CLAIMS

1. A lipid nanoparticle (LNP), comprising:

   (i) a lipid component comprising an ionizable lipid and a helper lipid, wherein the ionizable lipid is present at about 35 mol% to about 60 mol% of the lipid component, about 20 mol% to about 40 mol% of the lipid component, about 20 mol% to about 30 mol% of the lipid component, or about 25 mol% to about 40 mol% of the lipid component, and the helper lipid is present at about 20 mol% to about 40 mol% of the lipid component;

   (ii) a targeting moiety conjugated to the LNP, wherein the targeting moiety is an antibody or fragment thereof configured to bind to a receptors on the surface of T cells selected from the group consisting of CD2, CD3, CD4, CD5, CD6, CD7, CD8 and CD28; and

   (iii) a therapeutic agent encapsulated within the LNP, wherein the therapeutic agent comprises one or more nucleic acid molecules capable of inserting a heterologous object sequence into the genomic DNA of a T cell.

2. The LNP of claim 1, wherein the targeting moiety is an antibody or fragment thereof configured to bind to a CD3 receptor on the surface of the T cells.

3. The LNP of claim 1 or 2, wherein the heterologous object sequence comprises a chimeric antigen receptor (CAR).

4. The LNP of any one of claims 1-3, wherein the therapeutic agent comprises an mRNA encoding a gene modifying polypeptide and a template RNA comprising (a) a sequence that binds to the gene modifying polypeptide and (b) the heterologous object sequence.

5. The LNP of claim 4, wherein the gene modifying polypeptide comprises: (i) an endonuclease and/or DNA binding domain; and (ii) a reverse transcriptase (RT) domain, where (i) and (ii) are both derived from a retrotransposon.

6. The LNP of claim 4 or claim 5, wherein the gene modifying polypeptide comprises an amino acid sequence having at least 80% sequence identity (e.g. 80%, 85%, 90%, 95%, or 99% sequence identity) to an amino acid sequence of Table 4 or Table 5A.

7. The LNP of claim 6, wherein the gene modifying polypeptide comprises an amino acid sequence of Table 4 or Table 5A.

8. The LNP of any one of claims 1-3, wherein one of the nucleic acids encodes an enzyme selected from a nuclease, recombinase, integrase, transposase, retrotransposase, helicase, transcriptase, polymerase, reverse transcriptase, deaminase, methylase, demethylase, or a ligase.

9. The LNP of claim 8, wherein one of the nucleic acids encodes a nuclease, wherein the nuclease cleaves both strands of the genomic DNA.

10. The LNP of claim 9, wherein the therapeutic agent is a CRISPR system .

11. The LNP of claim 10, wherein the CRISPR system is a CRISPR-Cas9 system or CRISPR-Cas12 system.

12. A lipid nanoparticle (LNP) comprising:

    a. a lipid component comprising an ionizable lipid and a helper lipid;

    b. a first targeting moiety conjugated to the LNP, wherein the first targeting moiety is an antibody or fragment thereof configured to bind to CD3 on the surface of a T cell;

    c. a second targeting moiety conjugated to the surface of the LNP, wherein the second targeting moiety is an antibody or fragment thereof configured to bind to a receptor on the surface of a T cell selected from the group consisting of CD2, CD4, CD5, CD6, CD7, CD8 and CD28; and

    d. a therapeutic agent encapsulated within the LNP, wherein the therapeutic agent comprises one or more nucleic acid molecules.

13. The LNP of claim 12, wherein the second targeting moiety is an antibody or fragment thereof configured to bind to CD7.

14. The LNP of claim 12 or 13, wherein the therapeutic agent comprises two nucleic acid molecules, wherein the two nucleic acid molecules are RNA molecules.

15. The LNP of claim 12 or 13, wherein the therapeutic agent comprises three nucleic acid molecules, wherein the three nucleic acid molecules are RNA molecules.

16. The LNP of claim 12 or 13, wherein the therapeutic agent comprises one or two RNA molecules and one DNA molecule.

17. The LNP of any one of claims 12-16, wherein the therapeutic agent is capable of modifying, altering or effecting a change in the genomic DNA of a T cell.

18. The LNP of claim 17, wherein a chimeric antigen receptor (CAR) is inserted into the genomic DNA of the T cell.