CLAIMS

1. A method for assessing and optimizing cellular quality of a cell-based therapy, comprising:
   (a) determining one or more molecular characteristics of a pre-modified cell culture;
   (b) genetically modifying the cell culture via an automated cell engineering system;
   (c) determining the one or more molecular characteristics of the modified cell culture during and after the genetically modifying; and
   (d) optimizing one or more parameters of the automated cell engineering system to alter the one or more molecular characteristics of the modified cell culture.
2. The method of claim 1, wherein the one or more molecular characteristics are selected from the group consisting of a gene expression, a protein expression, an mRNA expression, and a copy number variation.
3. The method of claim 1 or claim 2, wherein the cell culture is an immune cell culture, a natural killer cell culture, and a cell culture for a neurodegenerative therapy.
4. The method of claim 3, wherein the immune cell culture is a T-cell culture.
5. The method of claim 4, wherein T cell culture is a chimeric antigen receptor T (CAR T) cell culture.
6. The method of claim 5, wherein the one or more molecular characteristics include T-cell activation, metabolism, exhaustion, and T-cell receptor diversity.
7. The method of any one of claims 1-6, wherein the optimizing in (d) occurs before, during, and/or after the genetically modifying.
8. The method of any one of claims 1-7, wherein the optimizing includes one or more of increasing or decreasing a flow rate of cell media, increasing or decreasing oxygen concentration, increasing or decreasing carbon dioxide

concentration, increasing or decreasing a glucose level, increasing or decreasing the temperature of a cell expansion, increasing or decreasing the pH of a cell media, modifying a cell transduction procedure, modifying a vector for use in a transduction procedure, and modifying a cell isolation procedure.

9. A method for assessing and optimizing cellular quality of a cell-based therapy, comprising:
   (a) determining one or more molecular characteristics of a pre-modified cell culture;
   (b) optimizing one or more parameters of an automated cell engineering systems to alter one the one or more molecular characteristics of the pre-modified cell culture;
   (c) activating the pre-modified cell culture with an activation reagent to produce an activated cell culture;
   (d) transducing the activated immune cell culture with a vector, to produce a transduced cell culture;
   (e) expanding the transduced cell culture;
   (f) concentrating the expanded cell culture of (e);
   (g) harvesting the concentrated cell culture of (f) to produce a genetically modified cell culture;
   (h) determining the one or more molecular characteristics of the cell culture during or after any one of steps (c)-(g); and
   (i) optimizing one or more parameters of any one of steps (c)-(g) to alter the one or more molecular characteristics of the cell culture.
10. The method of claim 9, wherein the one or more molecular characteristics are selected from the group consisting of a gene expression, a protein expression, an mRNA expression, and a copy number variation.
11. The method of claim 9 or claim 10, wherein the cell culture is an immune cell culture, a natural killer cell culture, and a cell culture for a neurodegenerative therapy.
12. The method of claim 11, wherein the immune cell culture is a T-cell culture.

13. The method of claim 12, wherein T-cell culture is a chimeric antigen receptor T (CAR T) cell culture.

14. The method of claim 13, wherein the one or more molecular characteristics include T-cell activation, metabolism, exhaustion, and T-cell receptor diversity.

15. The method of any one of claims 9-14, wherein the optimizing includes one or more of increasing or decreasing a flow rate of cell media, increasing or decreasing oxygen concentration, increasing or decreasing carbon dioxide concentration, increasing or decrease a glucose level, increasing or decreasing the temperature of a cell expansion, increasing or decreasing the pH of a cell media, modifying a cell transduction procedure, modifying a vector for use in a transduction procedure, and modifying a cell isolation procedure.

16. A method for assessing and optimizing cellular quality of a chimeric antigen receptor T (CAR T) cell culture, comprising:
    (a) determining one or more molecular characteristics of a pre-modified T-cell culture;
    (b) optimizing one or more parameters of an automated cell engineering system to alter one the one or more molecular characteristics of the pre-modified T-cell culture;
    (c) activating the pre-modified T-cell culture with an activation reagent to produce an activated T-cell culture;
    (d) transducing the activated T-cell culture with a vector encoding a chimeric antigen receptor, to produce a CAR T-cell culture;
    (e) expanding the CAR T-cell culture;
    (f) concentrating the expanded CAR T-cell culture of (e);
    (g) harvesting the concentrated CAR-T cell culture of (f);
    (h) determining the one or more molecular characteristics of the CAR T-cell culture during or after any one of steps (c)-(g); and
    (i) optimizing one or more parameters of any one of steps (c)-(g) to alter the one or more molecular characteristics of the CAR T-cell culture.

17. The method of claim 16, wherein the method produces at least about 100 million viable CAR T-cells

18. The method of claim 16, wherein the method produces at least about 2 billion viable CAR T-cells

19. The method of any one of claims 16-19, wherein the T-cell culture comprises peripheral blood mononuclear cells and/or purified T-cells.

20. The method of any one of claims 16-19, wherein the T-cell culture comprises at least one accessory cell.

21. The method of claim 20, wherein the accessory cell comprises a monocyte or a monocyte-derived cell.

22. The method of claim 20, wherein the accessory cell comprises antigens for a T-cell receptor, including CD28, CD40, CD2, CD40L and/or ICOS.

23. The method of any one of claims 16-22, wherein the activation reagent comprises an antibody or a dendritic cell.

24. The method of claim 23, wherein the antibody is immobilized on a surface.

25. The method of claim 24, wherein the surface is a surface of a bead.

26. The method of claim 23, wherein the antibody is a soluble antibody.

27. The method of claim 23, wherein the antibody comprises at least one of an anti-CD3 antibody and an anti-CD28 antibody.

28. The method of any one of claims 16-27, wherein the transducing comprises viral infection, electroporation, membrane disruption, or combinations thereof.

29. The method of any one of claims 16-28, wherein the vector is a lentiviral vector or a retrovirus.

30. The method of any one of claims 16-29, wherein the one or more molecular characteristics include T-cell activation, metabolism, exhaustion, and T-cell receptor diversity.
31. The method of any one of claims 16-30, wherein the one or more molecular characteristics are selected from the group consisting of a gene expression, a protein expression, an mRNA expression, and a copy number variation.
32. The method of claim 31, wherein at least about 500 gene expressions are determined.
33. The method of claim 31, wherein at least about 700 gene expressions are determined.
34. The method of claim 31, wherein about 780 gene expressions are determined.
35. The method of any one of claims 16-34, wherein the optimizing includes one or more of increasing or decreasing a flow rate of cell media, increasing or decreasing oxygen concentration, increasing or decreasing carbon dioxide concentration, increasing or decrease a glucose level, increasing or decreasing the temperature of a cell expansion, increasing or decreasing the pH of a cell media, modifying a cell transduction procedure, modifying a vector for use in a transduction procedure, and modifying a cell isolation procedure.

36. A method for assessing and optimizing cellular quality of a cell culture, comprising:

    (a) determining one or more molecular characteristics of a pre-modified cell culture;
    (b) genetically modifying the cell culture via an automated cell engineering system;
    (c) determining the one or more molecular characteristics of the modified cell culture during and after the genetically modifying; and
    (d) optimizing one or more parameters of the automated cell engineering system to alter the one or more molecular characteristics of the modified cell culture.