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UNITED FOR MEDICAL RESEARCH

Why Invest in NIH?

By ensuring steady and sustainable annual increases to the budget for the **National Institutes of Health**, Congress can save and improve lives, advance innovation and fuel the economy. Here are some other reasons why Congress must act to **#keepNIHstrong**.

NIH

amazing things

America's investment in biomedical research through the National Institutes of Health makes amazing things possible. The medical innovations on this page result directly and indirectly from NIH science, illustrating the ripple effect of NIH-funded research — knowledge that builds on knowledge that leads to discoveries and innovations that save and improve lives.

COVID-19-Diagnosing Face Mask

WHAT

A **wearable biosensor** that can provide rapid, on-the-spot detection of the SARS-CoV-2 virus from the wearer's breath.

SIGNIFICANCE

The button-activated mask gives results to the wearer within 90 minutes and is as accurate as standard PCR tests in detecting COVID-19. Wearable biosensors, which rely on a novel technology that embeds synthetic biology reactions into fabrics, can be programmed to provide on-the-go detection of other dangerous viruses, bacteria, toxins and chemical agents, holding great potential for healthcare workers, researchers, emergency response personnel and others at risk of exposure. The technology has attracted additional support from DARPA and the Defense Threat Reduction Agency.

WHO

James Collins, Ph.D., and **Peter Nguyen, Ph.D.**, and a team of researchers from the Wyss Institute for Biologically Inspired Engineering at Harvard University and the Massachusetts Institute of Technology. The researchers first applied this technology to diagnostics by integrating it into a tool to address the Zika virus outbreak in 2015.

> "We have essentially shrunk an entire diagnostic laboratory down into a small synthetic biology-based sensor."
>
> **Peter Nguyen, Ph.D.**
> Research Scientist, Wyss Institute

Image credit | Wyss Institute at Harvard University

Image credit | Felice Frankel and MIT News Office

> "We envision that this platform could enable next-generation wearable biosensors for first responders, health care personnel, and military personnel."
>
> **James Collins, Ph.D.**
> Wyss Institute and Termeer Professor of Medical Engineering & Science and Professor of Biological Engineering at MIT

Eric Leuthardt, MD, models the IpsiHand Upper Extremity Rehabilitation System

Image credit | Elizabeth Holland Durando, Washington University School of Medicine in St. Louis

The IpsiHand

WHAT

The first **FDA-approved device** using brain-computer interface (BCI) technology to help restore function to patients with chronic stroke. The device uses the uninjured, or ipsilateral, side of the brain to improve arm and hand function.

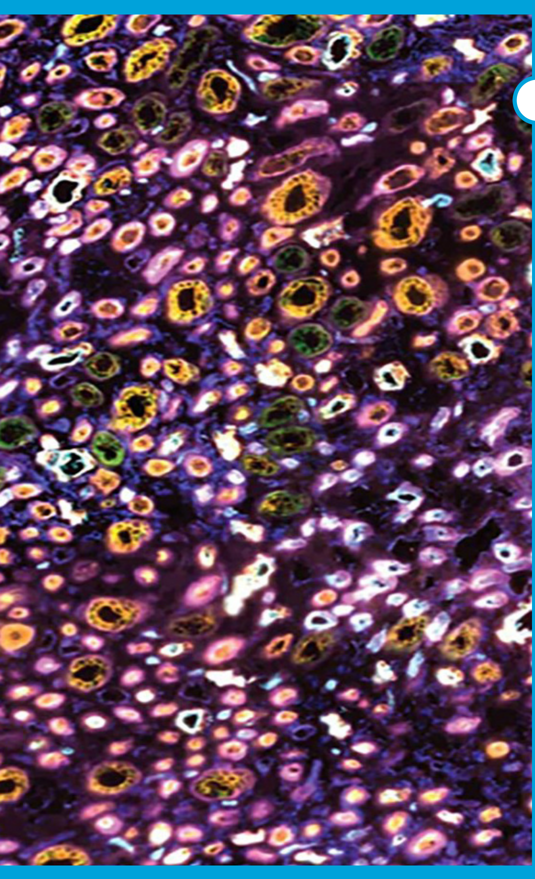
SIGNIFICANCE

The IpsiHand Upper Extremity Rehabilitation System offers new hope to people whose arm and hand function has been disabled by stroke. Generally, any motor impairments experienced by a patient six months after a stroke are considered permanent. However, in clinical trials, chronic stroke patients engaged in therapy using the IpsiHand showed significant improvement in motor control after 12 weeks.

WHO

Eric Leuthardt, MD, professor of neurosurgery at the Washington University School of Medicine in St. Louis, and **Daniel Moran**, Ph.D., professor of biomedical engineering at Wash U's McKelvey School of Engineering, developed the technology behind the IpsiHand and co-founded **Neurolutions** to bring the technology to market.

> "People have been trying for a long time to convert BCI from an experimental technology into something that will truly help patients. With this, we've shown that BCI is finally ready for prime time. I sincerely hope there are many more such devices to follow."
>
> **Eric Leuthardt, MD**



A CODEX MxIF image of human kidney medulla

Image credit | Dr. Elizabeth Neumann, Vanderbilt University Biomolecular Multimodal Imaging Center

HuBMAP (the Human BioMolecular Atlas Program)

WHAT

An audacious effort to create an open-access, high-resolution, 3D molecular guide to the healthy human body.

SIGNIFICANCE

The maps and atlas resulting from **HuBMAP** will enable a better understanding of how cells and tissues carry out daily processes to keep the human body alive and healthy. For instance, end-stage renal disease is one of the nation's most debilitating and expensive medical conditions, yet scientists don't know exactly why the kidney's filtration system stops working. Work at **Vanderbilt University** led by Richard Caprioli, Ph.D., professor and director of the Mass Spectrometry Research Center and Jeff Spraggins, assistant professor of cell and developmental biology, to develop a map of the human kidney may help solve this puzzle and enable better prevention and treatment.

WHO

The program involves collaborative research teams from across the country and around the globe and brings together software engineers, computational biologists, microscopists, pathologists, and other experts to map the body at cellular resolution.

Jeff Spraggins, Ph.D.

Image credit | Vanderbilt University

Richard Caprioli, Ph.D.

Image credit | Vanderbilt University

> "It's like Google Earth for the body. You can travel around inside a piece of tissue and explore different cells and microenvironments. It's breaking open our understanding of disease at an unprecedented level."
>
> **Richard Caprioli, Ph.D.**

Drew Weissman, MD, Ph.D.
Katalin Karikó, Ph.D.

Image credit | Penn Medicine News

> "mRNA vaccines are essentially plug and play. We believe you can change the part of the mRNA that encodes a protein, plugging in new code specific to the virus we hope to protect against, and cause one's body to produce proteins that match that virus' proteins. We do not have to develop and manufacture an entirely new formula."
>
> **Drew Weissman, MD, Ph.D.**

mRNA Vaccines

WHAT

Unlike traditional vaccines that contain a weakened or dead version of the virus they are intended to protect against, mRNA vaccines use specifically designed messenger RNA to instruct the body to make proteins that make the immune system respond to the virus. The immune system then builds up the necessary defenses against the viral proteins to protect against future infection and severe disease. The first-ever mRNA vaccines approved for use were the Pfizer/BioNTech and Moderna vaccines for COVID-19.

SIGNIFICANCE

mRNA vaccines are easier to standardize, scale and produce because they don't contain a version of the real virus. In fact, researchers have been studying mRNA technology for over a decade because they believe it holds great **potential** for a wide variety of diseases. For example, researchers have used custom-made mRNA to trigger the immune system to target specific **cancer** cells.

WHO

Many people contributed to the development of mRNA vaccines; three who stand out are Drew Weissman, Katalin Karikó and Kizzmekia Corbett.

- **Drew Weissman**, MD, Ph.D., Roberts Family Professor of Vaccine Research at the University of Pennsylvania Perelman School of Medicine, and **Katalin Karikó**, Ph.D., adjunct professor of Neurosurgery at Perelman and a senior vice president at BioNTech, helped pave the way for the COVID-19 vaccines from Pfizer/BioNTech and Moderna with key discoveries in 2005 about how to chemically modify mRNA so that it could be used safely and effectively in vaccines.
- More recently, while a research fellow at the National Institutes of Health's Vaccine Research Center, **Kizzmekia Corbett**, Ph.D., was doing groundbreaking research as part of a team studying coronaviruses and working with Moderna on an investigational mRNA vaccine for MERS. When COVID-19 emerged, they pivoted their work to develop the successful Moderna COVID-19 vaccine. Dr. Corbett is currently an assistant professor in the Department of Immunology and Infectious Diseases at the Harvard T.H. Chan School of Public Health and is the Harvard Radcliffe Institute Shultzer Assistant Professor.

Kizzmekia Corbett, Ph.D.

Image credit | National Institutes of Health

> "**Messenger RNA technologies** have been in development from a basic science perspective for [many] years. A lot of that work was funded by NIH... So, our understanding of how this technology works to make really good vaccines predates this pandemic. I think one of the worries that many people have is how fast and how new this technology is. But all science is compounded knowledge — everything builds on itself."
>
> **Kizzmekia Corbett, Ph.D.**

NIH-supported research is advancing our knowledge and making amazing things possible.

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