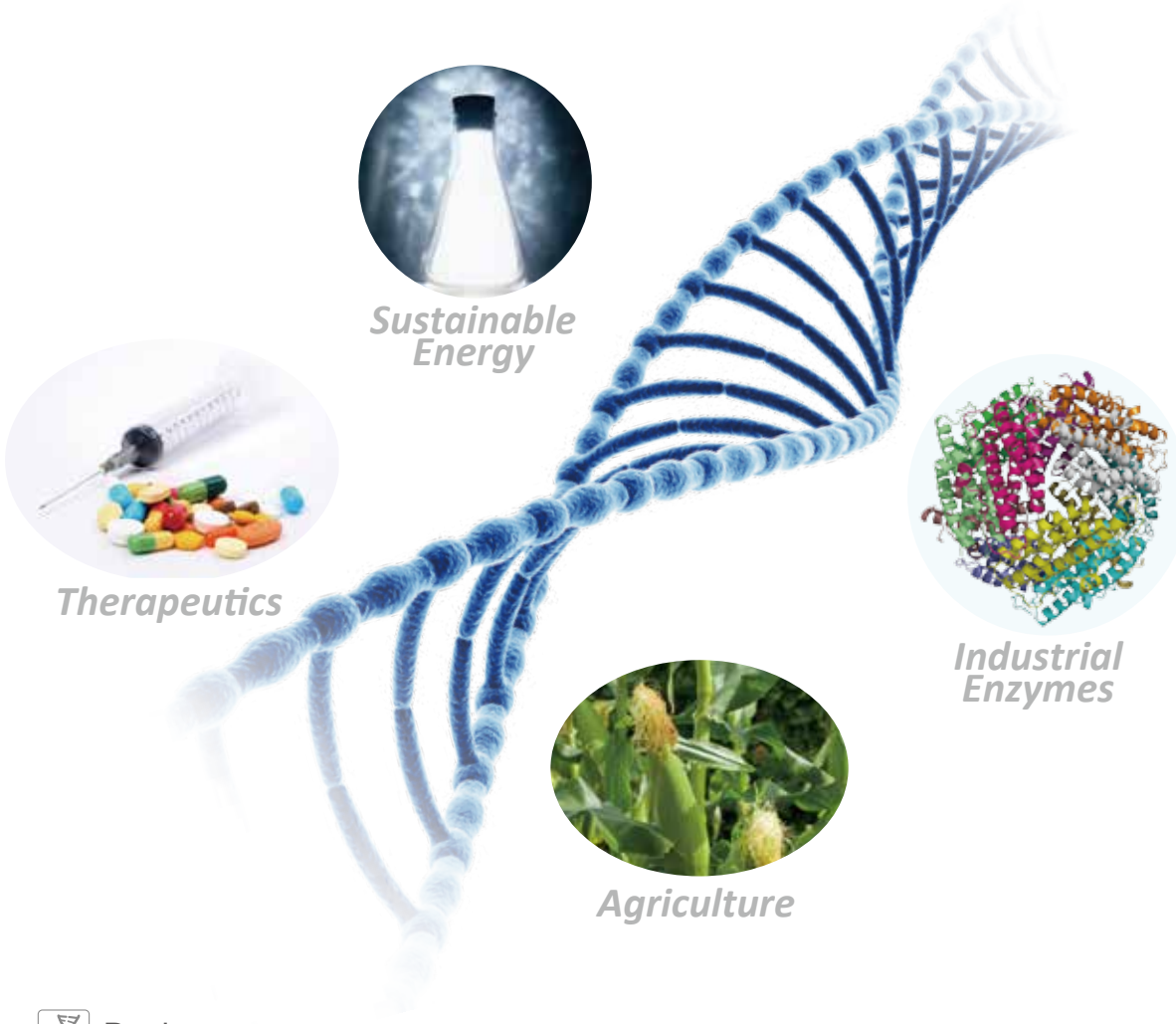
Synthetic Biology

Accelerating Discoveries, Expanding Possibilities



- Design
- Build
- Generate

GenScript
Make Research Easy

Solutions to Advance Synthetic Biology Research

Biosensors
Agricultural Products
Pharmaceuticals
Antibodies
Biomaterials
Vaccines
Industrial Enzymes
Biofuels

At GenScript we believe in the promise of synthetic biology to deliver new, effective disease therapies, create sustainable food and energy sources, develop systems to remove toxins from our environment, and provide scientific insight into the minimal elements required for life.

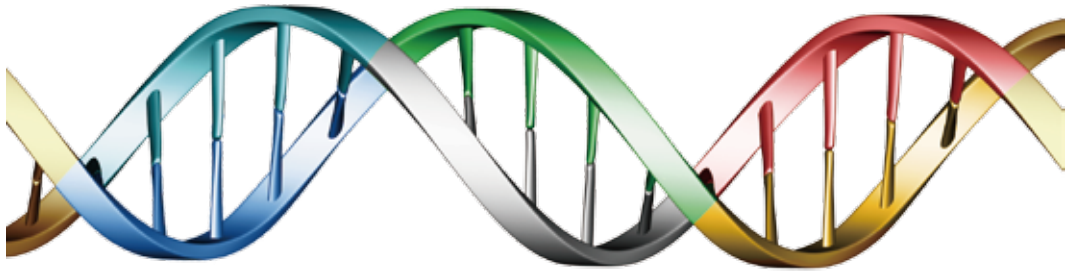
GenScript was the first commercial entity to provide gene synthesis services to the scientific community and has since expanded to provide a variety of solution-based services designed to make synthetic biology research easy. Powered by our unique combination of company attributes, our services provide the tools for synthetic biologists to design and build the genetic circuits and organisms that will generate valuable resources such as biofuels, food crops, and pharmaceuticals that will change our world forever.

Build
- Gene-on-Demand® Gene Synthesis
- CloneEZ® Seamless Cloning
- Mutagenesis
- Mutant Libraries
- Plasmid Preparation

Design
- OptimumGene™ Codon Optimization

Generate
- Protein Services
- BioProcess Services

Experience
Collaboration
Precision



Innovation
Ingenuity
Dedication

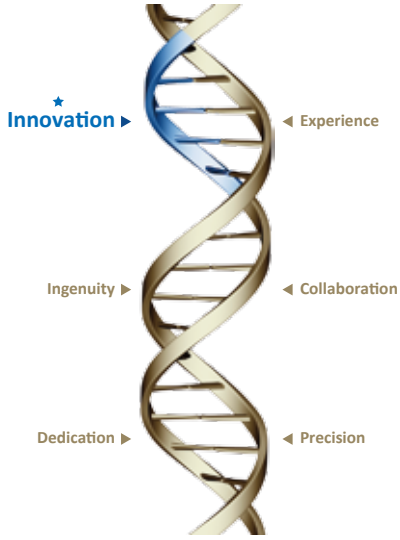
Design

Synthetic biologists design optimized genetic pathways that will subsequently be expressed in model, non-native hosts to produce valuable, natural products. However, genetic pathways that are not optimized for host cell expression can result in low target protein yield and solubility. GenScript provides a solution for genetic pathway optimization through our codon optimization technology, which optimizes the genes of engineered metabolic pathways to produce high yields of industrial enzymes or pharmaceuticals.

OptimumGene™ Codon Optimization Technology

OptimumGene™ Codon Optimization Technology increases protein yield and solubility in the host of your choice.

- Optimizes nearly every parameter known to influence transcription, translation, and protein folding
- Can increase protein yield up to 100-fold
- Can optimize protein expression in bacterial, yeast, mammalian, insect, and plant systems



Selected OptimumGene™ Parameters

Transcription:

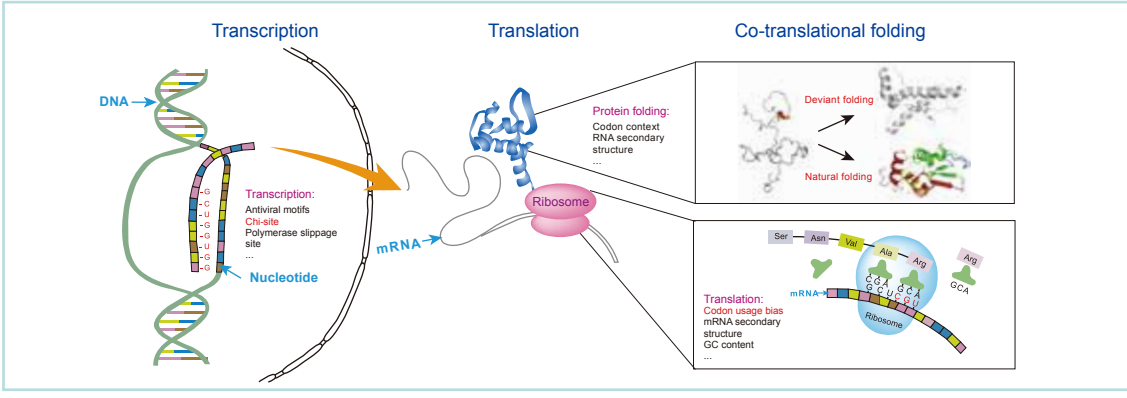
- GC content
- Cryptic splicing sites
- Negative CpG islands
- TATA boxes
- Termination signal

Translation:

- Codon usage bias
- mRNA secondary structure
- Premature PolyA sites
- RNA instability
- Ribosomal binding sites

Protein Folding:

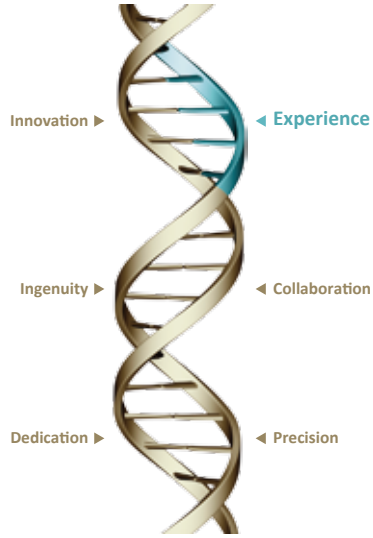
- Codon and anti-codon interaction



Technology Highlight: In 2012, GenScript was granted a patent for its OptimumGene™ Codon Optimization Technology (U.S. Pat NO. 8326547, "Method of sequence optimization for improved recombinant protein expression using a particle swarm optimization algorithm").

Build

Engineered genes and genetic circuits are the foundation of synthetic biology. One of the key bottlenecks in synthetic biology advancement is the construction of large, complex, mutation-free DNA constructs in a timely fashion. GenScript's gene synthesis and mutagenesis services can help you build any construct, from the smallest gene to a whole genome, in a short turnaround time with 100% sequence verification.



Gene-on-Demand® Gene Synthesis and Custom Cloning Services

Our Gene-on-Demand® Platform smoothly integrates codon optimization, *de novo* gene synthesis, and cloning technologies, to deliver sequence-verified constructs in turnaround times appropriate for any time-sensitive project.

- Custom gene synthesis
- Custom cloning
- Custom vector construction

Genes of any length and complexity

Gene up to **50** kb

High GC content

Repeat sequence

OptimumGene™ Codon Optimization

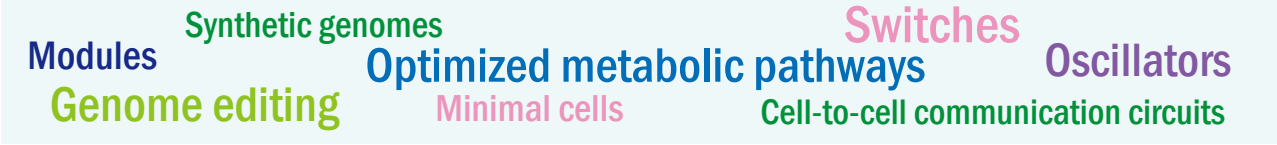
Gene-on-Demand® Gene Synthesis

Gene-on-Demand®

CloneEZ® Seamless Cloning

Our Track Record	Our Expertise
• 99.9% synthesis success rate • 98% of genes delivered on time • Record gene length >50,000 bp • Over 500,000 genes synthesized • 10 years of experience	Experts in synthesizing genes with: • GC content extremes (>70% or <30% GC) • Highly repetitive sequences • Strong secondary structures • Consecutive single-type nucleotides

Technology Highlight: CloneEZ™ Seamless Cloning Technology can clone any gene into any vector in 30 minutes, without the use of restriction digests and ligation reactions.

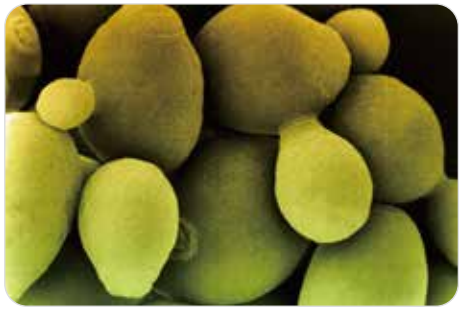


Feature Expertise: TALEN Gene Synthesis

Transcription Activator-Like Effector Nucleases (TALENs) are one of the latest breakthroughs in genome editing. TALENs are the combination of a high-specificity, high-affinity, DNA-binding protein with a functional nuclease (such as the endonuclease, FokI). The programmability of the DNA-binding portion of TALENs allows synthetic biologists to deliver virtually any nuclease to any target site of a genome for precise editing.

The DNA-binding motifs of TALENs are composed of 13 to 28 tandem near-repeats of amino acid sequences, which are encoded by complex, highly repetitive DNA sequences. Repetitive DNA sequences are difficult to synthesize, requiring great care and expertise. GenScript's extensive experience in complex gene synthesis includes synthesizing custom designed TALENs, up to 18 repeats, 100 nucleotides in length.

Gene-Brick™ Feature Collaboration: Building the First Synthetic Eukaryotic Genome

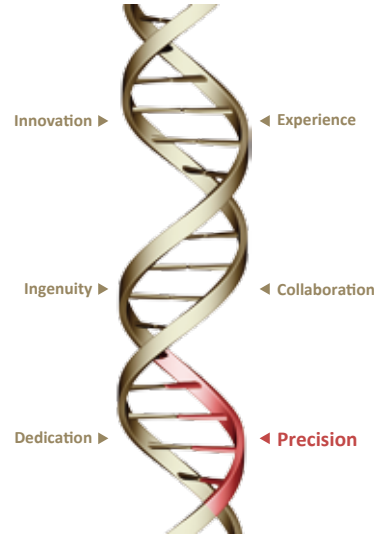


Gene-Brick™ is GenScript's premiere service for the synthesis of long DNA fragments (8-13 kb). The service can be used to construct a single genetic circuit or even a whole genome as described below.

In 2012, GenScript synthesized 17, 10 kb DNA fragments for the Johns Hopkins University Yeast Genome Project (Sc2.0), which will build the first synthetic eukaryotic genome (syntheticyeast.org/sc2-0/). When combined, the 17 fragments encode for a 170 kb yeast chromosome arm. Upon its completion, the synthetic genome will provide insight into the minimal elements required to sustain life.

Mutagenesis and Mutant Library Services

Mutagenesis allows for the design and production of new proteins with novel functions, and enzymes capable of catalyzing new reactions at high rates. These highly efficient mutants can break down biomass to produce biofuels, and increase carbon fixation rates to enhance the growth of crops for our food supply. Powered by our expertise in *de novo* gene synthesis, our mutagenesis services and libraries can bring any mutant design to fruition, from site-directed mutagenesis of a single gene for controlled rational design, to randomized libraries for directed evolution and screenings.



- Site-Directed Mutagenesis (unlimited mutations in a single construct)
- Site-Directed Mutagenesis Libraries
- Scanning Point Mutation Libraries
- Randomized and Degenerated Libraries

Technology Highlight: Large mutant libraries are crucial for increasing the efficacy of engineered protein screens in synthetic biology research. GenScript's **High-Throughout Protein Variants Service** has the unparalleled capacity to deliver up to 1,000 purified protein mutants in 30 days, starting from *de novo* gene synthesis.

Plasmid Preparation Services

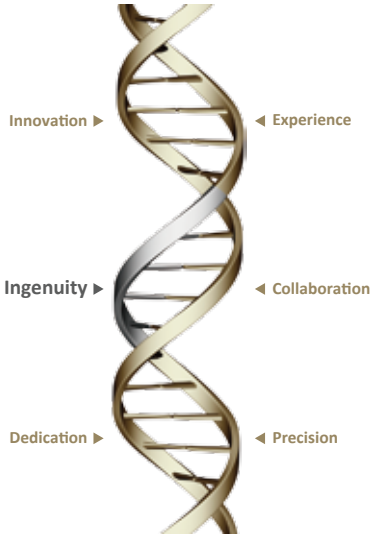
Large amounts of highly pure plasmid are useful for synthetic vaccine research or transfection of synthetic biology constructs for subsequent protein or antibody production.

High quality plasmid preparation services feature:

- Up to gram scale levels of purified plasmid
- ≥95% supercoiled plasmid
- Low endotoxin level (≤ 0.005 EU/μg)
- Bioburden testing
- Sterile filtration

Generate

Synthetic biology reaches far beyond the design of optimized genetic pathways. Purified proteins, cell lines, or antibodies are often the final products that synthetic biologists desire to produce or study. In addition, large-scale production of these biomolecules is often an important step in the research and development process. In anticipation of these research requirements, GenScript has developed a variety of services to help take your genetic design to the next level.



Protein Services

Flexible expression hosts, scale-up options, purification technologies, and one-stop packages make it easy to generate and/or study purified target proteins in any quantity.

GenScript protein services feature:

- **Flexible expression systems:** Bacterial, yeast, insect, mammalian
- **BacPower™ Guaranteed Protein Package:** Delivers purified protein starting from custom *de novo* gene synthesis
- **Large-scale protein production:** Up to 2,000 L (bacterial and yeast)
- **Purification technologies:** Affinity, gel filtration, ion exchange, hydrophobic interaction columns; HPLC
- **Structural biology services:** CrystalPro™ Gene-to-Structure Services, Co-crystallization

Bioprocess Services

Our mammalian cell expression systems can be used to produce engineered enzymes or synthetic antibodies. Scale-up bioprocess services are available to obtain high yields of target recombinant proteins.

- Transient protein expression
- **MamPower™ Guaranteed Protein and Antibody Packages:** Delivers purified proteins or antibodies starting from custom *de novo* gene synthesis
- Stable cell line development
- Process development

Our Commitment

For years, GenScript has supported synthetic biology research by participating in various activities and organizations including:

- **International Genetically Engineered Machine (iGEM):** Organization sponsor and sponsor of over 20 competitive collegiate teams
- **Synthetic Yeast Genome Project (Sc2.0):** Synthetic construct contributor
- **International Gene Synthesis Consortium (IGCS):** Co-founder
- **Cold Spring Harbor Asia Synthetic Biology Symposium:** Sponsor and presenter

We pledge to maintain our support until the promise of synthetic biology is realized.

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GenScript
Make Research Easy