Improving the safety and outcome of research using next-generation genome engineering

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Project Goals: The goals of this pilot program as an activity in the Secure Biosystems Design initiative is to contribute awareness and inform decision-making across biosystems design research. This is a part of BERs Genomic Science program, integrating ongoing efforts in microbiome, environmental genomics, and sustainability research in mission-relevant ecosystems.

The simplicity and flexibility of CRISPR/Cas offers unprecedented opportunities to rewrite genomes. Unfortunately, researchers developing new techniques for advanced genome editing rarely have the resources to properly assess all the risks they are introducing. Analysis is typically performed using a single, well-characterized genotype of interest under laboratory conditions. As such, current research lacks sufficient knowledge to detect, assess, and mitigate unintended consequences of these techniques. Until these knowledge gaps are addressed, scientists emphasize that precautions are necessary because this biotechnology is moving faster than regulation considerations and actions. Given the risk CRISPR/Cas-enabled gene drive systems pose (e.g., gene drives systems may escape confinement through accidents) and potential for far-reaching, even global spread from small releases, safeguarding genomes with a countermeasure against unwanted gene editing is a high priority. To mitigate these risks, this project leverages a nucleic acid-based approach to have an invading CRISPR/Cas system self-identify and self-destruct. Initial work has focused on implementing and evaluating this approach in microbial and plant systems. To this end, preliminary breakthroughs demonstrate that locking mechanisms can be incorporated into genomes to provide a useful containment or countermeasure measure to regulate or avert CRISPR/Cas gene-editing.

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