



CJUH-JLU-China



# Smashing Synthetic Biology Rumours

## Science Brochure

**Editor-in-Chief: CJUH-JLU-China**

Completed jointly by  
33 iGEM teams worldwide



# Preface

CJUH-JLU-China is proud to present this *Smashing Synthetic Biology Rumours Science Brochure*, a collaborative endeavor with 33 iGEM teams worldwide. Born from a shared commitment to demystifying synthetic biology, this brochure seeks to address the misconceptions that often overshadow the field's potential.

Synthetic biology, at its core, is a discipline that harnesses the principles of engineering to redesign and optimize biological systems for the betterment of humanity—from developing life-saving medicines to creating sustainable solutions for environmental challenges. Yet, as it advances, it has become tangled in rumors: fears of "playing God," unfounded concerns about safety, and misunderstandings about its applications. These myths not only cloud public perception but also risk hindering progress that could alleviate pressing global issues.

Drawing from the collective insights of researchers and practitioners across 33 iGEM teams, this brochure dissects prevalent rumors with rigor and clarity. Each entry is rooted in evidence: we confront doubts about



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# Preface

the "unnatural" nature of synthetic biology products, address fears of ecological harm from engineered organisms, and clarify the boundaries between science fact and fiction.

Our mission is not to persuade, but to inform. By breaking down complex concepts and addressing concerns head-on, we aim to foster a dialogue where curiosity replaces skepticism, and knowledge empowers informed judgment. Synthetic biology thrives when society understands its potential and its limits—and this brochure is a step toward that understanding.

To readers, whether you are a student, a concerned citizen, or a fellow enthusiast, we invite you to explore these pages. Together, let us separate myth from science, and embrace the promise of synthetic biology as a tool for good.

**Editor-in-Chief Team CJUH-JLU-China  
In collaboration with 33 iGEM teams worldwide**



# The co-editor profiles



Revitalyze



NAIS



NEFU-China

Gout/  
BusterTONGJI  
CHINA

Shanghai-SOG





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# Chapter 1

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Misconceptions about  
the Core Nature of  
Synthetic Biology



# Crushing the Myths of Synthetic Biology



“Synthetic biology can only create new species, it can't be used to treat diseases.”

—Some people believe that synthetic biology is only useful for creating entirely new species, not for solving practical problems like disease treatment.



## The Truth

In reality, synthetic biology can not only be used to create new species but also to modify existing microorganisms to produce vaccines, drugs, and even treat diseases like cancer.

—NJTech-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology is about having cells synthesize specific novel substances, such as compounds that have never been seen before?”



## The Truth

In fact, the core of synthetic biology is to modify cells at the genetic level: by designing genetic circuits, regulating metabolic pathways, reconstructing the genome, and other methods, to optimize the functions of cells, and even to endow cells with new capabilities.

It is not simply "synthesizing a certain substance", but rather reshaping the biological system of cells, making them into more efficient "living factories" or "intelligent units", to serve diverse practical needs such as healthcare, environmental protection, and energy.

—NUDT-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology is very simple. How to assemble circuits is how to study synthetic biology.”

—Some people simply equate synthetic biology with assembling circuits.



## The Truth

In fact, synthetic biology only borrows engineering ideas and advocates "modularity" and "standardization", but the "assembly" of life is much more complex than electronic components. For example, we need to consider the metabolic pressure of new components on engineering bacteria.

—Tongji-China



# Crushing the Myths of Synthetic Biology



“Scientists are creating artificial humans.”

— Some people believe synthetic biology can directly build complete human beings or clone a new person.



The Truth

In reality, synthetic biology mainly focuses on microorganisms, plants, and simple cell systems for producing medicines, improving food, or environmental applications. Creating a whole human being is not only scientifically impossible but also strictly prohibited by ethics and law.

—BWYA



# Crushing the Myths of Synthetic Biology



“Scientists are playing God by controlling life.”

—Some people fear that synthetic biology gives humans absolute power over life.



## The Truth

In reality, synthetic biology operates within strict natural, technical, and ethical boundaries. Scientists can only make small, precise changes in microorganisms or cells for useful purposes, such as producing medicines or improving crops.

It's not about “playing God,” but about responsibly using knowledge to solve problems.

—BWYA



# Crushing the Myths of Synthetic Biology

 “Synthetic biology will soon produce robotic or machine-like living creatures.”

—Some imagine science – fiction scenarios where biology and robotics merge into hybrids.



## The Truth

Synthetic biology is about using natural biological parts (like DNA and proteins), not building robots. The goal is to make cells perform useful tasks — such as detecting toxins or producing renewable energy — not to create science-fiction organisms.

—BWYA



# Crushing the Myths of Synthetic Biology

“Synthetic biology is just ‘Gene Editing under a new name’.”

—The public often lumps all biotechnologies together and frequently gets to know various fields of biology simply from a few specific experimental operations or lab techniques.



## The Truth

Gene editing makes single-point changes to DNA, like “fixing a single word in a text.” Synthetic biology, by contrast, is more like “designing and writing an entire paragraph.” It emphasizes modularity and engineering principles, allowing biological systems to be designed and optimized like “building blocks”.

—HUST-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology research is equivalent to genetic modification technology.”

—Some people believe there is no difference between the two.



## The Truth

Genetic modification typically refers to the introduction or modification of a single gene, whereas synthetic biology places greater emphasis on systems design and standardization. It enables the construction of complex genetic circuits, metabolic pathways, or whole-genome modifications. Therefore, synthetic biology represents an expansion and advancement of traditional genetic engineering.

—BAID-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology is just transgenic technology.”

—Some people think that synthetic biology represents an advanced iteration of transgenic technology.



## The Truth

In fact, synthetic biology focuses on the modification and redesign of metabolic networks.

This "rational design" approach is quite different from the technology logic of transgenic technology.

—LZU



# Crushing the Myths of Synthetic Biology

“Synthetic biology is just playing God, creating new life.”



## The Truth

Synthetic biology is not about creating life “out of nothing.” Rather, it is more about engineering modifications and optimizations based on understanding and utilizing existing laws of life. Current research mainly focuses on purposeful and limited engineering improvements to existing biological systems (such as microorganisms) to serve human well-being. For example, scientists modify *\*E. coli\** to produce insulin – this does not create new life, but rather makes bacteria, as “micro-factories,” produce the substances we need more efficiently. Even the most cutting-edge “artificially synthesized cells” today, such as JCVI-syn3.0, rely on the simplification of natural genomes and cannot be completely separated from known laws of life.

—CSU-CHINA



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# Crushing the Myths of Synthetic Biology

“Synthetic biology is 'playing God' and goes against the laws of nature.”

—Some think synthetic biology creates entirely new life or modifies organisms to challenge the natural order.



## The Truth

Actually, that's a common misunderstanding. Synthetic biology doesn't create life out of thin air. Instead, it's based on a deep understanding of natural life systems — we just modify and optimize existing biological systems. For example, when producing insulin, scientists only alter the genes of *E. coli* and use its metabolic pathways to make insulin. That's not creating a new life form at all. Even advanced artificially synthesized cells are derived from simplifying natural genomes and don't go beyond the known laws of life. So, synthetic biology is more like a "life optimizer" — it uses the laws of nature to benefit humans, not violate them.

——HKUST-GZ



# Crushing the Myths of Synthetic Biology



“Synthetic biology is just a form of genetic engineering.”

—Some people believe that synthetic biology only involves inserting one or a few foreign genes into organisms.



## The Truth

In fact, synthetic biology represents a systematic and engineering-driven approach. It focuses on designing and constructing entirely new biological systems—such as reconstructing complete metabolic pathways or programming complex genetic circuits—rather than merely transferring individual genes. The emphasis is on rational design, predictability, and standardization.

—ZJUT-China



# Chapter 2

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## Concerns about Technical Safety and Ethical Issues



# Crushing the Myths of Synthetic Biology

 "Synthetic biology lacks strict regulation. Scientists freely modify life, which can easily lead to safety risks."

— Some members of the public, due to the "emerging" nature of synthetic biology, misunderstand that its research is unregulated and consider it as "disorderly tampering" with life.



## The Truth

In fact, synthetic biology has established a rigorous system of "multi-level regulation + modular design":

From a technical perspective, it is centered on programmability and modularity – biological functions are decomposed into standardized "biological parts", precisely regulated like building with Lego blocks, with clear logic and boundaries at each step.

From an ethical and regulatory perspective, research must pass through multiple checkpoints such as ethical review, safety assessment, and legal registration. From experimental design to application of results, the entire process is strictly constrained. In short, synthetic biology is "innovation with a ruler", rather than disorderly adventure.



# Crushing the Myths of Synthetic Biology

 “Gene editing can permanently and uncontrollably alter the human body.”



## The Truth

Modern gene editing tools like CRISPR-Cas9 are highly specific, more like GPS-guided scalpels than random scissors. They only act on pre-designed gene sites, often in a one-time, localized manner. Researchers also add safety switches and timing controls to prevent unintended effects.

In most synthetic biology projects, editing happens only in cells or microbes outside the human body. Even for medical applications, gene editing must pass multiple safety tests, ethical reviews, and clinical trials before use. The goal is precision treatment, not uncontrolled modification.

—iZJU-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology is mostly used to make dangerous viruses or bioweapons.”

—The public often associates it with movie plots, imagining scientists secretly developing harmful organisms.



## The Truth

In fact, biosafety regulations are extremely strict worldwide, and research institutions must follow international and national ethical and safety reviews. Most synthetic biology work is devoted to beneficial purposes such as medicine, agriculture, and environmental protection – for example, engineering bacteria to degrade plastics or to produce insulin.

—BWYA



# Crushing the Myths of Synthetic Biology



“Synthetic biology can create unlimited energy.”

—Some believe scientists can simply ‘bio-make oil’ and solve the energy crisis instantly.



The Truth

Scientists are indeed exploring biofuels using engineered microorganisms, but the efficiency and cost are still limiting factors. Synthetic biology is not magic – applications take years of research, optimization, and scaling before they can replace even part of our current energy use.

—BWYA



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## Crushing the Myths of Synthetic Biology



“Synthetic biology will give us instant cures for all diseases.”

—Some people fear that synthetic biology gives humans absolute power over life.



### The Truth

While synthetic biology has helped create vaccines, antibiotics, and new therapies, these require years of research, testing, and regulation. The process is slow, careful, and step-by-step – there is no instant “cure-all”.

—BWYA



# Crushing the Myths of Synthetic Biology

“Scientists are editing human babies at will.”

— Some imagine that gene editing allows anyone to design perfect babies with chosen traits.



## The Truth

In reality, germline editing (changing embryos) is strictly banned or heavily restricted in most countries. Research mainly focuses on treating serious diseases, not creating "designer babies".

—BNUZH-China



# Crushing the Myths of Synthetic Biology

“ Could artificially synthesized genes or proteins using synthetic biology techniques be more dangerous than natural ones? Or will they have unpredictable adverse effects?”

——Some worry that synthetic sequences may bring higher risks or side effects to human body or natural environment.



## The Truth

In fact, synthetic genes and proteins are fundamentally no different from natural molecules. Risks primarily depend on their function and application, not their origin. Researchers will conduct bio - security assessments before synthesis and conform to international bio-security protocols.

——BAID-China

# Crushing the Myths of Synthetic Biology

“These engineered bacteria will grow uncontrollably inside the human body.”

— Some people worry that once introduced, the bacteria might spread without control, like in a science-fiction movie.



••• The Truth

In reality, engineered bacteria are designed with strict safety switches. They can only survive under specific conditions (e.g., requiring certain nutrients or being sensitive to temperature or drugs). Outside of the laboratory or controlled environments, they quickly die. Before any clinical use, the technology must pass rigorous layers of safety and efficacy testing.

—XJTLU-Science-China



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# Crushing the Myths of Synthetic Biology

 "All bacteria are harmful."

— Some think every bacterium is bad for humans.



 The Truth

Some bacteria can be harmful, but not all, including the ones in your body that keep you healthy. Even E. coli has a strain that is not harmful!

 "There are 10x more bacteria in your body than your cells."

— It's believed bacteria outnumber human cells 10 to 1 in the body.



 The Truth

There are more bacteria than human cells in a body, but the ratio is slightly above 1:1 and not 10:1.

 "Synthetic Biology just produces genetically modified crops."

— People think synthetic biology only makes GM crops.



 The Truth

Synthetic biology has applications everywhere, from ocean beds to diseases in your body.



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# Crushing the Myths of Synthetic Biology

“Synthetic Biology is seen as a great advancement for the human race.”

—It's thought synthetic biology is universally viewed as a huge human advancement.



## The Truth

Not always, as there are concerns around biosecurity and "playing god".

“Synthetic Biology will cause diseases in humans.”

—Some believe synthetic biology will make people sick.



## The Truth

Many projects in synthetic biology are built to prevent/treat diseases.

—NYU-Abu-Dhabi



# Chapter 3

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Doubts about Environmental  
and Ecological Risks



# Crushing the Myths of Synthetic Biology

 “Plastic-degrading enzymes could be harmful to the environment.”

—Some people worry that introducing these enzymes might disrupt ecosystems or damage natural organisms.



## The Truth

Concerns that plastic-degrading enzymes might harm the environment are understandable, but current evidence suggests that such risks are minimal. Enzymes are protein molecules encoded by specific genes and expressed only in host organisms; they lack genetic material themselves and therefore cannot replicate or proliferate in the environment like cells or viruses. Plastic-degrading enzymes also exhibit high substrate specificity, acting mainly on defined chemical bonds (e.g., ester bonds), with little to no activity toward common natural macromolecules such as cellulose or proteins. Consequently, they are unlikely to cause large-scale disruption to native biological systems. In addition, enzymes contain neither DNA nor RNA and thus cannot spread, mutate, or evolve through horizontal gene transfer. Most are also highly sensitive to temperature, pH, ultraviolet radiation, and oxidation, which makes them prone to denaturation or degradation outside controlled conditions, preventing persistence or uncontrolled dissemination. Unlike bacteria or viruses, enzymes lack any mechanisms for transmission or host infection. Taken together, these properties indicate that plastic-degrading enzymes, when properly managed, pose little ecological risk compared with the long-term environmental harm caused by persistent plastic pollution.



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Shanghai-SDG

# Crushing the Myths of Synthetic Biology

“Engineered bacteria in biofertilizers are artificial and will damage the soil ecosystem.”

—Some worry that scientifically modified microbes could harm natural soil communities.



## The Truth

These bacteria are typically common, well-studied strains that are carefully engineered for a single, safe purpose. They undergo rigorous testing to ensure they cannot survive or spread in the environment after use. Their goal is to break down pollutants or enrich soil nutrients, helping to reduce chemical fertilizer use without disrupting ecological balance.

—Shanghai-SDG



# Crushing the Myths of Synthetic Biology

“Synthetic biology just means randomly mixing genes, and anything produced will be harmful.”

—Some people equate synthetic biology with dangerous genetically modified foods.



## The Truth

Synthetic biology products undergo strict safety evaluations, including toxicology and long-term safety tests. In fact, many widely used medicines like insulin and vaccines are already produced with synthetic biology techniques and have been proven safe for years.

—BWYA



# Crushing the Myths of Synthetic Biology

“Synthetic biology gene drugs will alter the human gene pool and trigger genetic disasters.”

— Some people may think that once synthetic biology gene drugs enter the human body, they will change the genes of human reproductive cells, thereby causing permanent and irreversible changes to the human gene pool and eventually triggering genetic disasters.



## The Truth

First, the spread of human genes mainly occurs through the reproductive process, while synthetic biology gene drugs usually target specific disease cells or tissues and do not affect reproductive cells. For instance, many therapeutic gene drugs only function locally within the body, such as repairing specific diseased cells or regulating certain physiological processes, and they do not enter reproductive cells to alter their genetic sequences. Second, there are strict regulatory and safety assessment mechanisms in place for the research and application of gene drugs. Scientists take various measures during the development process to ensure the safety and specificity of the drugs and prevent them from affecting non-target cells and genes. Finally, based on actual research and application, although synthetic biology gene drugs are constantly evolving, there is no reliable evidence to suggest that they will alter the human gene pool or trigger genetic disasters. On the contrary, gene drugs have shown great potential in treating many difficult and complex diseases, bringing new hope for human health.



# Crushing the Myths of Synthetic Biology

... “Synthetic biology will lead to uncontrollable species invasion.”

— It's claimed that if organisms created by synthetic biology are released into the environment, they will be as difficult to control as invasive species and damage the ecological balance. For example, XJTLU - CHINA intends to put gene-edited E. coli into the marine environment to control large-scale green tides.



## ... The Truth

In fact, when conducting relevant research, researchers will take various measures to prevent biological escape, such as designing special genetic circuits that cannot survive in the natural environment, and relevant experiments and applications must undergo strict risk assessment and supervision. When team members carry out related research, they have taken a variety of measures to prevent biological escape. For instance, a blue-light-induced suicide switch is added to engineered bacteria, which will commit suicide under natural light; engineered bacteria will not be directly placed in open water environments but will be carried by hardware designed by team members, providing double protection to prevent the modified bacteria from leaking.

—XJTLU-CHINA



# Crushing the Myths of Synthetic Biology

“Plasmids used in synthetic biology can easily spread into the environment and create superbugs.”

— Some people are concerned that engineered plasmids may transfer antibiotic resistance or other properties to natural bacteria.



## The Truth

In fact, artificial plasmids are unstable in the natural environment without laboratory selection pressure, and can put a metabolic burden on host bacteria, making them at a disadvantage in the competition for survival. Secondly, the natural transfer of plasmids requires harsh conditions, and many artificial plasmids themselves lack transfer capacity, which greatly limits their diffusion. Finally, from the management point of view, research in this field is subject to strict international and domestic biosafety regulations and guidelines.

—XJU-China



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# Crushing the Myths of Synthetic Biology



“Organisms created by synthetic biology will reproduce uncontrollably, leading to the collapse of ecosystems.”

—Some fear that synthetic biology – modified or created organisms, once in nature, will reproduce uncontrollably like invasive species with no natural checks, stealing resources from other organisms, disrupting ecosystems, and causing collapse.



## The Truth

Researchers use biological designs like auxotrophic strains (unable to survive outside lab conditions) and safety mechanisms such as "suicide gene circuits" (self-destructing under specific signals) to prevent uncontrolled reproduction of synthetic organisms. Strict regulations also require comprehensive risk assessments before environmental release, with close monitoring of limited tests.

—CJUH-JLU-China



# Crushing the Myths of Synthetic Biology



“Engineered bacteria released by this project could cause uncontrollable environmental pollution.”

—Some people are concerned that this project might cause environmental pollution and that releasing engineered bacteria is uncontrollable.



## The Truth

Actually, we have incorporated multiple safety measures into the design of the bacteria. For instance, a built-in “suicide module” ensures that the bacteria activate self-destruction mechanisms after completing their intended function. Additionally, this technology will only be implemented after undergoing rigorous and comprehensive safety assessments to minimize any potential risks.

—ZJUT-China



CJUH-JLU-China



# Chapter 4

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Misunderstandings about  
Product Safety and  
Application Value



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# Crushing the Myths of Synthetic Biology

“Synthetic biology products are all ‘unnatural’ and must be harmful to humans and the environment.”

—People instinctively distrust “artificially” manufactured things, believing that “natural” is always better and safer.



## The Truth

“Natural” does not always equate to “safe,” and “artificially synthesized” does not necessarily mean harmful.

Many deadly toxins (such as botulinum toxin) are purely natural, while many life-saving drugs (such as insulin) have already been produced on a large scale through synthetic biology technologies (such as using engineered bacteria to produce recombinant human insulin), with their safety and efficacy thoroughly validated. The safety of synthetic biology products is determined based on their specific components and characteristics, not their production method. In fact, synthetic biology holds promise for producing purer, more efficient, and more environmentally friendly products (such as biodegradable plastics), thereby reducing reliance on traditional chemical synthesis (which may involve pollution) or agricultural extraction (which may consume large amounts of land resources).

—ZZU-China



CJUH-JLU-China



# Crushing the Myths of Synthetic Biology

 “Synthetic biology alters the genes of produced substances.”



## The Truth

Simply, synthetic biology modifies microbes into "micro-factories." For ginsenosides, yeast with added synthesis genes uses red algae components. The result matches natural versions in structure and effect, but is more efficient, eco-friendly, and stable. It's now transforming cosmetic raw material production, benefiting more.

—SCUT-China-L



CJUH-JLU-China



# Crushing the Myths of Synthetic Biology

 “Genetically modified foods affect future generations.”



## The Truth

Genetically modified foods are made by adding foreign genes to organisms via genetic engineering, which then produce target products. Like regular foods, GMOs break down in the human digestive tract. They don't build up in the body, even with long - term consumption. Without a basis for lasting effects, they can't be passed to future generations or alter our genes to impact them.

—SCUT-China-L



# Crushing the Myths of Synthetic Biology

“Synthetic biology will only benefit the big companies, with the average person taking the risk.”

—The technology will only end up being monopolized by big companies to make money, while the public gets no benefit and takes environmental and social risks.



## The Truth

While commercial applications are an important driver, the benefits have the potential to spread more widely: This technology has the potential to solve some problems in a sustainable way: the construction of bimodal biosensors based on quorum sensing signaling molecules by genetic engineering of *Escherichia coli*, the expression of  $\beta$ -galactosidase and  $\beta$ -glucuronidase driven by specific promoters of *Pseudomonas aeruginosa*, and the yellow and fluorescent hydrolysis of substrates ONPG and MUG, respectively. And the qualitative and quantitative detection of the *Pseudomonas aeruginosa* is realized. It further ensures the safety of the water body and brings water security to the public. It ensures the safety of drinking water for residents.

—YAU-China



# Crushing the Myths of Synthetic Biology



“Is synthetic meat definitely unsafe?”

——Some people believe that synthetic meat is definitely unsafe and unhealthy, and should never be consumed.



## The Truth

Actually, that's not the case. To a certain extent, synthetic meat is usually safe. One type of synthetic meat is cultivated using animal stem cells. Researchers "feed" the stem cells with sugar, amino acids, fats, minerals and various nutrients to promote their continuous proliferation and growth. Some experts believe that this kind of synthetic beef can not only maintain the same deliciousness as natural beef, but also have more advantages in other aspects, and is expected to solve the environmental and animal protection problems faced by current beef production.

——YAU-China



CJUH-JLU-China



LZU-MEDICINE-CHINA

# Crushing the Myths of Synthetic Biology

“Genetically modified organisms are all unnatural and can pose a threat to humans.”

— Some people believe that the probiotics modified through synthetic biology technology (such as the lactobacillus designed by our team) could pose unknown dangers to the human body like "artificial pathogens".



## The Truth

The engineering probiotics are based on the natural intestinal probiotics of the human body. They will only be applied in clinical settings after precise genetic regulation and strict safety tests. The risks are controllable. Before being used in humans, rigorous evaluations and tests will be conducted.

— LZU-MEDICINE-CHINA



# Crushing the Myths of Synthetic Biology

“Plant-based meat is more nutritious and healthier.”



The Truth

Plant – based meat is not low in energy. Moreover, most plant proteins are not easier to digest and absorb than animal proteins. Some plant proteins can even cause allergies. Therefore, the claims that "plant-based meat dumplings can be eaten without gaining weight" and "plant proteins are better than animal proteins" have no scientific basis.

—Jiangnan–China



CJUH-JLU-China



# Crushing the Myths of Synthetic Biology

“Engineered probiotics are 'unnatural' and dangerous to ingest.”



## The Truth

This is a common misconception. The chassis we use, *Saccharomyces boulardii*, is a safe, well-studied probiotic with decades of clinical use. The genetic modifications are precisely designed to add a specific therapeutic function—targeting a harmful pathogen—while being contained by robust safety mechanisms. It's not about creating something unnatural, but about enhancing nature's own tools to safely solve a specific health problem.

—Peking



## Crushing the Myths of Synthetic Biology

“Foods made with synthetic biology are unnatural and dangerous.”

—The term “Frankenstein foods” is sometimes used in the media to provoke fear.



### The Truth

In fact, synthetic biology in food production usually makes ingredients safer, cheaper, and more sustainable – for example, producing vitamins, milk proteins, or meat alternatives without harming animals. All such products must pass rigorous food safety regulations before reaching consumers.

—BWYA



# Crushing the Myths of Synthetic Biology



“Synthetic biology is just a cheap shortcut to replace natural farming or traditional medicine.”

—Some believe it simply copies existing methods without real innovation.



## The Truth

Synthetic biology doesn't replace nature but complements it. It allows precise control of biological processes, creating medicines, fuels, and materials that cannot be obtained easily through traditional means. For example, producing artemisinin (an anti-malaria drug) in yeast helps ensure global supply.

—BWYA



# Crushing the Myths of Synthetic Biology

“When purchasing citrus, one must choose pesticide-free options. Citrus grown with pesticides is harmful to the body and definitely not as safe as pesticide-free ones.”  
—Many people, upon hearing this, even completely avoid any citrus marked as “using pesticides”.



## The Truth

In fact, completely pesticide-free citrus is more risky. Without compliant pesticides or our Aphigo solution, citrus trees are easily severely affected by pests and diseases. This causes the fruits to become moldy (the mold produces patulin, which is far more toxic than legal pesticide residues) and rot quickly, making the citrus no longer fresh. Truly safe citrus requires proper pest control, not just pursuing the “pesticide-free” label. Our RNAi-based Aphigo is a greener alternative to pesticides, leaving no residues, thus making the citrus safer.

—SZU-China



# Crushing the Myths of Synthetic Biology

“You’re using waste oil in your experiments—does that mean the waste oil ends up being sold as cosmetics?”

—Misunderstandings about “waste recycling” often lead the public to concerns over product safety.



## The Truth

In fact, waste oil only serves as a carbon source for yeast, which breaks it down and rebuilds the molecules into completely new, safe products such as squalene. The process is more like “recycling and remanufacturing.” The final product has nothing direct to do with gutter oil.

—HUST-China



# Crushing the Myths of Synthetic Biology

“Only natural products are truly healthy. Microbial-derived ingredients can't compare with those extracted from sharks or plants.”

—People often equate “natural” with “safer” or “better,” and oppose it to anything “artificial”.



## The Truth

Microbially synthesized squalene is chemically identical to its natural counterpart. It also avoids killing endangered sharks and overcomes the challenges of plant extraction, such as low yield and high impurity levels. This approach is not only environmentally friendly but also ensures a stable supply of high-purity raw material.

—HUST-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology products are all ‘man-made’ and not as safe as natural products.”



## The Truth

The safety of a product does not depend on whether it is "natural" or "man-made," but on its composition, structure, and the purity and control of the production process. Many natural substances may also contain impurities or toxins. Products produced using synthetic biology technologies, such as hyaluronic acid (HA), human insulin, or certain food flavors obtained through microbial fermentation, are manufactured in strictly controlled sterile environments. The final products have high purity and can effectively avoid allergen or pathogen contamination that may occur in traditional extraction methods. These products must undergo rigorous safety assessments and regulatory approvals before being marketed, so their safety is guaranteed.

—CSU-CHINA



# Crushing the Myths of Synthetic Biology

“The intestines are neither the main organ for purine synthesis nor the main organ for uric acid excretion; therefore, engineered probiotics acting on the intestines have no therapeutic effect on gout.”

—Some people believe that engineered probiotics acting on the intestines (which can express xanthine, hypoxanthine transporters, and uric acid transporters) are unrelated to the two core links in the treatment of gout—namely, inhibiting purine synthesis and promoting uric acid excretion—and thus have no therapeutic effect on gout.



## The Truth

Thirty percent of the body's uric acid comes from dietary purines, with the intestines being the main site for absorbing exogenous purines. Excessive absorption raises blood uric acid levels, triggering hyperuricemia (gout). The engineered probiotic YES301, expressing xanthine, hypoxanthine and uric acid transporters, aids gout treatment by competing for and transporting intestinal purines out of the body and reducing exogenous uric acid absorption, with broad prospects.

—SKLBE-China



# Crushing the Myths of Synthetic Biology

“Engineering microbes to produce traditional Chinese medicine (TCM) compounds is a disrespectful Westernization of ancient knowledge.”

—Some may feel that using synthetic biology corrupts the natural and holistic principles of TCM.



## The Truth

This approach is actually a form of modern reverence. By programming microbes to sustainably produce rare and precious compounds (e.g., artemisinin, ginsenosides), we protect endangered plant species from over-harvesting and ensure a pure, consistent, and potent supply. It uses modern tools to preserve and scale ancient wisdom for a global population.

—NAIS



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# Crushing the Myths of Synthetic Biology

“The synthetic biological sensors used will falsely detect target substances, giving wrong results and having no practical value.”

—Some question the reliability of the synthetic biological sensors, worrying they might misidentify non-target substances or miss targets in real use, making the project practically useless.



## The Truth

Extensive optimization and testing have been carried out on the synthetic biological sensors. Molecular-level design ensures high specificity—recognition proteins bind strongly only to targets, barely reacting to similar substances. Lab tests with complex, real-environment-like samples (varying concentrations, interferents) across thousands of trials show over 98% accuracy. Comparisons with authoritative methods confirm strong consistency and accuracy. Field tests will also be conducted with professionals to refine performance, ensuring stable, accurate detection for practical use.

—CJUH-JLU-China



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# Chapter 5

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Rumours about Specific  
Technologies and Projects



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# Crushing the Myths of Synthetic Biology

“The synthetic genes in genetically modified crops have entered human DNA.”

—Incorrect descriptions in some online articles can lead to misunderstandings for people.



## The Truth

In fact, the DNA in food is degraded in the digestive tract and used as nutrition for our cells. It cannot be integrated into the human genome. Just like we won't become more like pigs just because we eat pork.

—WHU-China



CJUH-JLU-China



# Crushing the Myths of Synthetic Biology



“Gene editing as a universal cure for cancer.”

—Using CRISPR gene editing technology in synthetic biology, can directly repair cancer – causing genes and completely eliminate all types of cancer.



The Truth

In reality, CRISPR is mainly used in laboratory research, and its clinical application is still at an early trial stage. It is far from being a “one-shot cure for all diseases.” Even in the future, gene editing will not be applicable to all cancers, as different cancer types have complex and varied causes.

—Fudan



# Crushing the Myths of Synthetic Biology



“Super fungi will trigger a global ‘biochemical crisis.’”

—Super fungus—*Candida auris* has strong drug resistance and poses a significant threat to humans, affecting all populations. Infection can be fatal, and there are no effective countermeasures.



## The Truth

While *Candida auris* does have notable drug resistance, it mainly spreads in intensive care units and rarely infects healthy individuals. Infections are mostly limited to hospitalized patients with weakened immune systems. In China, only sporadic cases have been reported, with no outbreaks. The public does not need to panic or adopt special preventive measures.

—Fudan



# Crushing the Myths of Synthetic Biology

“Modifying mammalian cells to regulate exocytosis will cause the cells to lose control and secrete abnormal substances that harm health.”



## The Truth

This project's modification of mammalian cells is an engineering practice of "precisely weaving life functions":

- From a technical perspective, this project selects mammalian cell lines that have been verified through long-term research, and their physiological characteristics and metabolic pathways are clearly defined. It avoids unknown risks at the "basal" level. And the cleaved proteins in the project only act like "molecular hooks", specifically connecting vesicles with the cell skeleton – only regulating the "exocytosis initiation" as a single link, without interfering with core functions such as cell proliferation and apoptosis, and definitely not allowing the cells to "run wild".
- From a design perspective, the secretion process is triggered by signals: when the signal exists, exocytosis is initiated; when the signal disappears, the vesicles are anchored and secretion stops. It's like installing an "intelligent switch" in the cells, achieving "on-demand secretion". The functions of vesicle anchoring and signal response are split into independent modular components, like Lego blocks that can be combined – each module has clear functions and distinct boundaries. Even with iterative optimization, risks can be traced back, and "functional disorders" can be completely prevented from the source.



CJUH-JLU-China



2025 iGEM

# Crushing the Myths of Synthetic Biology

“The in vitro ATP cycle system is extremely unstable and may collapse and fail at any time.”

— Some people think that an artificially built complex in vitro ATP cycle system (with multiple enzymes, substrates and strict reaction conditions) may fail to stably supply ATP if there is any slight environmental change.



## The Truth

Researchers have fully addressed stability concerns. On one hand, they modify natural enzymes or select those from extremophiles to enhance tolerance to environmental changes. On the other hand, they build a "reaction microenvironment regulation network" (responsive elements, closed microfluidic chambers included) to buffer disturbances.

— BNU-China



# Crushing the Myths of Synthetic Biology



“Engineered microbes will escape and take over the natural world.”

—Some people fear that synthetic organisms will spread uncontrollably once released.



The Truth

Scientists design multiple safety locks, such as genetic “kill switches” or nutrient dependencies, so that engineered microbes cannot survive outside the lab or factory. Strict biosafety protocols also prevent uncontrolled release.

—BWYA



CJUH-JLU-China



NEFU-China

# Crushing the Myths of Synthetic Biology

“Cellulose is difficult to degrade efficiently, making the treatment of agricultural waste such as straw challenging.”



## The Truth

In reality, cellulose itself can be effectively degraded through biological or chemical means. The key component that hinders the efficient utilization of plant resources is lignin—a complex and stable polymer that provides structural support in plant tissues. Under natural conditions, even wood-eating termites cannot directly break down lignin; its degradation primarily relies on the slow action of specific microorganisms.

**Research Topic:** This study innovatively proposes an electrochemical – synthetic biology coupled strategy aimed at efficiently converting lignin into paracetamol (also known as acetaminophen).

—NEFU-China



# Chapter 6

Misjudgments about the  
Potential and Limitations of  
Synthetic Biology



# Crushing the Myths of Synthetic Biology

 “Genetic engineering can infinitely increase the amount of yield of target products.”

—Some believe that continuously adding genes can infinitely increase product levels.



## The Truth

In reality, cellular metabolic networks are constrained by energy availability, precursor substances, and regulatory networks. Excessive modification may impose excessive metabolic burdens, ultimately reducing growth and yield. Therefore, synthetic biology must balance between productivity and host health.

—BAID-China



# Crushing the Myths of Synthetic Biology

“The range of chassis organisms capable of gene editing in synthetic biology is very limited, confined to only a few model organisms such as E. coli and yeast. The application of this technology in more complex higher plants and animals, or even human cells, remains speculative and difficult to achieve.”



## The Truth

Currently, the range of chassis organisms for gene editing has far surpassed E. coli and yeast. The emergence of revolutionary gene editing technologies, represented by CRISPR, has significantly reduced the difficulty and cost of genetic manipulation across different organisms. Today, scientists can perform precise edits on almost any organism with a known genome. In the plant kingdom, synthetic biology has achieved remarkable successes. For instance, "Golden Rice," produced through gene editing of rice, is used to supplement vitamin A; major crops such as soybeans, corn, and wheat have been edited to enhance disease resistance, stress tolerance, and yield. In the animal domain, gene editing technology has been widely applied to the construction of model organisms, such as mice, zebrafish, and fruit flies.

—Nanjing—China



CJUH-JLU-China



# Crushing the Myths of Synthetic Biology



“Synthetic biology provides us with a powerful tool for designing life systems. Therefore, all we need to do is unleash our imagination to design new life systems that can solve problems, without requiring rigorous logic.”



## The Truth

Currently, the construction and optimization of most synthetic systems still rely on trial and error, lacking the capacity for rational design. Achieving quantitative controllability remains challenging, especially as the complexity of biological systems increases, further limiting rational design capabilities. Thus, as researchers in synthetic biology, while enhancing their capabilities in biosynthesis, they must also focus on cultivating rational design skills.

——Nanjing-China



# Crushing the Myths of Synthetic Biology

“Synthetic biology will soon be able to synthesize any complex life, including humans.”



## The Truth

Currently, synthetic biology mainly targets simple life forms such as microorganisms. Although technology is advancing – for instance, scientists have been able to synthesize yeast chromosomes – life systems are extremely complex. Synthesizing any life, especially complex animals and plants, faces enormous technical challenges and cannot be achieved in the short term.

“Synthesizing humans” is even more distant and involves severe ethical issues, which is a clearly prohibited red line in the international scientific community.

—CSU-CHINA