Claims:

1. A method of cellular reprogramming for the interconversion of a differentiated or somatic cell of a first cell phenotype to at least one desired second, multipotent, pluripotent, self-renewing or differentiating phenotype, the method comprising:

- transfecting a nucleated cell, wherein one or more transfection step is performed *in vitro*, and wherein said nucleated cell is transfected with: a) a nucleic acid, b) a vector, c) a vector comprising synthetic oligonucleotides, d) a vector for gene therapy, e) a virus, f) a polypeptide, g) a ribonucleic acid or, h) a deoxyribonucleic acid encoding a polypeptide, and wherein said polypeptide is;

i. one or more first polypeptide(s) selected from PRR+ Numb, Oct3/4, Sox2, Nanog and a polypeptide with LIF activity;

ii. one or more second polypeptide(s) selected from PRR+ Numb, Oct4, Sox2, Nanog, Notch, Fgf4, Hoxb4, Lin28, Lif, Lifr, Cntf, Cardiotrophin, Osm, Osm-r, Il6, Il6r, Hyper Il6, Il-11, Gp130, Stat3, C-myc, and a polypeptide with Lif Activity;

iii. one or more third polypeptide(s) selected from a short Numb isoform, Numblike, MyoD, myogenin, Myocardin, Ifrdl, Myf 5, Myf 6, Mef2, Gata 4, Gata 5, Gata 6, Sox9, CREB-binding polypeptide, Runx2, HNF- 1, HNF-3, HNF-4, HNF-6, Nurr1, REN, Neurogenin1, Neurogenin2, Neurogenin3, Mash1, Phox2a, Phox2b, dHand, Gata3, Shh, FGF8, Lmx1b, Nkx2.2, Pet1, Lbx1, Rnx, PITX2, D1x2, D1x5, Ngn2, Ptx3, Gata2, REST4, Foxa2, Sox17, HLXB9, Runx1/AML, Pdxl, OLIGI, OLIG2, NOV(CCN3), and Zfp488; and/or

iv. one or more fourth polypeptide(s) altering the amount, activity or antigenicity of a cellular protein.

~~The method of obtaining a self-renewing, multipotent, and/or pluripotent cell population from otherwise non-pluripotent cells, wherein the method is achievable without the requisite use of oncogenes or requisite use of integrating viral vectors and comprises:~~

~~selecting non-pluripotent, non-self-renewing cells;~~

~~introducing one or more nucleic acids or proteins selected from a long (Prr+) numb isoform, Nanog, Oct3/4, Sox2;~~

~~growing the selected cells in a growth medium comprising cytokines;~~

~~maintaining the cells under these culture conditions until the desired cell number of pluripotent cells is achieved; and~~

~~optionally differentiating said cells by further overexpression or introduction of nucleic acid(s) or protein(s) corresponding to one or more genes normally present in the desired cells, or to portion(s) of said genes normally present in the desired cells.~~

2. The method of claim 1, further comprising

-growing the transfected cell in a first incubation step effective that the transfected cell grows at a first growth rate;

-differentiating the transfected cell in a second incubation step; and/or

-culturing the transfected cell in an environment selected from de-cellularized cadaveric tissue, a two-dimensional scaffold, a three-dimensional scaffold, and hanging drops.~~wherein said nucleic acids or proteins correspond to a single gene or portion thereof.~~

3. The method of claim 1 further comprising

-assessing the transfected cell according to morphology, expression of cellular markers, transgenic markers, antibiotic markers, fluorescent markers, a marker gene encoded by a transgene expressing vector, an antibiotic resistance gene, a fluorescent protein gene, or a reporter gene under the control of a cell type specific promoter; and/or

-cryopreserving the transfected cell.~~wherein nucleic acid(s) or protein(s) utilized comprise ones selected from:~~

~~(a) OCT3/4 and Sox2, or a portion(s) thereof;~~

~~(b) NANOG, OCT3/4 and SOX2 or a portion(s) thereof;~~

~~(c) OCT3/4 and SOX2 and a transgene with LIF activity, or a portion(s) thereof;~~

~~(d) OCT3/4 and SOX2 and multiple transgenes with LIF activity, or a portion(s) thereof;~~

~~(e) Notch, or a portion(s) thereof;~~

~~(f) OCT3/4, SOX2 and Notch, or a portion(s) thereof;~~

~~(g) OCT3/4, SOX2, NANOG, and Notch, or a portion(s) thereof;~~

~~(h) OCT3/4, SOX2, NANOG, and a transgene with LIF activity, or a portion(s) thereof;~~

~~(i) OCT3/4, SOX2, NANOG, and multiple transgenes with LIF activity, or a portion(s) thereof;~~

~~(j) OCT3/4, Notch, HOXB4 and SOX2, or a portion(s) thereof;~~

~~(k) LIF, or a portion(s) thereof;~~

~~(l) ones with LIF activity, or a portion(s) thereof; (m) LIFR, or a portion(s) thereof;~~

~~(n) oncostatin M (OSM), or a portion(s) thereof;~~

~~(o) oncostatin M receptor (OSMR), or a portion(s) thereof;~~

~~(p) cardiotrophin-1, or a portion(s) thereof;~~

~~(q) CNTF, or a portion(s) thereof;~~

~~(r) lin28, or a portion(s) thereof;~~

~~(s) c-myc, or a portion(s) thereof; and/or~~

~~(t) Stat3, or a portion(s) thereof.~~

4. The method of claim1, wherein the vector comprises synthetic oligonucleotides directed against a HIV co-receptor, a decoy sequence, an HIV-2 RRE decoy sequence and/or an HIV-2 TAR decoy sequence, wherein the vector is capable of retarding HIV, SIV, or FIV infection.~~any one of claims 1 to 3 wherein a long (PRR+) numb isoform protein is:~~

~~(a) accompanied by other protein(s) including ones selected from a group consisting of human LIF, oncostatin-M, cardiotrophin-1, IL-11, IL-6, IL-6R, hyper IL-6, LIFR, gp130, OCT3 (OCT4), Nanog, SOX2, and/or FGF-4, or a portion(s) thereof; or~~

~~(b) replaced by transfection with protein(s) including ones selected from a group consisting of human LIF, oncostatin M, cardiotrophin-1, IL-11, IL-6, IL-6R, hyper IL-6, LIFR, gp130, OCT3 (OCT4), Nanog, SOX2, and/or FGF-4, or a portion(s) thereof.~~

5. The method of claim 1, wherein the synthetic oligonucleotides comprise miRNA, siRNA, or shRNA sequences directed against an HIV co-receptor, against CXCR4 and/or against CCR5.~~any one of claims 1 to 4, wherein the selected cell is modified to express:~~

~~(a) telomerase altering the cell's lifespan;~~

~~(b) a gene product deficient in a patient; or~~

~~(c) a nucleic acid sequence encoding a protein selected from aspartoacyclase (ASP), HRPT, HTT, NPC1, GBA, PARK2, VHL, Beta-glucuronidase, hexosaminidase A (HEXA), hexosaminidase B (HEXB), HRPT, HTT, galactosidase alpha (GLA), glucosidase beta acid (GBA), von Rippel Lindau tumor suppressor (VHL), Beta globin (HBB), NPC1, and PARK25.~~

6. The method of claim 1, wherein the nucleated cell is selected from the group of stem/progenitor cells and somatic cell types, said stem/progenitor cells comprising donor cells, autologous cells, HLA type compatible cells, reprogrammed cells, induced multipotent cells, induced pluripotent cells, cells derived from bone marrow, peripheral blood, placental blood, amniotic fluid, umbilical cord blood, banked sources, cryopreserved sources, skin, adipose tissue, non-human embryo cells, hematopoietic cells, spermatogonia, primordial germ cells, leukocytes, lymphocytes, epithelial cells, buccal cheek cells, and genetically-modified cells.~~any one of claims 1 to 5 modified by the exclusion of proteins corresponding to numb.~~

7. The method of claim 1, wherein the nucleated cell is transfected with a vector encoding a second polypeptide, wherein the vector encoding said second polypeptide does not integrate into the genome of said cell, wherein the second polypeptide is selected from PRR+ Numb, Oct4, Sox2, Nanog, Notch, FGF4, HOXB4, LIN28, LIF, LIFR, CNTF, cardiotrophin, OSM, OSM-R, L6, IL6R, hyper IL6, IL-11, gp130, stat3, c-myc, and a polypeptide with LIF activity.~~any one of claims 1 to 6, wherein the selected cell or its progeny is modified to express:~~

~~(a) a beneficial nucleic acid sequence;~~

~~(b) a synthetic oligonucleotide, siRNA, shRNA, microRNA, or antisense RNA;~~

~~(c) a nucleic acid sequence or protein retarding infection by a virus;~~

~~(d) a nucleic acid sequence or protein rendering said cells and/or their progeny less capable of sustaining viral replication;~~

~~(e) a nucleic acid sequence or protein rendering said cells and/or their progeny less capable of sustaining viral transcription;~~

~~(f) a synthetic oligonucleotide directed against an immunodeficiency virus co-receptor;~~

~~(g) a decoy RNA;~~

~~(h) a viral psi sequence; or~~

~~(i) a nucleic acid sequence or protein rendering said cells and/or their progeny disease resistant.~~

8. The method of claim 1, wherein the nucleated cell is transfected with a third one or more polypeptide, and/or with ribonucleic acids or deoxyribonucleic acids encoding one or more third polypeptides, wherein the one or more third polypeptide is selected from a short Numb isoform, Numblike, MyoD, myogenin, Myocardin, Ifrdl, Myf 5, Myf 6, Mef2, Gata 4, Gata 5, and Gata 6, Sox9, CREB-binding polypeptide, Runx2, HNF-I, HNF-3, HNF-4, HNF-6, Nurrl, REN, Neurogenin1, Neurogenin2, Neurogenin3, Mash 1, Phox2a, Phox2b, dHand, Gata3, Shh, FGF8, Lmxlb, Nkx2.2, Pet1, Lbx1, Rnx, PITX2, Dlx2, Dlx5, Ngn2, Ptx-3, Gata2, REST4, Foxa2, Sox17, HLXB9, Runx1/AML, Pdxl, OLIG1, OLIG2, NOV(CCN3), and Zfp488, or said nucleic acid comprises antisense Hes1 RNA.~~said selected cell and/or its progeny are incubated in a growth medium comprising cytokines selected from a group consisting of EGF, bFGF, LIF, steel factor, IL-6, hyper IL-6, IL-7, oncostatin-M, cardiotrophin-1 and other growth enhancing cytokines.~~

9. The method of claim 8,~~1~~ wherein the nucleated cell is transfected with a first polypeptide, or with one or more ribonucleic acids or deoxyribonucleic acids encoding a first polypeptide selected from PRR+ Numb, Oct3/4, Sox2, and Nanog; and wherein the nucleated cell is transfected with a second one or more polypeptide(s) and/or with one or more ribonucleic acids or deoxyribonucleic acids encoding the second one or more polypeptide(s) selected from PRR+ Numb, Oct4, Sox2, Nanog, Notch, LIN28, HoxB4, FGF4, LIF, LIFR, cardiotrophin, oncostatin, oncostatin receptor, IL6, hyper IL6,

gp130, stat3, c-myc, CNTF, and a polypeptide with LIF activity.~~said cell and/or its progeny are differentiated by overexpression or introduction of nucleic acid(s) or protein(s) corresponding to one or more transcription factors normally present in the desired cells.~~

10. The method of claim 2, wherein the transfected cell is grown in an environment selected from decellularized cadaveric tissue, a two-dimensional scaffold engineered to replicate tissue structure, a two-dimensional scaffold engineered to replicate an organ, a three-dimensional format, a three-dimensional scaffold engineered to replicate tissue structure, a three-dimensional scaffold engineered to replicate an organ, and an ink-jet style cartridge for subsequent placement of the transfected cell in a desired position utilizing ink-jet printer technology for tissue engineering.~~any one of the preceding claims, wherein said cells and/or their progeny further overexpress:~~

~~(a) Mash1 (Ascl1), or a portion(s) thereof;~~

~~(b) MyoD, myogenin, Myf5, Myf6, Mef2, myocardin, IFRD1, a muscle transcription factor and/or a muscle type specific bHLH-encoding sequence, or a portion(s) thereof;~~

~~(c) Foxa2, Sox17, HLXB9, and/or Pdx1, or a portion(s) thereof;~~

~~(d) Hepatic nuclear factor (HNF)-1, HNF-3, HNF-4, HNF-6, and/or CREB-binding protein, or a portion(s) thereof;~~

~~(e) Runx1/AML1 and/or NOV (CCN3), or a portion(s) thereof;~~

~~(f) Sox9, CREB-binding protein, Gata6 and/or Runx2, or a portion(s) thereof;~~

~~(g) OLIG1, OLIG2, and/or Zfp488, or a portion(s) thereof;~~

~~(h) MyoD, myogenin, myocardin, Myf5, Myf6, Mef2A, Gata4, Gata5, and/or Gata6, or a portion(s) thereof;~~

~~(i) Gata4, Gata5, and/or Gata6, or a portion(s) thereof;~~

~~(j) myocardin, or a portion(s) thereof;~~

~~(k) myogenin and MyoD, or myogenin, or a portion(s) thereof;~~

~~(l) Runx2, or a portion(s) thereof;~~

~~(m) Mash1 (Ascl1), Ngn2, Nurr1, Lmx1b, and/or Ptx-3, or a portion(s) thereof;~~

~~(n) Mash1 (Ascl1), Phox2b, Lmx1b, Nkx2.2, Pet1, Gata2, Gata3, and/or Pet1, or a portion(s) thereof;~~

~~(o) Mash1 (Ascl1), Phox2a and/or REST4, or a portion(s) thereof;~~

~~(p) Mash1 (Ascl1), PITX2, Dlx2, Dlx5, HES1 targeting synthetic oligonucleotides, Phox2a, and/or REST4, or a portion(s) thereof;~~

~~(q) Mash1 (Ascl1), Phox2a, Phox2b, dHand, Gata2 and/or Gata3, or a portion(s) thereof;~~

~~(r) Mash1 (Ascl1), Nurr1, REN, Neurogenin1, Neurogenin2, Neurogenin3, Mash1, Phox2b, Phox2a, dHand, Shh, FGF8, Lmx1b, Nkx2.2, Pet1, Lbx1, Rnx, Gata3, and/or anti-sense Hes1 RNA or a portion(s) thereof;~~

~~(s) PRR-Numb and/or Numblike; and~~

~~(t) a transcription factor(s) normally present in the desired cells or a portion(s)thereof.~~

11. The method of claim 2, further comprising isolating transfected cells, wherein transfected cells are isolated from the growth or differentiation medium after achieving a desired cell number and/or a desired state of differentiation.~~any one of claims 1 to 10 wherein said cells and/or their progeny are incubated in a differentiation medium.~~

12. The method of claim ~~1~~1, wherein the vector encodes one or more polypeptide(s).~~said cells and/or their progeny are incubated in a differentiation medium comprising one or more agents selected from the group consisting of:~~

~~(a) retinoic acid, Neurotrophin 3 (NT3), nerve growth factor (NGF), glial cell-line derived growth factor (GDNF), and/or interferon-Y (IFNY), hexamethylene bis-acrylamide, dimethyl sulfoxide (DMSO), fetal bovine serum (FBS), normal bovine serum (NBS), retinoic acid, cardiomyocyte conditioned medium, vascular endothelial growth factor (VEGF), LIF, thrombopoietin, a colony stimulating factor, M-CSF (CSF-1), GMCSF, IL-7, a cytokine promoting CD4+ T cell differentiation, sodium butyrate, activin A, epidermal growth factor, basic fibroblast growth factor, noggin, insulin-like growth factor and nicotinamide;~~

~~(b) retinoic acid, Neurotrophin 3 (NT3), nerve growth factor (NGF), glial cell-line derived growth factor (GDNF), and/or interferon-Y (IFNY);~~

~~(c) hexamethylene bis-acrylamide or dimethylsulfoxide;~~

~~(d) fetal bovine serum (FBS);~~

~~(e) normal bovine serum (NBS), dimethylsulfoxide, retinoic acid and/or cardiomyocyte conditioned medium;~~

~~(f) vascular endothelial growth factor (VEGF), thrombopoietin, and colony stimulating factors appropriate to the desired cell type;~~

~~(g) LIF, Neurotrophin 3 (NT3), and/or nerve growth factor (NGF);~~

~~(h) a colony stimulating factor, optionally M-CSF (CSF-1), GM-CSF, IL-7, or a cytokine promoting CD4+ T cell differentiation; and/or~~

~~(i) sodium butyrate, activin A, retinoic acid, epidermal growth factor, basic fibroblast growth factor, noggin, insulin-like growth factor II and nicotinamide.~~

13. The method of claim 1~~according to any one of claims 1, 3-9 and 10-12~~, wherein the vector is capable of retarding HIV-I, HIV-2, and/or FIV infection and includes a decoy sequence, a synthetic oligonucleotide sequence(s) and a synthetic oligonucleotide sequences(s) directed against an HIV viral genomic sequence, a synthetic oligonucleotide directed against an HIV enzyme(s), and/or an a synthetic oligonucleotide directed against an HIV co-receptor(s).~~a protein, nucleic acid or agent is present in order to screen for its ability to induce phenotypic changes or differentiation of selected cells into desired cell populations.~~

14. The method of ~~any one of the preceding claims~~claim 2, wherein the a growth medium comprises one or more cytokines selected from EGF, IL-I, oncostatin, CNTF, soluble gp130, bFGF, steel factor, LIF, cardiotrophin, OSM, IL6, hyper IL6, and a cytokine having LIF activity; and/or a differentiation medium comprises an agent selected from the group consisting of retinoic acid, Neurotrophin 3 (NT 3), nerve growth factor (NGF), glial cell-line derived growth factor (GDNF), interferon (IFN-Y), hexamethylene bis acrylarnide, dimethylsulfoxide, fetal bovine serum (FBS), normal bovine serum (NBS), vascular endothelial growth factor (VEGF), thrombopoietin, a colony stimulating factor, M-CSF (CSF-I), GM-CSF, IL-7, and cardiomyocyte conditioned medium.~~said cells and/or their progeny are cultured in three-dimensional or two-dimensional scaffolding, said cells and/or their progeny are grown in a de-cellularized organ or on de-cellularized tissue, or said cells or their progeny are utilized in conjunction with inkjet style printing or 3D printing technology for tissue engineering.~~

15. The method of claim 1, wherein the nucleated cell is transfected only with a first polypeptide; or with one or more nucleic acids encoding one first polypeptide, wherein the one first polypeptide is Oct3/4; and/or only with a second one or more polypeptide, or with one or more nucleic acids encoding one or more second polypeptide selected from PRR+ Numb, Sox2, Nanog, Notch, LIN28, HoxB4, FGF4, LIF, LIFR, cardiotrophin, oncostatin, oncostatin receptor, IL6, hyper IL6, gpl30, stat3, c-myc, CNTF, and a polypeptide with LIF activity.~~any one of claims 1-9, 10, 13 and 14, performed in vivo.~~

16. The method ~~of any one~~ of claim~~s~~ 1 ~~to 15~~, wherein one or more transfecting steps comprises one or more of electroporation, a non-integrating vector, a nanocapsule, a nanovault, a cationic lipid, a liposome, or comprises avoiding retroviral/lentiviral integration or other random alteration of the genomes of the transfected cell.~~the method of transfection utilizes electroporation, liposomes, nanocapsules, nanovaults, non-integrating viral vectors, and/or another approach avoiding retroviral/lentiviral integration or other random alteration of the cell's genome.~~

17. The method of claim 1 wherein the transfected nucleic acid, vector, polypeptide, or nucleic acid encoding a polypeptide is one altering cellular differentiation, cellular protein antigenicity, neoplastic potential, the amount or activity of an enzyme, a cellular protein, a structural protein, a receptor protein, a signal transduction protein, a cellular transport protein, a membrane associated protein, an HLA type protein, a protein involved in DNA repair and chromosome maintenance; a protein involved in synapse formation and maintenance; a protein involved in neurite outgrowth or

axon outgrowth and formation; a protein involved in cellular repair, a transcription factor protein, a cell fate determinant, a protein deficient in a patient or subject, telomerase, aspartoacyclase, hexosaminidase A (HEXA), hexosaminidase B (HEXB), HPRT, Huntingtin, galactosidase alpha (HLA), glucosidase beta acid (GBA), von Hippel Lindau tumor suppressor (VHL), Beta globin (HBB), NPC , and/or PARK.~~The cell populations produced according to the methods of any one of claims 1 to 16.~~

18. The method of claim 1, wherein the nucleated cell is screened for HLA type and/or the transfected cell is screened for successful transfection, initiation of differentiation, or using standard PCR or nucleic acid hybridization-based methods.~~The cell population derived from a patient or a donor, for use in fields utilizing cellular therapies, gene therapy, or animal husbandry produced by the recombinant methods of claims 1 to 16.~~

19. The method of claim 1, wherein the transfected cell is genetically-modified.~~Use of the cell population of claim 17, wherein the cell population is in screened screening based on cell type specific markers; transgenic marker expression under the control of cell type specific promoters; or transgenic marker expression under the control of neurotransmitter related promoters.~~

20. The method of claim 1, wherein the nucleated cell is transfected simultaneously with two or more nucleic acids, two or more vectors, or two or more polypeptides.~~A vector suitable for use in any one of the methods of claims 1 to 16, comprising~~

~~(a) a promoter and multiple transgenes inducing cell reprogramming;~~

~~(b) a promoter, a transgene inducing cell reprogramming, and a selectable marker gene; (c) a regulable transactivating element, an internal ribosome reentry site (IRES), a selection marker, and a target heterologous gene operated by a regulable promoter.~~

21. The method of claim 1, wherein neoplastic potential is altered in the transfected cell.~~Use of the vector of claim 20 in the preparation of a pharmaceutical composition for introduction into the circulatory system, nervous system, organ or tissue of a patient.~~

22. The method of claim 1, wherein the transfected cell is capable of promoting growth in a target tissue, ameliorating a disease, ameliorating an injury or repairing a tissue.~~Use of claim 21, wherein the pharmaceutical composition is used in the treatment of a patient with a condition or disease:~~

~~a. ameliorated by correction of a genetic deficiency;~~

~~b. dependent upon expression of genes producing susceptibility~~

~~c. ameliorated by renewed cell proliferation; or~~

~~d. characterized by dysplasia, cancer or aberrant cell behaviour.~~

23. The method of claim 1, wherein the method does not use oncogenes.~~Use of the protein of any one of claims 1 to 8, 10 and 12 in the preparation of a pharmaceutical composition for introduction into the circulatory system, nervous system, organ or tissue of a patient.~~

24. The method of claim 1, wherein the vector:

targets a sequence with at least 70% identity to a viral genomic nucleotide sequence or its complement; comprises synthetic oligonucleotide sequences that reduce the ability of target cells to sustain HIV replication by > 70;

comprises synthetic oligonucleotide sequences that reduce HIV viral activity by > 70%; and/or

comprises one or more synthetic nucleotide sequence comprising SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 8, the nucleotides at positions 12-26 of SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, and/or SEQ ID NO: 17; or

wherein the vector comprises a polycistronic expression cassette, a transcriptional promoter element, and multiple nucleic acid coding sequences operably linked to a transcriptional promoter element.~~Use of claim 23, wherein the pharmaceutical composition is used in the treatment of a patient with a condition or disease:~~

~~a. ameliorated by correction of a genetic deficiency;~~

~~b. dependent upon expression of genes producing susceptibility~~

~~c. ameliorated by renewed cell proliferation; or~~

~~d. characterized by dysplasia, cancer or aberrant cell behaviour.~~

25. The method of claim 1 further comprising screening an agent by incubating said cell in the presence of an agent and assessing the nucleated cell according to morphology, gene expression, cell sorting, expression of cellular markers, transgenic markers, antibiotic markers, fluorescent markers, a marker gene encoded by a transgene expressing vector, an antibiotic resistance gene, a fluorescent protein gene, and/or a reporter gene under the control of a cell type specific promoter.