WHAT IS CLAIMED IS:

1. A vector comprising:

(a) a first polynucleotide comprising a constitutive promoter operably linked to a nucleic acid encoding a chimeric antigen receptor (CAR), wherein the CAR comprises a single chain antibody or a single chain antibody fragment comprising an anti-CD19 binding domain, a transmembrane domain, a costimulatory, and an intracellular signaling domain; and

(b) a second polynucleotide comprising a nucleic acid encoding a polypeptide that enhances an immune cell function, or a functional derivative thereof; wherein the first polynucleotide is operably linked to the second polypeptide via a linker peptide;

wherein the anti-CD19 binding domain comprises:

(i) a light chain variable domain including a light chain complementary determining region 1 (LC CDR1) of SEQ ID NO: 1, a light chain complementary determining region 2 (LC CDR2) of SEQ ID NO: 2, and a light chain complementary determining region 3 (LC CDR3) of SEQ ID NO: 3; and

a heavy chain variable domain including a heavy chain complementary determining region 1 (HC CDR1) of SEQ ID NO: 4, a heavy chain complementary determining region 2 (HC CDR2) of SEQ ID NO: 5, and a heavy chain complementary determining region 3 (HC CDR3) of SEQ ID NO: 6; or

(ii) a light chain variable domain including a light chain complementary determining region 1 (LC CDR1) of SEQ ID NO: 193, a light chain complementary determining region 2 (LC CDR2) of SEQ ID NO: 194, and a light chain complementary determining region 3 (LC CDR3) of SEQ ID NO: 195; and

a heavy chain variable domain including a heavy chain complementary determining region 1 (HC CDR1) of SEQ ID NO: 196, a heavy chain complementary determining region 2 (HC CDR2) of SEQ ID NO: 197, and a heavy chain complementary determining region 3 (HC CDR3) of SEQ ID NO: 198; or

(iii) a light chain variable domain comprising a light chain complementary determining region 1 (LC CDR1), a light chain complementary determining region 2 (LC CDR2), and a light chain complementary determining region 3 (LC CDR3) disclosed in Table 2; and

a heavy chain variable domain comprising a heavy chain complementary determining region 1 (HC CDR1), a heavy chain complementary determining region 2 (HC CDR2), and a heavy chain complementary determining region 3 (HC CDR3) disclosed in Table 2.

2. The vector of claim 1, wherein the polypeptide that enhances an immune cell function, or a functional derivative thereof is selected from the group consisting of a cytokine, an interferon, a chemokine, an antibody or antibody fragment, a checkpoint inhibitor antagonist, a dominant negative receptor, a switch receptor, and a combination thereof.

3. The vector of claim 1 or 2, wherein the polypeptide that enhances an immune cell function, or a functional derivative thereof is:

(a) a chemokine, a chemokine receptor, a cytokine, a cytokine receptor, and a combination thereof;

(b) a cytokine selected from the group consisting of Interleukin-2 (IL-2), Interleukin-3 (IL-3), Interleukin-6 (IL-6), Interleukin-7 (IL-7), Interleukin-7 receptor (IL-7R), Interleukin-11 (IL-11), Interleukin-12 (IL-12), Interleukin-15 (IL-15), Interleukin-15 receptor (IL-15R), Interleukin-18 (IL-18), Interleukin-18 receptor (IL-18R), Interleukin-21 (IL-21), granulocyte macrophage colony stimulating factor, alpha, beta or gamma interferon, erythropoietin, and a combination thereof; or

(c) a chemokine selected from CCL21, CCL19, or a combination thereof.

4. The vector of claim 1, wherein the polypeptide that enhances an immune cell function, or a functional derivative thereof further comprises:

(a) a leader sequence selected from the group consisting of an IL-2 signal sequence, an IL-12 signal sequence, a kappa leader sequence, a CD8 leader sequence, or any equivalent thereof;

(b) a CD8 leader sequence; or

(c) the amino acid sequence of SEQ ID NO: 25 or an amino acid sequence having about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 25.

5. The vector of claim 1, wherein the polypeptide that enhances an immune cell function, or a functional derivative thereof comprises:

(a) an IL-18 polypeptide or a polypeptide having the amino acid sequence of SEQ ID NO: 105, SEQ ID NO: 215, SEQ ID NO: 106, SEQ ID NO: 107 or an amino acid sequence having about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 105, SEQ ID NO: 215, SEQ ID NO: 106, or SEQ ID NO: 107; and/or

(b) a CD8 leader sequence, or the amino acid sequence of SEQ ID NO: 25 or an amino acid sequence having about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 25.

6. The vector of claim 5, wherein the IL-18 polypeptide comprises:

(a) a mutation at a position selected from the group consisting of position 42, 74, 85, 87, 89, 104, 112, 10, 132, 143, 149, 163, and 189 of SEQ ID NO: 107; or

(b) E42A; E42K; K89A; E42A and K89A; E42K and K89A; E42A and C74S; E42A, C74S, and K89A; C74S, and K89A; C74S, C112S, and C112S; E42A, C74S, C112S, and C112S; E42A, K89A, C74S, C112S, and C112S in SEQ ID NO: 107.

7. The vector of claim 6, wherein the IL-18 polypeptide:

(a) exhibits at least an about 2-fold increased activity when compared to WT IL-18;

(b) is resistant to IL18BP inhibition when compared to WT IL-18; and/or

(c) requires at least an about 4 fold concentration of IL-18BP for neutralization when compared to WT IL-18.

8. The vector of claim 1, wherein the vector:

(a) is selected from the group consisting of a DNA, a RNA, a plasmid, a lentivirus vector, an adenoviral vector, or a retroviral vector;

(b) is a lentiviral vector;

(c) is an *in vitro* transcribed vector;

(d) further comprises a rev response element (RRE), a poly(A) tail, a 3' UTR, a woodchuck hepatitis virus posttranscriptional regulatory element (WPRE), and/or a cPPT sequence; or

(e) comprises a WPRE sequence of SEQ ID NO: 100.

9. The vector of claim 1, wherein the constitutive promoter:

(a) comprises a promoter selected from the group consisting of an EF-1alpha promoter, a PGK-1 promoter, a truncated PGK-1 promoter, an UBC promoter, a CMV promoter, a CAGG promoter, and an SV40 promoter;

(b) is an EF-1 promoter; or

(c) comprises the sequence of SEQ ID NO: 101.

10. The vector of claim 1, wherein:

(a) the light chain variable region comprises the amino acid sequence of SEQ ID NO: 7 or 199, or an amino acid sequence having at least about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 7 or 199;

(b) the heavy chain variable region comprises the amino acid sequence of SEQ ID NO: 8 or 200, or an amino acid sequence having at least about 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 8 or 200;

(c) the light chain variable region comprises the amino acid sequence of SEQ ID NO: 7 and the heavy chain variable region comprises the amino acid sequence of SEQ ID NO: 8; or

(d) the light chain variable region comprises the amino acid sequence of SEQ ID NO: 199 and the heavy chain variable region comprises the amino acid sequence of SEQ ID NO: 200.

11. The vector of claim 1, wherein the anti-CD19 binding domain:

(a) is a scFv;

(b) comprises an amino acid sequence selected from the group consisting of SEQ ID NO: 9, 18, 64, 75, 86, 190, 157, 212, 201, 226, 179, 168, and 146, or a sequence having 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 9,18, 64, 75, 86, 190, 157, 212, 226, 201, 179, 168, and 146;

(c) is encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 21, SEQ ID NO: 24, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 104, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 116, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 225, and SEQ ID NO: 216;

(d) is encoded by a nucleic acid a sequence having 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 21, SEQ ID NO: 24 SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 104, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 116, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 225, or SEQ ID NO: 216;

(e) is encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, SEQ ID NO: 23, SEQ ID NO: 24, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 104, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 116, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 225, and SEQ ID NO: 216; or

(f) is encoded by a sequence having 90%, about 91%, about 92%, about 93%, about 94%, about 95%, about 96%, about 97%, about 98%, or about 99% identity to SEQ ID NO: 19-24, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 104, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 116, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 225, or SEQ ID NO: 216.

12. A vector comprising:

(a) a first polynucleotide comprising a constitutive promoter operably linked to a nucleic acid encoding an anti-CD19 chimeric antigen receptor (CAR), wherein the CAR comprises:

(i) an anti-CD19 binding domain comprising:

(1) LC CDR1 of SEQ ID NO: 1, LC CDR2 of SEQ ID NO: 2, and LC CDR3, HC CDR1 of SEQ ID NO: 4, HC CDR2 of SEQ ID NO: 5, and HC CDR3 of SEQ ID NO: 6; or

(2) LC CDR1 of SEQ ID NO: 193, LC CDR2 of SEQ ID NO: 194, LC CDR3 of SEQ ID NO: 195; HC CDR1 of SEQ ID NO: 196, HC CDR2 of SEQ ID NO: 197, and HC CDR3 of SEQ ID NO: 198; or

(3) a light chain variable domain comprising a light chain complementary determining region 1 (LC CDR1), a light chain complementary determining region 2 (LC CDR2), and a light chain complementary determining region 3 (LC CDR3) disclosed in Table 2; and a heavy chain variable domain comprising a heavy chain complementary determining region 1 (HC CDR1), a heavy chain complementary determining region 2 (HC CDR2), and a heavy chain complementary determining region 3 (HC CDR3) disclosed in Table 2;

(ii) a transmembrane domain selected from CD28 or CD8 transmembrane domain;

(iii) a costimulatory domain comprising an intracellular signaling domain of a protein selected from the group consisting of OX40, CD27, CD2, CD28, ICOS, and 4-1BB; and

(iv) an intracellular signaling domain comprising of CD3-zeta;

(b) a second polynucleotide comprising a nucleic acid encoding Interleukin-18 (IL-18), and/or Interleukin-18 receptor (IL-18R);

wherein the first polynucleotide is operably linked to the second polypeptide via a linker peptide selected from the group consisting of F2A, E2A, P2A, T2A, and Furin-(G4S)2-T2A (F-GS2-T2A).

13. A vector comprising:

(a) a first polynucleotide comprising a constitutive promoter operably linked to a nucleic acid encoding an anti-CD19 chimeric antigen receptor (CAR), wherein the CAR comprises:

(i) an anti-CD19 binding domain comprising the amino acid sequence of SEQ ID NO: 9, 18, 64, 75, 86, 190, 157, 212, 201, 226, 179, 168, or 146;

(ii) a transmembrane domain selected from CD28 or CD8 transmembrane domain;

(iii) a costimulatory domain comprising an intracellular signaling domain of a protein selected from the group consisting of OX40, CD27, CD2, CD28, ICOS, and 4-1BB; and

(iv) an intracellular signaling domain comprising of CD3-zeta; and

(b) a second polynucleotide comprising a nucleic acid encoding Interleukin-18 (IL-18) and/or Interleukin-18 receptor (IL-18R);

wherein the first polynucleotide is operably linked to the second polypeptide via a linker peptide selected from the group consisting of F2A, E2A, P2A, T2A, or Furin-(G4S)2-T2A (F-GS2-T2A).

14. A vector comprising:

(a) a first polynucleotide comprising a constitutive promoter operably linked to a nucleic acid encoding an anti-CD19 chimeric antigen receptor (CAR), wherein the CAR comprises:

(i) an anti-CD19 binding domain comprising the amino acid sequence of SEQ ID NO: 9, 18, 64, 75, 86, 190, 157, 212, 201, 226, 179, 168, or 146;

(ii) a transmembrane domain comprising the amino acid sequence selected from the group consisting of SEQ ID NO: 29, 31, and 33;

(iii) a costimulatory domain comprising an amino acid sequence selected from the group consisting of SEQ ID NO: 37, SEQ ID NO: 39, SEQ ID NO: 41, SEQ ID NO: 43, SEQ ID NO: 46, SEQ ID NO: 48, and SEQ ID NO: 50; and

(iv) an intracellular signaling domain comprising the amino acid sequence of SEQ ID NO: 52 or SEQ ID NO: 54; and

(b) a second polynucleotide comprising:

(i) a nucleic acid encoding the amino acid of SEQ ID NO: 105, 215, 106, or 107, and/or

(ii) an IL-18 polypeptide comprising E42A; E42K; K89A; E42A and K89A; E42K and K89A; E42A and C74S; E42A, C74S, and K89A; C74S, and K89A; C74S, C112S, and C112S; E42A, C74S, C112S, and C112S; E42A, K89A, C74S, C112S, and C112S in SEQ ID NO: 107;

wherein the first polynucleotide is operably linked to the second polypeptide via a linker peptide selected from the group consisting of F2A, E2A, P2A, T2A, and Furin-(G4S)2-T2A (F-GS2-T2A).

15. A vector comprising:

(a) a first polynucleotide comprising a constitutive promoter operably linked to a nucleic acid encoding an anti-CD19 chimeric antigen receptor (CAR), wherein the CAR comprises:

(i) an anti-CD19 binding domain comprising the amino acid sequence of SEQ ID NO: 9, 18, 64, 75, 86, 190, 157, 212, 201, 226, 179, 168, or 146;

(ii) a transmembrane domain comprising the amino acid sequence of SEQ ID NO: 29;

(iii) a costimulatory domain comprising the amino acid sequence of SEQ ID NO: 37; and

(iv) an intracellular signaling domain of SEQ ID NO: 52 or SEQ ID NO: 54; and

(b) a second polynucleotide comprising:

(i) a nucleic acid encoding the amino acid sequence of SEQ ID NO: 105, 215, 106, or 107, and/or

(ii) an IL-18 polypeptide comprising E42A; E42K; K89A; E42A and K89A; E42K and K89A; E42A and C74S; E42A, C74S, and K89A; C74S, and K89A; C74S, C112S, and C112S; E42A, C74S, C112S, and C112S; E42A, K89A, C74S, C112S, and C112S in SEQ ID NO: 107;

wherein the first polynucleotide is operably linked to the second polypeptide via a linker peptide selected from the group consisting of F2A, E2A, P2A, T2A, and Furin-(G4S)2-T2A (F-GS2-T2A).

16. The vector of claim 1, wherein the first polynucleotide comprises:

(a) an amino acid sequence encoded by a nucleic acid sequence selected from the group consisting of SEQ ID NO: 66, 77, 88, 148, 170, 181, 203, 214, 159, 192, 23, and 20; and/or

(b) an amino acid sequence encoded by a nucleic acid sequence selected from the

group consisting of SEQ ID NO: 65, 76, 87, 147, 169, 180, 202, 213, 158, 191, 22, and 19.

17. A modified cell comprising a vector of any one of claims 1-16.

18. The modified cell of claim 53, wherein the modified cell is

(a) an immune cell or precursor cell thereof; or

(b) selected from the group consisting of a T cell, a Natural Killer (NK) cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell, a Natural Killer T (NKT) cell, a dendritic cell, a macrophage, a human embryonic stem cell, and a pluripotent stem cell from which lymphoid cells may be differentiated.

19. The modified cell of claim 17, further comprising:

(a) a switch receptor comprising a first polypeptide that comprises at least a portion of an inhibitory molecule selected from the group consisting of PD1, TGFβR, TIM-2 and BTLA, conjugated to a second polypeptide that comprises an intracellular signaling domain of a molecule selected from the group consisting of OX40, CD27, CD28, IL-12R, ICOS, and 4-1BB;

(b) a dominant negative receptor comprising a truncated variant of a receptor selected from the group consisting of PD1, TGFβR, TIM-2 and BTLA; and/or

(c) a polypeptide that enhances an immune cell function, or a functional derivative thereof selected from the group consisting of a chemokine, a chemokine receptor, a cytokine, a cytokine receptor, Interleukin -7 (IL-7), Interleukin-7 receptor (IL-7R), Interleukin-15 (IL-15), Interleukin-15 receptor (IL-15R), Interleukin-21 (IL-21), CCL21, CCL19, and a combination thereof.

20. A composition comprising a modified cell or a population of modified cells of claim 17.

21. Use of the modified cell of claim 17 for the manufacture of a medicament for treating a mammal having a disease associated with expression of CD19.