THE FRONT ROW
at Scripps Research

Decoding viruses for vaccine innovation

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ABOUT THE LECTURE

Understanding how viruses infect human cells is fundamental to designing effective vaccines. In his Front Row lecture, Scripps Research professor Andrew Ward explored how structural biology and advanced imaging techniques are transforming vaccine development. By visualizing viral proteins at the atomic level, his lab uncovers structural weak spots that can be targeted by the immune system. Ward also shared how his research contributes to ongoing efforts to prepare for future pandemics.

TOP TAKEAWAY POINTS

- Structural biology now allows scientists to see viral proteins in atomic detail. The Ward lab specializes in cryo-electron microscopy, a powerful imaging technique that reveals how viruses interact with the immune system. This structural data has paved the way for precise vaccine design, as demonstrated by Ward's work in mapping and analyzing the spike proteins of HIV, coronaviruses and other pathogens.

- The Ward lab achieved a major milestone by revealing the first high-resolution structure of a human coronavirus spike protein, providing a detailed "blueprint" that has guided vaccine development against coronaviruses. His lab also contributed to refining, stabilizing and patenting structural modifications such as the "2P mutation" in coronavirus spike proteins—which ensured the protein remained in the right shape for COVID-19 vaccines to work effectively.

- Years of foundational research in RNA technology, protein engineering and immune system responses allowed scientists to develop COVID-19 vaccines in record time. Modified RNA (mRNA) research began in the 1970s as a tool for delivering protein therapeutics—not vaccines. The ability to rapidly develop mRNA-based vaccines when the pandemic struck was a testament to basic research and reinforced the need to invest in pandemic preparedness before a crisis occurs.

- Viruses like HIV and influenza use various evasion strategies to avoid detection by the immune system. By identifying structural weak spots on viral proteins, the Ward lab is mapping how antibodies interact with these viruses. His lab is also analyzing antibody sequences and structures—key information for guiding vaccine design and improving antibody-based therapies.

- In addition to the need for investment in scientific infrastructure, Ward highlighted the critical role of mentorship in advancing biomedical research. He has dedicated funding to train the next generation of scientists, emphasizing that sustained support for young researchers is key to driving medical breakthroughs and preparing for future pandemics.

- Ward also emphasized that his success—and his lab's contributions to COVID-19, HIV and influenza vaccines—was only possible because of the fertile scientific environment at Scripps Research. He credited these accomplishments to the institute's early commitment to cutting-edge technology and its dedication to fostering a collaborative culture.

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