



invitrogen

# Synthetic vaccine research and development

Comprehensive and innovative synthetic  
biology solutions and technologies

**ThermoFisher**  
SCIENTIFIC

# From plan to product, Thermo Fisher Scientific supports your synthetic vaccine goals

We combine next-generation sequencing, *in silico* gene design and synthesis, synthetic biology products, and manufacturing capabilities to form a comprehensive synthetic vaccine development workflow.

## **Going from drug research to application—faster**

The health care demands in developing and developed countries are wide-ranging and growing. Worldwide, the health care industry requires ways to streamline the drug research–development–application pipeline to make it more efficient and scalable, and to deliver cost-effective vaccines for infectious diseases and novel solutions for large, aging populations. This industry has the potential to treat, heal, and save millions of people.

## **Solutions for improved vaccines**

By accessing modern analysis techniques and precision molecular manipulation tools, the promise of significant health improvements and preventive strategies for all individuals is closer than ever. We're partnering with the industry's most forward-thinking leaders to improve the therapeutic pipeline and success rate of experiments and trials. Together, we're employing innovative, rigorous, and robust tools to provide comprehensive solutions to the pharmaceutical and biopharmaceutical industries to better develop, optimize, and mass-produce the prophylactics and treatments needed.



# Our end-to-end solutions support your goals to:

## 1. Develop better vaccines

- Enhanced and longer-lived immune responses
- Improved efficacies and safety profiles
- Immune responses that are more focused on relevant targets and epitopes
- More fine-tuned effector functions

## 2. Expedite research and development

- Unlimited flexibility in vaccine design
- Reduce costs and time-to-market

## 3. Meet your production goal

- Reduce production costs
- Increase capacity
- Achieve rapid availability of your product

## 4. Work in regulated environments

- Maintain GMP conformity
- Utilize chemically defined media and supplements
- Incorporate certified-origin components

# Workflow solutions for synthetic vaccine research and development:

## OPTIMIZE antigens

- Gene design and synthesis
- Test and deploy synthetic genes, variants, libraries
- Employ analysis from synthetic sequential permutational libraries
- Modulate immunogenicity by design
- Get fast results; high expression and capacity

## DEVELOP immunogen

- Vector construction
- Seamless cloning and assembly
- High-order genetic assembly
- Plasmid transfection
- Engineer for efficacy and high titer
- Separate candidates, e.g., by magnetic bead or FACS strategies

## PRODUCE immunogen

- Various cell types
- Cell culture, media optimization, and fermentation
- Chemically defined, AOF media and matched feed

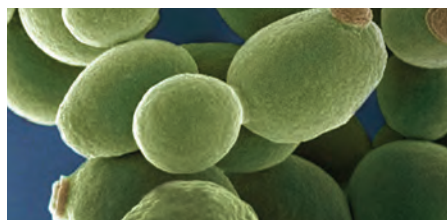
## PURIFY immunogen

- Resins and chromatography
- Polish RNA, DNA, and protein with high-capacity, high-resolution chromatography resins
- Rapid assays for key contaminants and impurities

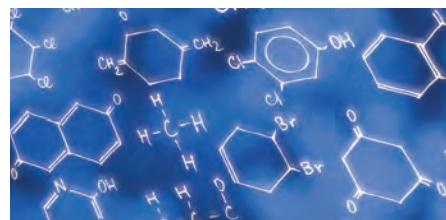
Our comprehensive portfolio of industry-leading brands and products for research and development includes:



Invitrogen™ Vector NTI™ sequence analysis software



Invitrogen™ GeneArt™ cloning, assembly, and site-directed mutagenesis kits



Invitrogen™ *in vitro* transcription kits



Invitrogen™ GeneArt™ Precision TALs



Gibco™ cell culture products



Applied Biosystems™ POROS™ chromatography resins

The Ion™ S5 Next-Generation Sequencing System:  
Simplicity. Speed. Scalability.



- Simple setup
- Flexible output
- Rapid run times
- Turnkey variant reports

Watch the demo at [thermofisher.com/ions5](http://thermofisher.com/ions5)

# Proven synthetic vaccine capabilities

We have a proven track record for our Invitrogen™ GeneArt™ molecular engineering tools in vaccine development. Below are a few examples of how our tools are fueling industry breakthroughs:

## Successful testing of an engineered HIV vaccine

In February 2008, GeneArt was awarded two US patents to protect the use of specific, custom-designed HIV gene sequences for development of therapeutics or vaccines. In a 40-person clinical trial, the prophylactic vaccination proved to be safe and well-tolerated, and it triggered a strong and lasting immune response in 90% of the vaccinated subjects (*J Exp Med* 205:63 (2008)). In 2009, GeneArt was awarded a contract by the HIV Vaccine Consortium (UK) to design and produce two HIV vaccine candidates based on the HIV gene sequences used in the 2008 trial.

## Production of synthetic genes for the development of an H1N1 vaccine in 5 days

In May 2009, the Invitrogen™ GeneArt™ Gene Synthesis and Assembly platform was employed to create synthetic H1N1 genes for a top European pharmaceutical company, and the product was delivered within a 5-day period. GeneArt created an additional ten H1N1 viral coat protein constructs for the Robert Koch Institute (the central federal institution responsible for disease control and prevention in Germany).

## The proof is in the publications

Our tools and technologies for synthetic biology have been widely cited, and have been featured in the *Journal of Virology*, the *Journal of Immunology*, *Human Vaccines*, and the *Proceedings of the National Academy of Sciences of the United States of America*, among several others. Research topics have included the implications of synthetic biology, vaccine development, and research breakthroughs related to HIV, Ebola viruses, and malaria.



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Find out more at [thermofisher.com/syntheticbiology](https://www.thermofisher.com/syntheticbiology)

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