For the better part of the past decade, researchers have been reprogramming adult cell types, either into induced pluripotent stem cells (iPSCs), which themselves can give rise to diverse cell types, or directly into other differentiated cell types through a process called direct reprogramming. Such approaches support the switching of diverse cell types once believed to be permanently locked in their differentiated form.

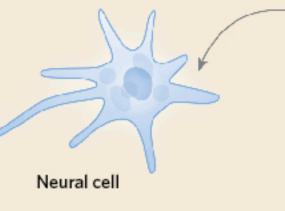
Traditionally, relevant transcription factors encoded by genetic material were carried by retro- or lentivirus vectors and integrated into the host cell genome. More recently, the use of nonintegrating vectors, RNA, or small molecules have been developed to minimize the chance of harmful mutations.

Adult

fibroblast cells

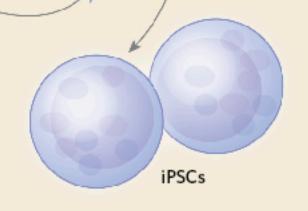
Fibroblasts were the first and remain the most common type of cell to be reprogrammed, but other cells, such as lymphocytes, which can be isolated from blood, are also proving to be successful starting points for stem-cell generation.

Viral vector



OR

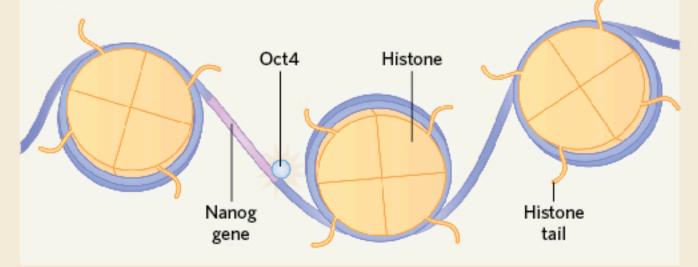
Direct reprogramming into another adult cell type



Dedifferentiation into a pluripotent state

OPEN CHROMATIN

Transfected transcription factors, such as Oct4, induce the expression of pluripotency-related genes, such as *Nanog*, or cell-type-specific genes in the case of direct reprogramming.



CLOSED CHROMATIN

Sequences from pioneer factors, such as the myogenic factor MyoD, are also employed to increase reprogramming efficiency in the face of closed chromatin, which can inhibit access of the transfected transcription factors to their target genes.

