab at Pasteur, she needed to gain more expertise, so she applied to over 50 postdoctoral positions abroad.¹² In 1996, Charpentier accepted a year-long position in Dr. Elaine Tuomanen's research lab at the Rockefeller University in New York City.¹³ From 1997 to 1999, she undertook a second postdoctoral opportunity as an Assistant Research Scientist in Dr. Pamela Cowin's lab at the New York University Medical Center, where she worked on projects related to mammalian gene manipulation.¹⁴ Between 1999 and 2002, Charpentier worked on research at several different U.S. institutions, including St. Jude Children's Research Hospital and the Skirball Institute of Biomolecular Medicine.¹⁵ She returned to Europe in 2002 to serve as Lab Head and Guest Professor at the University of Vienna.¹⁶ Currently, Charpentier works in Berlin as the Scientific and Managing Director of the Max Planck Unit for the Science of Pathogens, an independent research institute that she co-founded with the Max Planck Society in 2018.¹⁷

Nobel Prize in Physiology or Medicine



Photo courtesy of University of Alberta

Michael Houghton is one of three winners of the 2020 Nobel Prize in Physiology or Medicine for the discovery of the hepatitis C virus. Harvey J. Alter and Charles M. Rice are the two other awardees.¹⁸ Houghton was born in the United Kingdom in 1949 and spent significant time, from the late 1970s to early 2000s, working at three U.S. based companies, G.D. Searle & Company, Chiron Corporation, and Epiphany Biosciences.¹⁹ At 17, he learned about Louis Pasteur’s work and became inspired to pursue a career in microbiology.²⁰ After high school, he received a scholarship to study biological sciences at the University of East Anglia, where he obtained his undergraduate degree in 1972.²¹ Shortly thereafter, he attained his doctorate in 1977 in biochemistry from King’s College London.²² Currently, he works at the University of Alberta in three different capacities: as the Canada Excellence Research Chair in Virology, Li Ka Shing Professor of Virology, and as the Director of the Li Ka Shing Applied Virology Institute.²³ Discovering

the hepatitis C virus was a tremendously demanding and tedious process that began with the pioneering work of Harvey J. Alter, who identified the pattern of the “non-A, non-B hepatitis.”²⁴ Houghton and his colleagues worked tirelessly at the Chiron Corporation, a former California-based biotechnology firm, where they ultimately discovered the virus in 1989.²⁵ Houghton’s and his colleagues’ groundbreaking research was further developed by Charles M. Rice, who successfully proved to the scientific community that the hepatitis C virus indeed caused “non-A, non-B” hepatitis.²⁶ Scientific breakthroughs in hepatitis C research led to life-saving medical developments in diagnosing and treating hepatitis C for millions of people around the world.

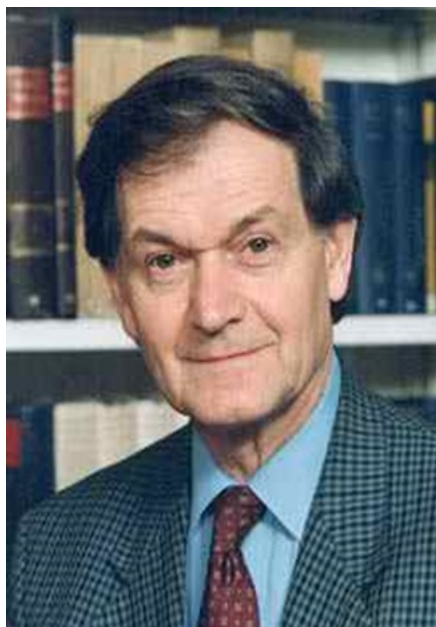
Nobel Prize in Physics



Photo courtesy of UC Berkley

Reinhard Genzel is one of three winners of the 2020 Nobel Prize in Physics.²⁷ Houghton was recognized for his discovery of a “supermassive black hole at the center of the Milky Way, an extremely heavy, invisible object about 4 million times the mass of our sun.”²⁸ Genzel was born in Bad Homburg vor der Höhe, Germany on March 24, 1952.²⁹ Like his father, Ludwig Genzel, he studied Physics throughout college and in graduate school.³⁰ Genzel received a BS from the University of Bonn in 1975 and a PhD in Radio Astronomy from the University of Bonn in 1978.³¹ Upon graduation, Dr. Genzel relocated to the United States where he would remain for eight consecutive years in academic positions within U.S. higher educational institutions, including Harvard University and the University of California, Berkley.³²

Most notably, from 1981 to 1986, he worked at the University of California, Berkley's Department of Physics at the ranks of Associate and Full Professor.³³ In 1986, he relocated to Germany to become the Director of the Max Planck Institute for Extraterrestrial Physics in Munich and to serve as an Honorary Professor at the Ludwig-Maximilian University.³⁴ However, even during his time abroad, Genzel maintained his connection to the University of California, Berkley as a Visiting Professor.³⁵ Moreover, in 1999, he returned to the University of California, Berkley as a Full Professor in a part-time capacity.³⁶ Currently, Genzel is a Professor Emeritus at the University of California, Berkley and continues to serve as the Director of the Max Planck Institute.³⁷



*Photo courtesy of MacTutor
History of Mathematics Archive*

Roger Penrose is a British mathematical physicist and another 2020 Nobel Laureate in Physics.³⁸ He is recognized for his groundbreaking work on the features of black holes, including the finding that “black hole formation is a robust prediction of the general theory of relativity.”³⁹ Penrose was born on August 8, 1931 in Colchester, United Kingdom.⁴⁰ From 1939 until the end of WWII, Penrose spent his childhood in Ontario, Canada where his father worked at the Ontario Hospital.⁴¹ After the end of World War II, the Penrose family moved back to the United Kingdom.⁴² Inspired by his scientist father, who introduced him to mathematics through home-made, wooden puzzles, Penrose obtained postsecondary degrees in Mathematics from the University of College London and the University of Cambridge (St. John’s College), where he completed his PhD in 1957.⁴³ In 1959, he won the prestigious North Atlantic Treaty Organization (NATO) Research Fellowship, which afforded him the opportunity to temporarily work at Princeton, Syracuse, and Cornell Universities until 1961.⁴⁴ Thereafter, he briefly returned to the United Kingdom to work as a Researcher at King’s College, London,

before coming back to the United States for a second time to work as a Visiting Associate Professor at the University of Texas at Austin from 1963 to 1964.⁴⁵ Penrose would spend more than a decade working in prestigious academic positions in Britain before returning to the United States for a third time in 1983.⁴⁶ Upon being invited to teach by then Provost Bill Gordon, Penrose worked as a Lovett Professor at Rice University from 1983 to 1987.⁴⁷ Additionally, in 1987, he became a Distinguished Professor of Physics and Mathematics at Syracuse University.⁴⁸ He is currently affiliated with Oxford University as a Professor Emeritus.⁴⁹

Nobel Prize Laureates & U.S. Research Institutions and Universities

U.S. research institutions and universities have played a prominent role in Nobel Prize winners' career trajectories.⁵⁰ These institutions tend to be the entry point for many foreign academics and scientists who later go on to win Nobel Prizes. Four of this year's 12 Nobel Prize winners were involved with a U.S. institution of higher education or scientific research at some point in their lives (see Table 1). Considering the affiliations of the native-born Laureates, it is noteworthy that these are leading institutions that attract large numbers of international students and faculty, setting the stage for ongoing training and international collaboration.

Table 1. 2020 Nobel Prize Laureates and U.S. Institutions of Higher Education and Scientific Research*

Name	Field	Country of Birth	Affiliation with U.S. Educational or Scientific Institutions
Foreign-Born Winners			
Emmanuelle Charpentier	Chemistry	France	Rockefeller University, New York University Medical Center, St. Jude Children's Research Hospital, Skirball Institute of Biomolecular Medicine
Reinhard Genzel	Physics	Germany	Harvard University, University of California, Berkeley
Michael Houghton	Physiology or Medicine	United Kingdom	G.D. Searle & Company, Chiron Institute, Epiphany Biosciences
Roger Penrose	Physics	United Kingdom	Princeton University, Syracuse University, Cornell University, the University of Texas at Austin, and Rice University
Native-Born Winners			
Harvey J. Alter	Physiology or Medicine	United States	University of Rochester, University of Washington, Georgetown University
Jennifer A. Doudna	Chemistry	United States	Pomona College, Harvard Medical School, University of Colorado Boulder, Yale University, University of California, Berkeley
Andrea Ghez	Physics	United States	Massachusetts Institute of Technology, California Institute of Technology, University of California at Los Angeles
Louise E. Glück	Literature	United States	Sarah Lawrence College, Columbia University, Yale University
Paul R. Milgrom	Economic Sciences	United States	University of Michigan, Yale University, Northwestern University, Stanford University
Charles M. Rice	Physiology or Medicine	United States	University of California, Davis, California Institute of Technology, Washington University, Rockefeller University
Robert B. Wilson	Economic Sciences	United States	Harvard University, University of California, Los Angeles, Stanford University

Source: IIR Analysis of the Biographies of the 2020 Nobel Prize Laureates.

* This table reflects analysis of individuals who were awarded a 2020 Nobel Prize and therefore excludes the World Food Programme from the analysis.

International Collaboration Among Nobel Prize Winners

Scientific collaborations with colleagues around the world have been an important part of previous Nobel Laureates' process of attaining a Nobel Prize and this year continues this trend.⁵¹ In recent years, international scientific collaborations have "become the rule: scientists now live in a hyperconnected world" thanks to improved digital technologies and increasing trends in "student migration, brain circulation, and the internationalization of universities."⁵² Among 2020 winners, the most notable collaborations occurred between European and American scientists, a likely collaboration according to UNESCO's (2015) global analysis of which countries tend to work together on scientific endeavors.⁵³ More specifically, 2020 reflects a history of fruitful collaborations between American, French, and British Nobel Laureates, a demonstrated tendency in international scientific collaborations given that that approximately 60% of American scientists' collaborators are from the United Kingdom, France, or Germany.⁵⁴

The noteworthy French-and-American collaboration is a story of friendship and transnational scientific discovery by Drs. Emmanuelle Charpentier of France and Jennifer Doudna, an American, who were co-awarded the 2020 Nobel Prize in Chemistry. By the time they met each other at a scientific conference in Puerto Rico in 2011, they had both been independently researching RNAs in the CRISPR-Cas9 system, which is in essence "an immune system within bacteria" that protects against viral infections through the "DNA-slicing enzyme called Cas-9."⁵⁵ When they met at the conference, the personal and professional connection was immediate and they quickly "recognized that they brought complementary strengths to the study of CRISPR-Cas."⁵⁶ By the time the conference ended, they had plans to collaborate on their CRISPR-Cas9 research activities, in spite of the "huge gulf between their laboratories," Doudna's at the University of California, Berkeley and Charpentier's at Umeå University in Sweden.⁵⁷ Within a year, Charpentier, Doudna, and other colleagues co-authored a highly influential paper,⁵⁸ in which the research team demonstrated how the "CRISPR-Cas9 system could be programmed to cut specific sites in isolated DNA,"⁵⁹ a remarkable advancement in the science of genetic engineering.⁶⁰ Since their monumental discovery, "genome researchers and biotechnologists have rushed to use the new CRISPR technique," which has a wide-range of potential applications, including generating "pest-and disease-resistant" crops and livestock, along with genetically engineered wild mosquito populations to inhibit their ability to spread mosquito-borne diseases like Zika or malaria.⁶¹ In addition to the 2020 Nobel Prize in Chemistry, Charpentier and Doudna have been co-awarded a litany of other prestigious awards.⁶² Today, while they are less actively collaborating on the CRISPR-Cas9 project, they continue to think about potential improvements to their discovery.⁶³ Doudna has also assumed a central role in transnational discussions about ethical issues around and practices of using CRISPR-Cas9.⁶⁴

Other important examples of transatlantic scientific collaborations include the 2020 Nobel Laureates in Physiology or Medicine and their research on the hepatitis C virus. More specifically, the British-born Michael Houghton collaborated with his American counterparts, Charles M. Rice and Harvey J. Alter. Over three decades ago, Houghton and Alter co-authored a significant paper together, along with other colleagues, entitled, “Detection of Antibody to Hepatitis C Virus in Prospectively Followed Transfusion Recipients with Acute and Chronic non-A, non-B Hepatitis.”⁶⁵ The research team concluded in this paper that “hepatitis C virus is the predominant agent of transfusion-associated non-A, non-B hepatitis” and that screening of blood donors could significantly reduce the number of hepatitis C cases.⁶⁶ More recently in 2018, Houghton co-authored a paper with Rice and colleagues entitled “Critical Challenges and Emerging Opportunities in Hepatitis C Virus Research in an Era of Potent Antiviral Therapy: Considerations for Scientists and Funding Agencies.” This publication reported on recent advances in treating hepatitis C infections and argued for the need of a vaccine “to prevent chronic infection, [which is] essential for global hepatitis C virus eradication.”⁶⁷

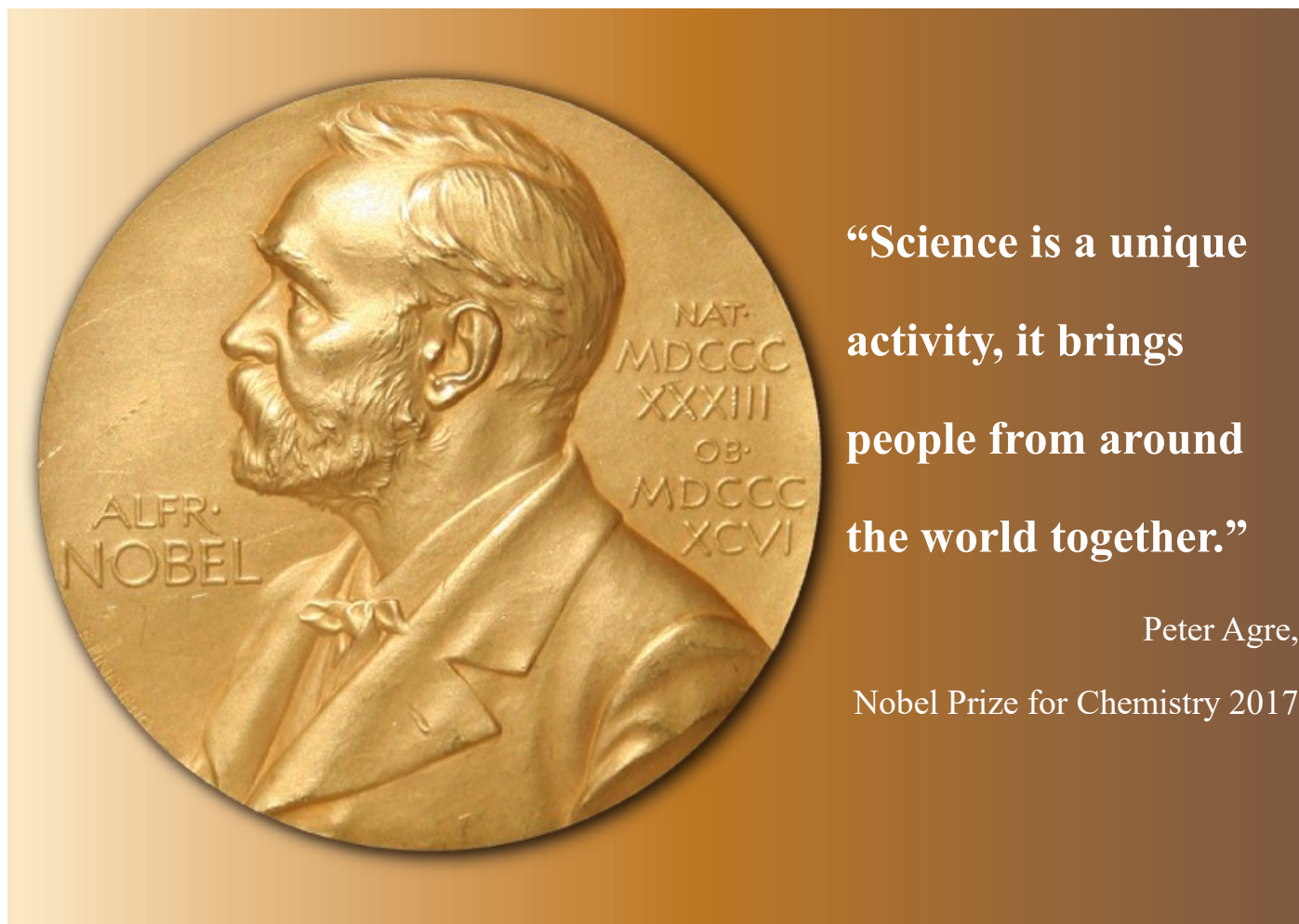


Image courtesy of Wikipedia

Immigrant Winners of Other Prestigious Awards

Similar to the Nobel Prize, immigrants in the United States frequently win other prestigious awards. For example, a significant share of MacArthur Fellowships has been awarded to immigrants. Moreover, immigrants are also claiming the spotlight as recipients of the Schmidt Science Fellowships. In 2020, four MacArthur Fellows and at least four Schmidt Science Fellows are immigrants. It is possible that several of this year's fellows are future Nobel Laureates.

Foreign-Born 2020 MacArthur Fellows

In 2020, four out of 21 (19 percent) of the MacArthur Fellows are foreign born. The MacArthur Fellowship, colloquially known as the “Genius Grant,” is an annual prize awarded by the John D. and Catherine T. MacArthur Foundation to somewhere between 20 to 30 individuals who have demonstrated exceptional creativity and dedication in their professional pursuits.⁶⁸ While MacArthur nominees and winners can be from any field, they must be either U.S. residents or citizens.⁶⁹ To support the 2020 MacArthur Fellows’ creative freedom and potential, the MacArthur Foundation will gift each fellow a \$625,000 stipend over the course of five years. Since 1981, 230 out of 1,061 total MacArthur Fellows (22 percent) were born outside of the United States.⁷⁰ The top five countries of birth have been the United Kingdom (27), China (18), Canada (16), Germany (14), and India (10).

2020 MacArthur Fellows

21 Extraordinarily
Creative
and Inspiring
Individuals

www.macfound.org/fellows
#MacFellow

MacArthur
Foundation



Image courtesy of MacArthur Foundation

Cristina Rivera Garza is a prolific author and a Distinguished Professor in Hispanic Studies at the University of Houston.⁷¹ Rivera Garza was born on October 1, 1964 in Matamoros, Mexico. She obtained her BA degree in Urban Sociology from the National Autonomous University of Mexico in 1987. Shortly thereafter, she moved to the United States in 1989 to pursue her PhD at the University of Houston. After completing her PhD in 1995, and prior to joining the University of Houston as a Distinguished Professor in 2016, she worked at various universities in San Diego and Mexico. As an award-winning author, she has written a plethora of works including six novels, three collections of short stories, five collections of poetry and three non-fiction books. Some of her most famous works include, *No One Will See Me Cry* (2003), *The Illiac Crest* (2017), and *The Taiga Syndrome* (2018). Rivera Garza uses her writing to critically reflect on “culturally constructed notions of language, memory, and gender roles from a transnational perspective.”⁷²



Photo courtesy of MacArthur Foundation

Polina V. Lishko is a cellular and development biologist extraordinaire and Associate Professor in the Molecular and Cell Biology Department at the University of California, Berkeley.⁷³ Lishko was born in 1974 and grew up in Kiev, Ukraine. As the daughter of two chemists, she continues her family’s engagement with the scientific community. In 1996, Lishko earned a Specialist Degree from the Taras Shevchenko National University of Kyiv. In 2000, she went on to earn a PhD from the National Academy of Sciences of Ukraine. Lishko came to the United States to work as a Postdoctoral Fellow at Harvard University. From 2006 to 2011 Lishko worked as an Adjunct Instructor at the University of California, San Francisco. Then, in 2012, Lishko accepted a position at the University of California, Berkeley, where she currently works as an Associate Professor in the department of molecular and cell biology. Lishko’s research explores “the cellular mechanisms that make fertilization possible,” work that is critical for understanding events contributing to “the appearance of new life” and could advance male infertility treatments, inform developments of safe male contraceptives, and even forge new approaches to pain management.⁷⁴



Photo courtesy of MacArthur Foundation

Mohammad R. Seyedsayamdost is a biological chemist and an Associate Professor of Chemistry at Princeton University.⁷⁵ Seyedsayamdost has a very international background; he was born in Iran and raised in Germany and Australia. In 1997, he came to the United States to pursue his undergraduate education at Brandeis University. In 2001, he graduated with honors with a combined BS/MS degree in Biochemistry. He continued his education at the Massachusetts Institute of Technology (MIT) where he received his PhD in 2008. Upon graduation, he assumed a postdoctoral position at Harvard University and continued working there until joining Princeton University's faculty in 2013. Seyedsayamdost's research is "expanding the toolbox available to synthetic organic chemists and opening up access to a new trove of previously unknown and potentially therapeutic biochemical compounds," research that is crucial for developing novel antibiotic treatments to emergent infectious diseases and pathogenic bacteria.⁷⁶



Photo courtesy of MacArthur Foundation

Nanfu Wang is an award-winning Documentary Filmmaker with four feature films to date including *Hooligan Sparrow* (2016), *I am Another You* (2017), *Out of Many, One* (2018), and *One Child Nation* (2019).⁷⁷ Wang was born in 1985 in a rural village in Jiangxi, China. Prior to pursuing her education, she worked as an elementary school teacher. Wang holds a continuing education degree and three MA degrees. She earned her first MA degree in 2010 from Shanghai University and completed the other two MA degrees in the United States, one in 2012 at Ohio University and the other one in 2014 from New York University. Wang's films provide poignant and provocative accounts of political and human rights issues in China and examine how personal and social life is shaped by authoritarian governance.



Photo courtesy of MacArthur Foundation

Foreign-Born 2020 Schmidt Science Fellows

The Schmidt Science Fellowship is a unique, professional development and postdoctoral opportunity for emerging scientists in the natural sciences, engineering, computing, or mathematics.⁷⁸ The Fellowship typically lasts anywhere from 11 to 14 months, although it can be extended up to an additional year.⁷⁹ Nominees are chosen through a partnership with foremost scientific and engineering institutions worldwide.⁸⁰ Winners are selected based on their demonstrated record of outstanding accomplishments, leadership, and overall fit with the program's vision for international and interdisciplinary research.⁸¹ In addition to receiving a \$100,000 stipend, fellows are matched with acclaimed senior scientists around the world who supervise and mentor them throughout the course of the fellowship.⁸² The program's objective is to foster the next generation of interdisciplinary and internationally collaborative scientists who strive to address global problems through scientific innovations.⁸³ The program is in its third year and is jointly funded by Eric and Wendy Schmidt and the Rhodes Trust.⁸⁴ Since its inception in 2018, there have been 56 Schmidt Science Fellows, and at least 19 of them, or more than one-third (34 percent), have been foreign-born individuals affiliated with U.S. institutions. To date, at least 26% of foreign-born fellows have come from India (3) and China (2).⁸⁵ A further indication that the next generation of leading scientists will be truly global as the international community of science has extended well beyond Europe and the United states.



In 2020, at least four of 22 Schmidt Science Fellows, or 18 percent of the winners, are foreign-born individuals currently affiliated with U.S. institutions.

Deepak Krishnamurthy is a PhD candidate in Mechanical Engineering at Stanford University.⁸⁶ Krishnamurthy is from Chennai, South India. He moved to the United States in 2014 to pursue his PhD at Stanford University. Before coming to the United States, Krishnamurthy earned his MS degree in Fluid Mechanics at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bengaluru, India. From 2007 to 2011, he completed his undergraduate education at the Birla Institute of Technology and Science (BITS)-Pilani. Krishnamurthy's research centers on "organismal biophysics and developing new tools for biology" and employs a biology perspective to analyze the "schistosomiasis parasite and human infection."⁸⁷ His research serves to advance knowledge on the behaviors of single-cell organisms and furthers understanding of marine life.



Photo courtesy of Schmidt Science Fellows



Photo courtesy of Schmidt Science Fellows

Sofia Landi is a neuroscientist and Postdoctoral Associate at the Rockefeller University.⁸⁸ Originally from Argentina, Landi completed the first half of her postsecondary education from 2005 to 2010 at the University of Buenos Aires. She came to the United States to pursue her graduate education. From 2012 to 2019, she was a PhD student and Graduate Research Fellow at the Rockefeller University. Landi is recognized for her original research that found two new neural regions vital for facial recognition processes. As a Schmidt Science Fellow, she will continue her neuroscience research but shift her focus to better understanding memory and how the brain “allows us to mentally time travel through our map of memories.”⁸⁹

Fernando Soto is a nanoengineer and a Postdoctoral Scholar at Stanford University’s Canary Center for Cancer Early Detection.⁹⁰ Similar to his fellow foreign-born 2020 Schmidt Science Fellows, Soto came to the United States to pursue his graduate studies. After he graduated with a BS in Nanotechnology Engineering from the Tijuana Institute of Technology in 2013, Soto relocated to California. From 2012 to 2019, Soto studied and worked at the University of California, San Diego. By 2019, he obtained his MS and PhD in Nanoengineering and gained valuable scholarly work experience as a Research and Teaching Assistant. Soto is known for developing “microengines the size of a human cell.”⁹¹ As a Schmidt Science Fellow, Soto will design innovative “autonomous biorobots” or machines that imitate biological systems and could help automate work tasks that are too risky or otherwise inaccessible for humans.⁹²

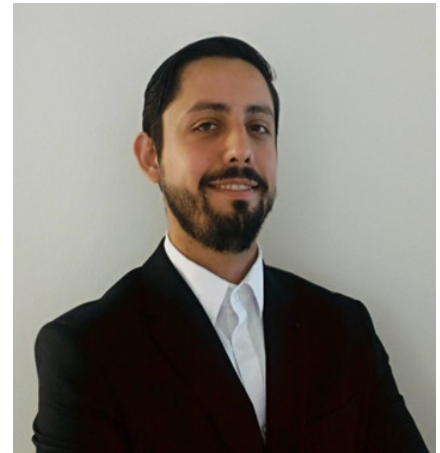


Photo courtesy of Schmidt Science Fellows



Photo courtesy of Schmidt Science Fellows

Yuanzhao Zhang is a Postdoctoral Fellow for Cornell University’s Center for Applied Mathematics.⁹³ Zhang is another 2020 Schmidt Science Fellow whose immigration story is rooted in his aspirations for graduate education at a prominent U.S. institution of higher education. Before relocating to the United States, Zhang studied Mathematics at Zhejiang University in Hangzhou, China from 2010 until 2014. Shortly after graduating from college, he began his graduate education at Northwestern University. First, he completed a MS in Applied Mathematics in June 2015 and then obtained his doctoral degree in Physics in August 2020. As a scientist, Zhang has been dedicated to theorizing and predicting collective behavior in complex systems such as “the synchronous flashing of fireflies without a leader.”⁹⁴ As a Schmidt Science Fellow, he will broaden his research agenda to investigate the effects of cellular heterogeneity on the circadian clock, which governs humans’ sleep-wake cycle.

Immigrant Workers in the Biomedical Industry

The biomedical industry and its hundreds of thousands of highly-skilled, immigrant workers are vital to ongoing efforts to discover the COVID-19 vaccine. For example, immigrant scientists, such as virologists, immunologists, and chemists, comprise a key part of the Pharmaceutical and Medicine Manufacturing sector workforce.⁹⁵ Below, we highlight several of the highly-skilled immigrant workers who are steadfastly researching the novel coronavirus and remain committed to finding a vaccine that would save thousands of lives around the world.

Immigrants occupy a significant number of essential positions across several segments of the biomedical industry, including Medical Equipment and Supplies Manufacturing, Pharmacies and Drug Stores (Retail), and Pharmaceutical and Medicine Manufacturing. Note that individuals who work in an industry can work in any occupation within that industry. As depicted in Table 2, immigrants account for 19 percent of the workers in these three sectors. Compared to the Pharmacies and Drug Stores (Retail) sector, immigrant workers comprised larger shares of the workforce in the Medical Equipment and Supplies Manufacturing and the Pharmaceutical and Medicine Manufacturing sectors.

Sixty-four percent of immigrant workers in these sectors are naturalized U.S. citizens.⁹⁶ This is not surprising since immigrants working in these sectors tend to have resided in the United States for many years. The median year of immigration is 1995 for workers in the Medical Equipment and Supplies Manufacturing sector, 1999 for those in the Pharmacies and Drug Stores (Retail) sector, and 1997 for those in the Pharmaceutical and Medicine Manufacturing sector. This means that roughly half of these workers have been in the United States for more than 20 years.⁹⁷

Table 2. Share of Foreign-Born Workers In Select Segments of the Biomedical Industry

Biomedical Industry Segment	Number of Foreign-Born Workers	Share of All Workers in Industry Segment
Medical Equipment and Supplies Manufacturing	156,302	23%
Pharmacies and Drug Stores (Retail)	164,649	15%
Pharmaceutical and Medicine Manufacturing	139,317	24%
Total	460,268	19%

Source: IIR analysis of American Community Survey (ACS) 2014-2018 5-year survey data.

Table 3 shows the top countries of origin of immigrant workers in three sectors of the biomedical industry. The top five countries of origin are the same for all sectors – China, India, Mexico, the Philippines, and Vietnam -- but the percentage of immigrant workers that originate from each country varies across industry sectors. Consistent with these countries of origin, the top languages spoken at home for all immigrant workers in these three sectors are Spanish, English, Hindi and related languages, Vietnamese, and Filipino/Tagalog.⁹⁸

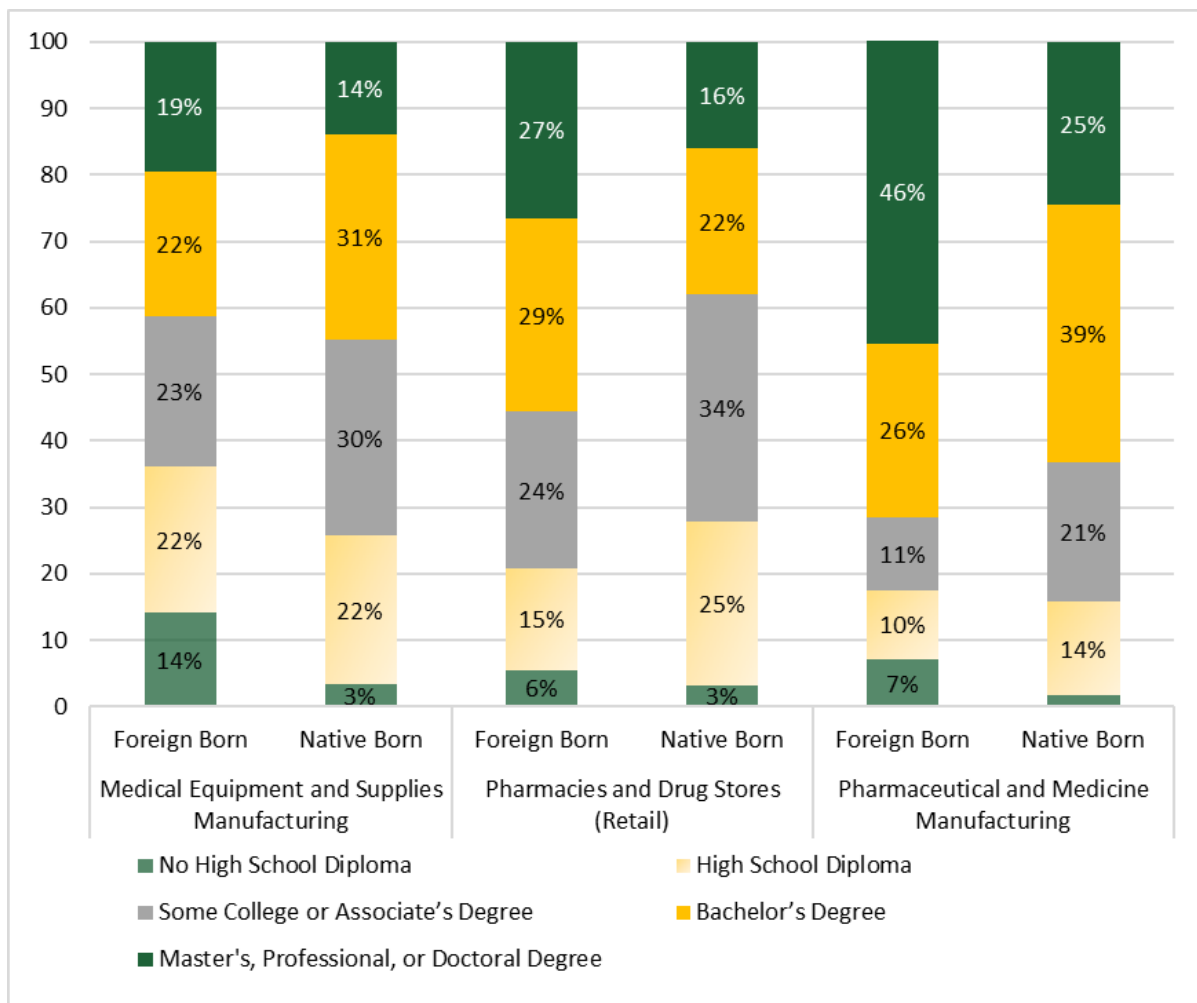
Table 3. Country of Origin of Foreign-Born Workers In Select Segments of the Biomedical Industry

Medical Equipment and Supplies Manufacturing		Pharmacies and Drug Stores (Retail)		Pharmaceutical and Medicine Manufacturing	
Mexico	14%	India	12%	India	18%
Vietnam	9%	Mexico	9%	China	12%
India	8%	Philippines	7%	Mexico	9%
Philippines	8%	Vietnam	7%	Philippines	5%
China	5%	China	4%	Vietnam	3%
145 Other Countries	56%	147 Other Countries	61%	148 Other Countries	53%

Source: IIR analysis of American Community Survey (ACS) 2014-2018 5-year survey data.

When compared to their native-born counterparts, immigrant workers in these sectors of the biomedical industry are more likely to have a master’s, professional, or doctoral degree (Figure 3). In the Pharmaceutical and Medicine Manufacturing segment, for example, 46 percent of foreign-born workers have an advanced degree compared to 25 percent of native-born workers. In the Pharmacies and Drug Stores sector, 27 percent of immigrant workers have a master’s degree or higher compared to 16 percent of native-born workers. Conversely, while the foreign born are more likely to have an advanced degree, foreign-born workers in these sectors are also more likely than the native born to have less than a high school diploma. These individuals are unlikely to be in scientific research occupations, but rather occupy other jobs requiring less education within these sectors of the biomedical industry.

Figure 3. Educational Attainment of Foreign-Born versus Native-Born Workers In Select Sectors of the Biomedical Industry, Age 25+



Source: IIR analysis of American Community Survey (ACS) 2014-2018 5-year survey data.

Immigrant Scientists in Pursuit of the COVID-19 Vaccine

Creating and administering a vaccine during a global pandemic requires many different skills, and immigrants fill many roles from top scientists and business leaders to research assistants and pharmacy workers, to administrative and janitorial staff that keep research labs clean and operational. In this section we highlight several immigrants who are working in the biomedical industry and on the COVID-19 vaccine in a variety of capacities.

Noubar Afeyan is a “two-time immigrant,” co-founder, and chairman of Moderna, a Cambridge-based biomedical technology company at the forefront of developing a COVID-19 vaccine called mRNA-1273 as part of its Coronavirus Efficacy (COVE) study.⁹⁹ Moderna is in many ways an immigrant-run company given that several other members of its leadership team are immigrants. The company also has a history of hiring foreign-born, high-skilled workers; for instance, in 2019 Moderna sponsored the renewal of 27 work visa applications. Afeyan was born on July 25, 1968 in Beirut, Lebanon to foreign-born Armenian parents. To escape the Lebanese Civil War, his family immigrated to Canada when Afeyan was only a teenager. After completing his college education at McGill University, Afeyan became a migrant for the second-time when he relocated to the United States. In 1987, he obtained his PhD in Biochemical Engineering from the Massachusetts Institute of Technology (MIT). Afeyan has a remarkable professional record as an inventor, entrepreneur, chief executive officer (CEO), and venture capitalist for close to three decades. Among his most notable achievements are establishing over 50 life science and technology startups and creating over 100 patented inventions. In honor of Afeyan’s significant societal contributions as a foreign-born U.S. citizen, the Carnegie Corporation awarded him the 2016 Great Immigrant award, while the International Institute of New England honored him with the 2017 Golden Door Award for “his extraordinary impact on the lives of others through a life of accomplishment, industry, and service.”¹⁰⁰ Since January 13, 2020, Moderna has been working closely with federal agencies, including the National Institute of Health and the Food and Drug Administration, to advance the vaccine’s development under Operation Warp Speed. Afeyan remains dedicated to his lifelong mission of “improving the human condition” through scientific innovations and entrepreneurship.¹⁰¹



Photo courtesy of Flagship Pioneering

Albert Burla is the Chairman and Chief Executive Officer of Pfizer but also has a long history of serving Pfizer in various other roles since 1993.¹⁰² Burla was trained as a Doctor of Veterinary Medicine and holds a PhD in Biotechnology of Reproduction from the Veterinary School of Aristotle University of Thessaloniki, Greece. He left Greece in his early 30s to work for Pfizer around the world, “My wife and I lived in eight different cities from five different countries until I got to where I am now [as chairman and CEO].”¹⁰³ Burla moved to the United States in 2001 to assume a leadership position at Pfizer’s New York Global Headquarters. Since then, he steadily advanced in the company until he reached his current position. Despite his long residency in the United States, Burla maintains that he was “born, raised, studied, fell in love, and got married in Thessaloniki. Thessaloniki was and is the center of my life.”¹⁰⁴ Currently, Burla is leading Pfizer in the development of a novel coronavirus vaccine, which will soon be piloted in Rhode Island, Texas, New Mexico, and Tennessee. Studies of the vaccine suggest that it may be as much as 90 percent effective in preventing the novel coronavirus.¹⁰⁵ In a nutshell, Burla is living up to Pfizer’s mission of driving “breakthroughs that change patients’ lives, with a focus on driving the scientific and commercial innovation needed to have a transformational impact on human health.”



Photo courtesy of Wall Street Journal

David Da-I Ho is a renowned Taiwanese-American molecular biologist and acquired immunodeficiency syndrome (AIDS) researcher who is now leading his research lab, Aaron Diamond AIDS Research Center (ADARC), at Columbia University in the race to find a cure for the coronavirus.¹⁰⁶ Ho’s ambitious vision entails developing novel coronavirus treatment compounds for animal testing within a year, a process that typically takes five to 10 years. Ultimately, Ho wants to develop a single pill that could treat the novel coronavirus and its potentially emergent strains. Ho’s pursuit for the vaccine seems promising in light of the human and financial resources he is dedicating to the discovery efforts including Aaron Diamond AIDS Research Center’s staff of over 36 scientists and about eight million dollars from private

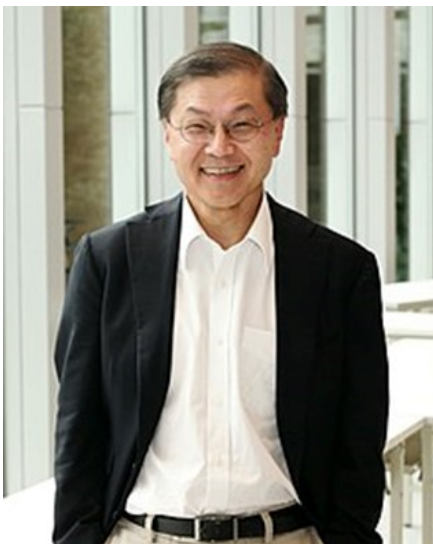


Photo courtesy of Wikipedia

donations. With respect to Ho’s immigrant background, he was born on November 3, 1952 in a small Taiwanese town called Taichung. He and his mother emigrated to the United States in 1965, nine years after Ho’s father had emigrated to set up a home for them in Los Angeles. Ho was just 12 years old at the time of his arrival and only spoke in Chinese. While he initially struggled to master the language barrier, Ho developed his English fluency within 6 months and began to academically and socially thrive at school. Ho’s unwavering work ethic throughout his secondary education culminated in his admission into the Massachusetts Institute of Technology’s (MIT) physics undergraduate program. However, Ho felt homesick in Boston and longed to be back in California, so he transferred to the California Institute of Technology and graduated with honors in 1974. Right after college, Ho returned to the East coast for Harvard Medical School and stayed this time until he graduated in 1978.



Photo courtesy of Philadelphia Inquirer

Yaya Dia is a West African immigrant and Research Technician at the Wistar Institute, a Philadelphia-based biomedical research institution that specializes in early stage discovery of cancer, immunology, and infectious diseases.¹⁰⁷ More specifically, Dia works within the Weiner Laboratory on a team of scientists committed to developing a “synthetic DNA vaccine and nanoparticles” in response to the pandemic.¹⁰⁸ Dia immigrated from Burkina Faso to the United States at the age of nine. Early on he was a bright, hardworking student in grade school with a “mentality to be number one.”¹⁰⁹

After high school, he pursued an associate’s degree in business from the Philadelphia Community College. However, the one biology course he took on a whim “spoke to his heart” and inspired him to consider a career in medicine.¹¹⁰ Upon encouragement from his biology professor, he applied to work at the Wistar Institute, where he now assists with ongoing studies of a novel coronavirus vaccine developed by Inovio Pharmaceuticals, Inc. For instance, Dia measures vaccinated monkeys’ blood samples and monitors their immune system’s response to the vaccine. His future career aspirations include becoming a neurosurgeon, entrepreneur, or a research scientist.

“Innovation is really a form of intellectual immigration. Leaving the comforts of what you know, exposing yourself to criticism, going to something that others don't believe to be possible and to keep at it until you make it a reality.”

Noubar Afeyan,
Chairman and Cofounder of Moderna*

*Marguerite Ward, “The Vaccine Breakthroughs at Moderna and Pfizer are the Latest Examples of How Immigrants Have Been Driving Billions in American Innovation for Decades,” *Business Insider*, November 22, 2020.

Meet Eric Yuan, Immigrant Creator of Zoom

During the COVID-19 pandemic and lockdown, Americans as well as people across the world have been turning to technology to communicate with others. One popular virtual meeting software is Zoom, which was created by a Chinese immigrant. Eric Yuan grew up in Tai'an in Shandong Province, China.¹¹¹ He is the son of mining engineers. While studying at Shandong University, he used to ride the train 10 hours to visit his girlfriend in college. According to Yuan, that is where he first envisioned Zoom. "I was young then — 18 or 19 years old — and I thought it would be fantastic if in the future there was a device where I could just click a button and see her and talk to her."¹¹²

Today, Yuan is married to that girlfriend, is a U.S. citizen, and a billionaire. He came to the United States in the mid-1990s to work in Silicon Valley, but getting here was difficult. Yuan explained, "The first time I applied for a U.S. visa, I was rejected. I continued to apply again and again over the course of two years and finally received my visa on the ninth try."¹¹³ He finally arrived in Silicon Valley in 1997 and initially worked for WebEx, which was then acquired by Cisco, and he became Cisco's Corporate VP of engineering. At that point, Yuan's entrepreneurial spirit kicked in. "I firmly believed I could develop a platform that would make customers happy, so in June of 2011, I decided it was time to make the video communications solution I imagined during my college train trips a reality."¹¹⁴ Zoom was launched in 2012, and in the following years, they've hosted billions of meeting minutes each year.



Photo courtesy of Zoom

"The first time I applied for a U.S. visa, I was rejected. I continued to apply again and again over the course of two years and finally received my visa on the ninth try."

Today, approximately one-third of the Fortune 500 companies and 90 percent of the top 200 U.S. universities use Zoom. "Every day is a record," Yuan says.¹¹⁵ In 2020 use of Zoom dramatically increased. In April of this year alone, use of Zoom increased 30-fold. More than 300 million people participate in virtual Zoom meetings every day.¹¹⁶ Yuan's invention has allowed many people to work remotely, and this trend is likely to continue well beyond the pandemic. People across the globe are using Zoom in myriad ways. Doctors are using it to meet with and diagnose patients; teachers conduct classes using it; lawyers and judges appear virtually in court; actors conduct virtual performances; candidates campaign virtually; friends and families are using it to spend time with each other, and couples date on their screens. Countless people have attended Zoom weddings, funerals, and other life events. Eric Yuan was named one of *Time Magazine's* 100 Most Influential People of 2020 and ranks among the 400 richest people in the United States, according to *Forbes*.¹¹⁷

Conclusion

The 2020 Nobel Laureates and the MacArthur and Schmidt Science Fellows highlight the importance of international collaboration for scientific and medical discoveries. Several of this year's winners worked together across international boundaries and made critical contributions to the study of disease and illness. While the world is in the midst of a global COVID-19 pandemic, doctors, scientists, and researchers are working together to better understand this virus and develop a vaccine. Immigrant scientists in the United States are essential members of these research teams. It is likely that future Nobel Prizes will recognize the research being conducted on the COVID-19 vaccine today.

"As a teenager I dreamed of living in the US. Like many immigrants drawn here, the US was not just a country, but an animating idea where people from different places, different religions, different races, could come together as one."

Noubar Afeyan,
Chairman and Cofounder of Moderna*

*Marguerite Ward, "The Vaccine Breakthroughs at Moderna and Pfizer are the Latest Examples of How Immigrants Have Been Driving Billions in American Innovation for Decades," *Business Insider*, November 22, 2020.

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About the Institute for Immigration Research

The Institute for Immigration Research (IIR) is a multidisciplinary research institute at George Mason University. The IIR's mission is to produce valid, reliable, and objective multidisciplinary research on immigrants and immigration to the United States and to disseminate this information through peer-reviewed academic journals, as well as in print and digital formats that make this research easily accessible to policy-makers, the media, the business community, and the general public. Our faculty affiliates, graduate students, and partners are at the forefront of research examining the economic contributions of all immigrant in the United States. The IIR produces high quality, timely research and analysis intended to promote informed action.

The IIR was founded in 2012 through the generous donation of Ms. Diane Portnoy and is a joint venture with The Immigrant Learning Center, Inc. (ILC) of Malden, Massachusetts.

The IIR is located on the campus of George Mason University in Fairfax, Virginia, outside the nation's capital, Washington, DC. Its strategic location allows the IIR to draw on unparalleled academic, government, and private resources to advance its mission in research, education, and professional opportunities for current and future scholars of immigration studies. Through conferences, workshops, lectures, and other events, the IIR is able to engage in community outreach with one of the most diverse populations in the United States.

Endnotes

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