VolkswagenStiftung

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

European Academies
easac
Science Advisory Council

iap SCIENCE RESEARCH HEALTH
the interacademy partnership

Leopoldina
Nationale Akademie
der Wissenschaften

OCTOBER 11-13, 2017 / HERRENHAUSEN PALACE

INTERNATIONAL WORKSHOP
ASSESSING THE SECURITY IMPLICATIONS OF GENOME EDITING TECHNOLOGY

The academies of science, including the InterAcademy Partnership (IAP), the European Academies Science Advisory Council (EASAC), the US National Academies of Sciences, Engineering, and Medicine (NASEM), and the German National Academy of Sciences Leopoldina, are convening an international workshop of experts in genetic engineering, security studies and public policy. This workshop will examine the latest advances in genome editing and analyse current and potential applications in a wide range of organisms such as microbes, plants, animals and humans. Participants will also address the debates about their potential risks and misuse. The need for international dialogue is particularly important because of the rapid development and wide-spread use of genome editing tools, such as the CRISPR-Cas9 system, in countries with various, sometimes divergent, regulations and governance of research. The project will explore near- middle- and long-term security concerns – relating to intentional misuse - that may arise from these applications and discuss technical, operational, regulatory and governance strategies that may aid the scientific and security communities in preventing or mitigating those security concerns. A report summarising the workshop discussions will be published jointly by the academies.

Additional background information on scope

The life sciences and medical research are being rapidly advanced by tools that enable controlled changes to be made to an organism's DNA. In particular, recent advances in endonuclease-based methods for genome editing, such as the CRISPR-Cas9 system, have quickly become core technologies in biological and medical laboratories around the world. These tools enable scientists and clinicians to make faster, easier, more efficient, precise and cheaper changes to DNA, with potential applications in microbes, plants, animals and humans. For example, these tools can be used to investigate gene functions to gain a fundamental understanding of development, to create new animal models in which to better study and understand disease, to design livestock or food crops with desired properties, or to create new human therapeutics.

The rise and ease of new genome editing technologies and their potential applications have fuelled debates about their utility and safety among publics, scientists, and policy makers. The different technologies and their potential risks are often becoming conflated in these debates. However, genome editing technologies and their applications may vary in their degree of potential risks. Thus, approaches to mitigate or prevent security concerns will depend on a clear and accurate understanding of both the differences between genome editing technologies and the technical requirements to develop and use them.

In some cases, CRISPR-Cas9-based genome editing tools can be used in specific systems such as a "gene drive". Gene drives are systems that enable genetic modifications to be inherited in all offspring, thus ensuring that they spread and persist in a population via sexual reproduction. This technology has the potential to help address problems in public health and sustainability. For example, it may be possible to combat vector-borne diseases such as malaria or to control invasive organisms to maintain biodiversity and critical economic resources. However, the potential for genetic changes to be intentionally spread in an ecosystem also raises key questions about how to assess the safety and security of gene drive applications and provide appropriate research oversight.

There are several other potential security concerns that may be raised by genome editing tools. These techniques might be useable by "do-it-yourself" biology communities outside of formal institutional oversight structures. These tools could also be used in research that has dual use applications, such as understanding host-pathogen interactions or designing microbial pathogens with altered functions that could result in pathogen resistance to potent countermeasures. Finally, the use of genome editing tools in humans to enhance or degrade immune responses or affect other physiological properties linked to disease resistance could render targeted populations more vulnerable to certain biological threats.

With the onset of new technologies that make gene editing cheaper and more precise, there is need for collective vigilance in determining what is possible, coupled with appropriate preparedness and responsiveness.