Top synthetic biology news from academic labs in 2019


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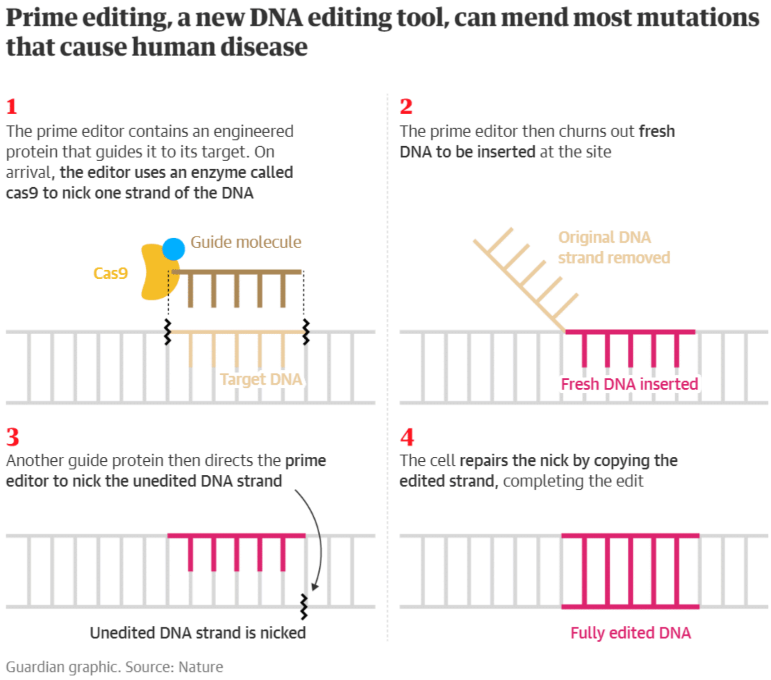
This week, we are bringing you some of the hottest research news in synthetic biology in 2019: what were the most exciting academic articles published this year by synthetic biology researchers, and why?

On Monday, scientists reported in Nature a new DNA editing tool, prime editing, that can be a real search-and-replace function for DNA, and repair any of the 75,000 known mutations that cause inherited disease in humans. Unlike base editors, which can perform 25% of possible nucleotide substitutions, prime editors have the ability to change any nucleotide to any other nucleotide, according to GEN, and the technology makes fewer off-target edits when compared with CRISPR-Cas9.

“You can think of prime editors as being like word processors capable of searching for target DNA sequences and precisely replacing them with edited DNA sequences,” said David Liu of the Broad Institute for *The Guardian.* “Potential impacts include being able to directly correct a much larger fraction of the mutations that cause genetic diseases, and being able to introduce DNA changes into crops that result in healthier or more sustainable foods,” Liu said.



Prime editing can ‘nick’ and replace sections of mutated DNA strands

Image: The Guardian.

The Broad Institute has applied for a patent on prime editing, and is already making it freely available to academic and non-profit researchers for non-commercial uses. It has also given an exclusive license for the commercial development of human therapeutics to Prime Medicine, a new company co-founded by Liu, according to STAT News.

What about other research projects this year? Check out the comments from some academics:

Dr. Tom Ellis, Professor of Synthetic Genome Engineering at Imperial College London, said "Jason Chin's group at The MRC Laboratory of Molecular Biology showed they could synthesize the whole *E. coli* genome with recoding and also that they could rearrange the layout of the genome." "They created a strain that isn't using three of the codons that the rest of nature does," he told STAT.

Niko McCarty, PhD student in Bioengineering at Caltech: "CRISPR Multiplexing is fully coming of age, with 25 CRISPR RNAs expressed from a single array in mammalian cells." Researchers at ETH Zurich have refined the CRISPR-Cas technology: they reported in August that it is now possible to modify dozens, if not hundreds, of genes in a cell simultaneously.

Isaac Larkin, PhD candidate at Northwestern, said: "Some of my favorites were Zhang lab's CRISPR transposon paper, because of its potential applications for efficient delivery and insertion of large genetic payloads; Baker lab's paper demonstrating that gamers playing FoldIt could design stable globular proteins from scratch; the implementation of an integral feedback controller genetic circuit in bacteria, because the more control theory gets applied to bioengineering the better and more reliable bioengineering will get."

Isaac also mentioned the Baker lab's work demonstrating the therapeutic potential of designed proteins and the Jewett lab's collaboration with LanzaTech that "showed that rapid cell-free prototyping could be used to optimize metabolic pathway performance, and that the improvements worked when transferring from a cloning workhorse like *E. coli* lysate into an industrial bacterial strain from a completely different branch of the tree of life."

Dr. Leonardo Rios, Lecturer at Edinburgh University, highlighted a study by MIT and Harvard that demonstrated how programmable CRISPR-responsive smart materials could open the door to novel tissue engineering, bioelectronic, and diagnostic applications. Another interesting study was by Columbia researchers, who developed a method that could prevent human-engineered proteins from spreading into the wild. "Useful for the big challenge of synbio containment," according to Rios.

Rios also mentioned Hachimoji DNA and RNA: Hoshika et al. added an additional four synthetic nucleotides to produce an eight-letter genetic code and generate so-called hachimoji DNA. "With more diversity in the genetic building blocks, scientists could potentially create RNA or DNA sequences that can do things better than the standard four letters, including functions beyond genetic storage," according to Nature.

Another great study this year was by Professor Sang Yup Lee of KAIST and his team, who developed a strain that demonstrated the highest efficiency in producing fatty acids and biodiesels ever reported.

Rios also mentioned the study by UC Berkeley researchers who found a way to make the main chemicals in marijuana, THC and CBD, from yeast; one by Caltech researchers who used machine-learning-guided directed evolution for protein engineering; and a cloning method, COMPASS, that allows building tens to thousands of different plasmids in a single cloning reaction tube.

Here are some of the most popular tweets and Facebook posts about research in the field this year:

October

Biomedical engineers at @DukeEngineering have devised a #machinelearning approach to modeling the interactions between complex variables in engineered #bacteria that would otherwise be too cumbersome to predict. https://t.co/hZKSjyhfsi #synbio #biotech #biotechnology

— SynBioBeta (@SynBioBeta) October 5, 2019

September

The @biobitsproject system enables protein synthesis at very low cost, making it ideal for educational uses ranging from the demonstration of fundamental cellular processes to hands-on #syntheticbiology https://t.co/w3wHFUCGlE @miniPCR @JessicaCStark #STEMed #STEM #synbio #edtech

— SynBioBeta (@SynBioBeta) September 15, 2019

Scientists construct energy production unit for a synthetic cell https://phys.org/news/2019-09-scientists-energy-production-synthetic-cell.html #synbio #syntheticbiology #microbiology #bioengineering

Posted by SynBioBeta on Thursday, September 19, 2019

August

Bacteria could be used to produce large quantities of #medicines and #fuels using a new gene programming technique https://t.co/bs06E6jyMf @SBSatEd #synbio #biology #biobased #biotech #biotechnology #microbiology pic.twitter.com/e2pS5agv2k

— SynBioBeta (@SynBioBeta) August 26, 2019

Understanding how metabolic pathways in a cell interact and ensure its proper functioning is necessary for designing…

Posted by SynBioBeta on Thursday, August 1, 2019

July

DNA isn't the only molecule we could use for #digitalstorage. It turns out that liquid solutions containing sugars, amino acids and other small molecules could replace hard drives too. https://t.co/Amwp83POaF #DNAdatastorage #synbio #biotech

— SynBioBeta (@SynBioBeta) July 4, 2019

Molecular thumb drives: Researchers store digital images in metabolite molecules. New research shows that DNA isn't the…

Posted by SynBioBeta on Friday, July 5, 2019

June

A 5,000-year-old toy has inspired an inexpensive, hand-powered centrifuge for preparing scientific samples including DNA. https://t.co/25RIPluR85 @FuturityNews @PLOSBiology #citizenscience #diybio @BhamlaLab #frugalscience

— SynBioBeta (@SynBioBeta) June 11, 2019

Biological Cruise Control Engineered into Living Cells http://bit.ly/2IVCUXU #synbio

Posted by SynBioBeta on Thursday, June 20, 2019

May

Synthetic biologists hack bacterial sensors:
Technology could enable new medical, industrial, environmental #biosensors https://t.co/5Gk03gSjsp #synbio #syntheticbiology

— SynBioBeta (@SynBioBeta) May 22, 2019

“They have taken the field of synthetic #genomics to a new level, not only successfully building the largest ever…

Posted by SynBioBeta on Wednesday, May 15, 2019

April

A research group from ETH Zurich recently reported the generation of a synthetic version of the model bacterium Caulobacter crescentus genome. This work advances our knowledge on synthetic chromosome construction strategies: https://t.co/8euUbqN0ed #synbio @konvavitsas

— SynBioBeta (@SynBioBeta) April 16, 2019

Folding Revolution: New #deeplearning approach predicts protein structure from amino acid sequencehttp://bit.ly/2GiRDdZ…

Posted by SynBioBeta on Thursday, April 18, 2019

March

Genome engineers made more than 13,000 #CRISPR edits in a single cell:
A team at @geochurch’s Harvard lab wants to redesign species with large-scale DNA changes. https://t.co/lAqglhn27g #synbio #geneediting #genomeediting #biotech @antonioregalado @harvardmed @wyssinstitute

— SynBioBeta (@SynBioBeta) March 26, 2019

UC Berkeley synthetic biologists have engineered brewer’s yeast to produce marijuana’s main ingredients—mind-altering…

Posted by SynBioBeta on Friday, March 1, 2019

February

With twice the information storage capacity of natural nucleic acids, these eight-letter, or “hachimoji” molecules—could have countless biotechnological applications, say scientists. https://t.co/WPi2UIA1F5 #synbio #syntheticbiology #biotech #biotechnology #DNA #biology

— SynBioBeta (@SynBioBeta) February 22, 2019

IGI scientists use #nanotechnology to sneak #DNA into plant cells, creating a novel delivery method for #CRISPR-Cas9….

Posted by SynBioBeta on Monday, February 25, 2019

January

A KAIST research team completed a metabolic map that charts all available strategies and pathways of chemical reactions that lead to the production of various industrial #biobased #chemicals. https://t.co/T2IiYPHloS #biochemicals #biobased #synbio #biotech @mbelmbel99 #bioeconomy

— SynBioBeta (@SynBioBeta) January 17, 2019