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A colony of haploid embryonic stem cells.(Photo by: AZRIELI CENTER FOR STEM CELLS AND GENETIC RESEARCH/HEBREW UNIVERSITY OF JERUSALEM)

Israeli scientists generate atlas of the human genome using stem cells

By JUDY SIEGEL-ITZKOVICH
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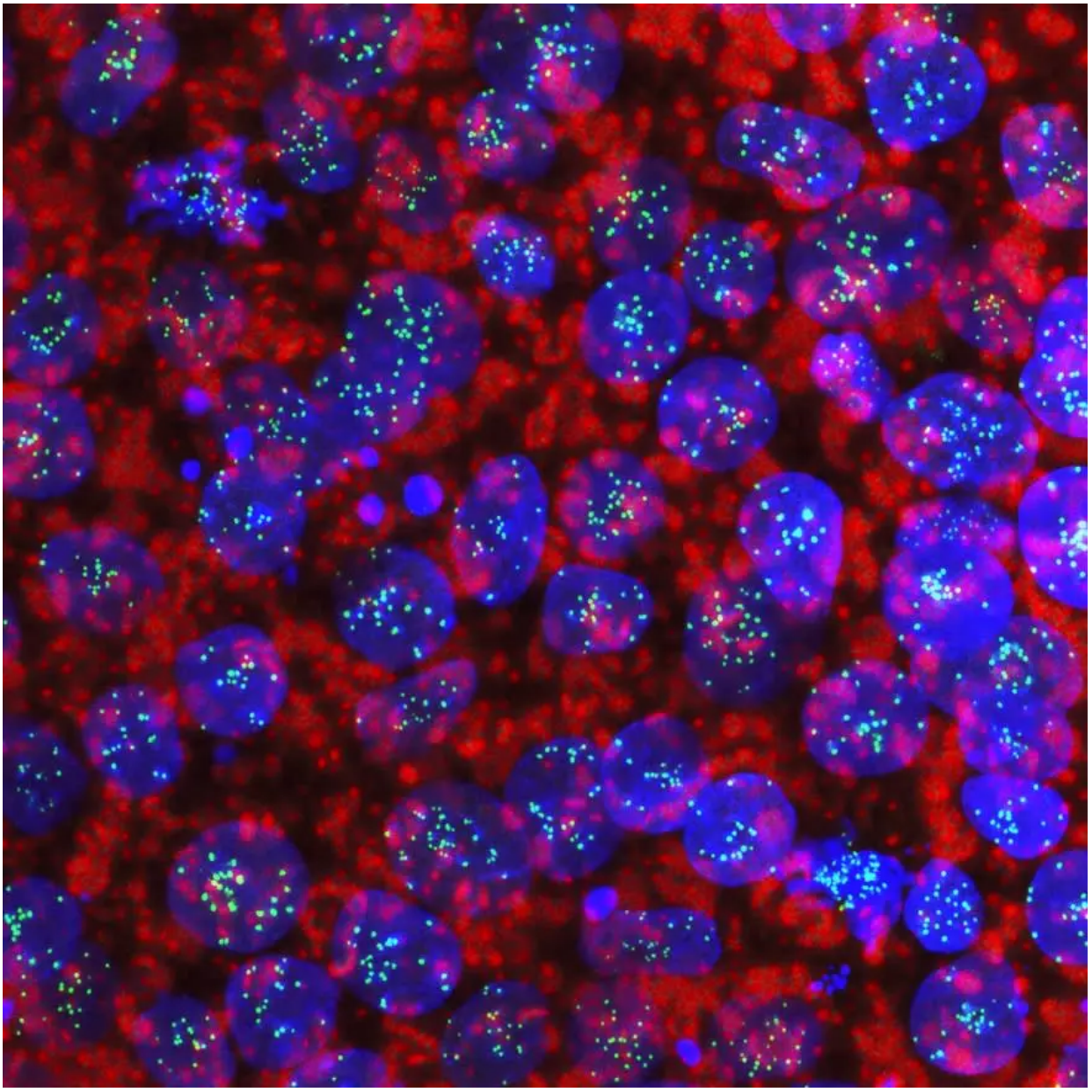
"The more complete a picture we have of the nature of these cells, the better chances we have for successful therapies."

An atlas of the human genome using state-of-the-art gene-editing technology and human embryonic stem cells, which explains the roles that genes play in health and disease, has been created by Hebrew University scientists.

Prof. Nissim Benvenisty, director of the university's Azrieli Center for Stem Cells and Genetic Research and the senior author of the study, and colleagues published their findings in the prestigious journal Nature Cell Biology.

Embryonic stem cells, which can become an adult cell in our bodies, are a unique resource. Their versatile nature puts them at the center of attention in the fields of regenerative medicine, disease modeling and drug discovery. In addition, the sequencing of the human genome and the identification of the entire set of genes responsible for our genetic identity are another milestone that has led to a new challenge of understanding the function of the genes in the human genome.



The new Hebrew University study provides a novel tool to map the function of all human genes using human embryonic stem cells. The researchers analyzed virtually all genes in the human genome by generating more than 180,000 distinct mutations, combining CRISPR–Cas9 screening technology with a new type of embryonic stem cells that was recently isolated by the same research group. This type of stem cells harbors only a single copy of the human genome, instead of two copies from the mother and father, making gene editing easier thanks to the need of mutating only one copy for each gene.

They showed that only 9% of all the genes in the human genome are essential for the growth and survival of human embryonic stem cells, while 5% of them actually limit the growth of these cells. They were able to analyze the role of genes responsible for all hereditary disorders in early human development and growth. They also showed how cancer-causing genes can affect the growth of the human embryo.

“This gene atlas enables a new functional view on how we study the human genome and provides a tool that will change the fashion by which we analyze and treat cancer and genetic disorders,” Benvenisty said. One of the team’s key findings was the identification of a small group of genes that are uniquely essential for the survival of human embryonic stem cells but not to other cell types. These genes are thought to maintain the identity of embryonic stem cells and prevent them from becoming cancerous or turning into adult cell types.

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“This study creates a new framework for the understanding of what it means to be an embryonic stem cell at the genetic level,” said Dr. Atilgan Yilmaz, a postdoctoral fellow and a lead author on the paper. “The more complete a picture we have of the nature of these cells, the better chances we have for successful therapies in the clinic.”