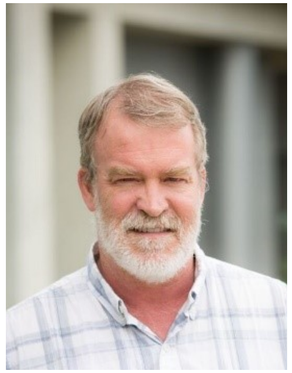
Building Decision Points Into Research's Slipperiest Slopes

Evans, John H., Craig Callender, Neal K. Devaraj, Farren J. Isaacs, and Gregory E. Kaebnick. "Building Decision Points Into Research's Slipperiest Slopes." *Issues in Science and Technology* 41, no. 4 (Summer 2025): 78–82. https://doi.org/10.58875/NLSE3159

background



chair: social ethicist of biotechnology
(John Evans, UCSD)

philosopher of science
(Craig Callender, UCSD)

bioethicist
(Gregory Kaebnick, Hastings Center)

chemical/synthetic biologists
(Neal Devaraj, UCSD) (Farren Isaacs, Yale)

background

statement in Science did not include what precursor technologies should be allowed

agreed that nobody should create mirror bacteria

however concrete steps are needed to ensure regulation against doing so does not limit beneficial research

provide a framework for how and whether to advance mirror life research

aimed to allow aspects of mirror research to continue such that harms are avoided while still pursuing possible benefits

such a framework can also be useful in thinking about other potentially dangerous technologies.

How to consider precursor knowledge

research on mirror biology could produce insights both practical and profound. Studying mirror biomolecules could help scientists understand the origin of life and bring advances in cell replacement therapies, biomanufacturing, biosensing, and environmental remediation.

ban might be interpreted as allowing any precursor research, up to point where making a mirror bacteria becomes almost trivial.

it could also be interpreted as not allowing any research that could someday be used to build mirror bacteria. stifle biochemistry and synthetic biology broadly

all biochemistry produces precursor knowledge.

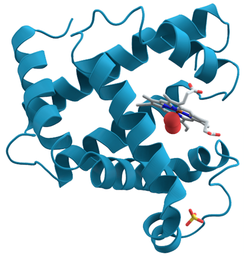
how to “look before you leap” for mirror life? Creating mirror cells—if it can be done—will be a multistep process. Each step will have distinct benefits as well as possible risks. The field needs ways to pause and reassess research along that path—well before a mirror cell is created.

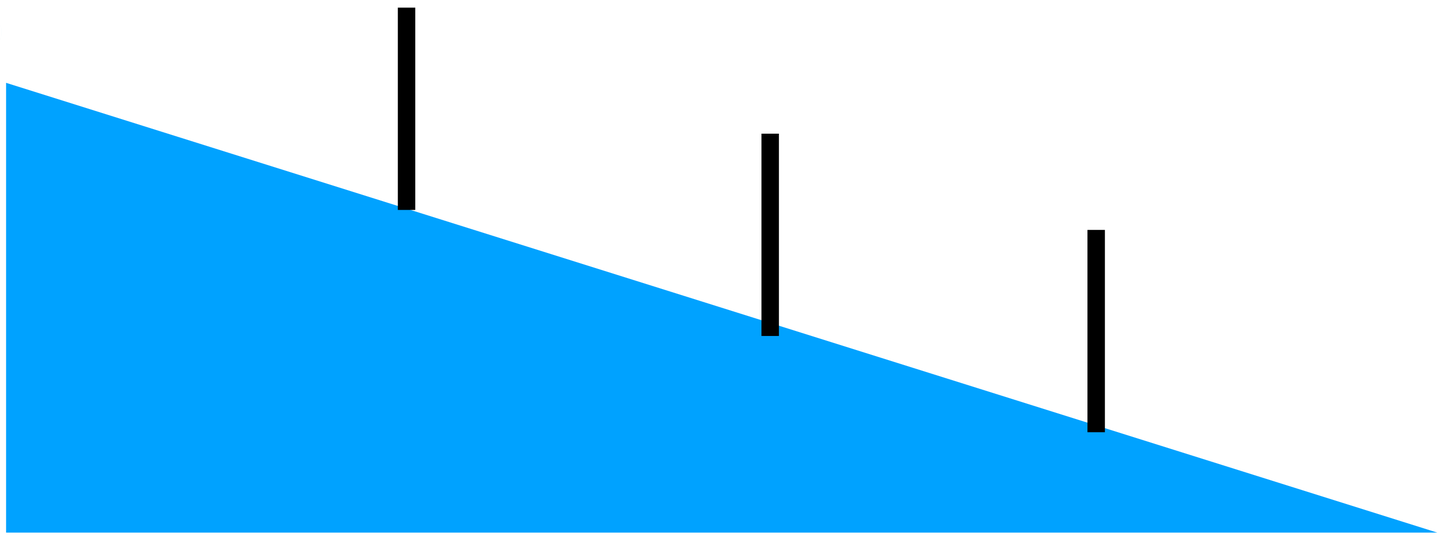
erecting barriers on the slippery slope

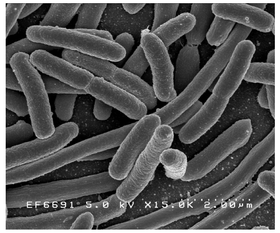
slippery slope metaphor is helpful

acceptable research is at the top; the scenario that must be avoided sits at the bottom

What is needed are barriers along the slope; research above a given barrier would be acceptable and permitted, and below not. Each barrier would provide a place where scientists and society could stop and reassess whether the benefits and risks justify that barrier and, if not, to consider what the next barrier should be







The right barriers can allow research to proceed and yield benefits, much as the barriers on the human gene editing slope have enabled breakthroughs like somatic treatments for sickle cell anemia.

possible barriers suggested

barriers are staged from more benign and feasible applications to more dangerous ones in which the requisite know-how remains undeveloped.

1. make a non-mirror ribosome from scratch.

arrest any further slide down the slope to making mirror life
forfeit beneficial research in non-mirror biology, such as a more complete understanding of protein synthesis

2. construction of a mirror ribosome.

without a mirror ribosome to synthesize mirror proteins, there cannot be a viable cell

mirror ribosome is a strong barrier is that it would be crystal clear if a scientist had crossed it.
pause research for further risk analysis. Analysis would weigh potential benefits of having a mirror ribosome itself, such as synthesizing mirror pharmaceuticals that are more stable and less immunogenic.

possible barriers suggested

3. Creation of a cell wall or membrane enclosing mirror machinery.
obvious when a cell wall is being created, there is a clear upslope and downslope. There is no cell without an enclosure, and the statement in Science does not claim that cell components are dangerous by themselves.

4. Blocked reproduction in the lab
no danger in a single, isolated cell; the threat is in the potential for out-of-control growth
this has the advantage of being a clear boundary scientifically, as well as socially and culturally

5. Blocked reproduction outside the lab
another way to create a barrier would be to ensure that any mirror bacteria synthesized be rendered incapable of living outside of very narrow, tightly controlled conditions.

setting and shifting barriers

Each barrier becomes a place to pause as knowledge accumulates and society assesses potential benefits and risks. Enables questions to form higher up on the slope. For example, how valuable is the knowledge below the mirror ribosome barrier to science and the broader public? invite broader public deliberation?

Scientists should consider the risks of creating mirror life. However, to heed that warning without foreclosing useful discoveries, there need to be guidelines about what precursor research is acceptable.

Louis Pasteur - Il n’existe pas une catégorie de sciences auxquelles on puisse donner le nom de sciences appliquées. Il y a la science et les applications de la science, liées entre elles comme le fruit à l’arbre qui l’a porté.

"There is no category of sciences that can be called applied sciences. There is science and the applications of science, linked together like fruit to the tree that bore it.

distinction between "pure" and "applied" science is blurry, as the act of scientific discovery often leads to practical applications.