Type of genetic engineering

Three types of genetic modification by the gene engineered technology: gene knockout. gene knock-in, gene overexpression.

Gene knockout, gene knockin, gene overexpression can be further categorized as below.

Type	Segment type	Characterization	Technology options
Gene knockout	Knockout, KO	Systemic gene fragment knock out	ESC Targeting, CRISPR
	Conditional knockout, CKO	Gene fragment knock out in specific tissues or cells	ESC Targeting, CRISPR
	KO-first	Mating with Cre mouse to obtain reporter and knockout mice; mating with Flp mouse to obtain flox mice	ESC Targeting, CRISPR
Gene knock-in	Constitutive mutation	Systemic introduction of genetic mutation	ESC Targeting, CRISPR
	Conditional mutation	Mutation introduced in specific tissues or cells	ESC Targeting, CRISPR
	Knockin	Exclusive expression of exogenous genes	ESC Targeting, CRISPR
	Co-expression	Exogenous gene is expressed without affecting the endogenous gene expression	ESC Targeting, CRISPR
	Humanization	The mouse endogenous gene was replaced with a human homologous gene	ESC Targeting, CRISPR
Gene overexpression	Random transgenesis	Gene of interest randomly integrated into the mouse genome	Pronuclear injection or Lentivirus infection
	PiggyBAC transgenesis	Gene of interest integrated into the transposase recognition sites of mouse genome	Piggybac Transgene
	Site-specific knockin	Gene of interest specifically incorporated into safe harbor sites such as Rosa26 or H11	ESC Targeting, CRISPR