Claims

1. A nucleic acid comprising:

(a) a cluster of differentiation 46 (CD46) transgene;

(b) a cluster of differentiation 55 (CD55) transgene;

(c) a cluster of differentiation 47 (CD47) transgene;

(d) a TNF α-induced protein 3 (A20) transgene;

(e) a heme oxygenase (HO-1) transgene; and

(f) a thrombomodulin (THBD) transgene;

wherein the CD46 transgene, the CD55 transgene, and the CD47 transgene are under the control of a ubiquitous promoter; and

wherein the nucleic acid comprises a ubiquitous chromatin opening element.

2. The nucleic acid of claim 1, wherein the transgenes are arranged into cistrons comprising one or more transgenes, wherein each cistron is controlled by a different promoter.

3. The nucleic acid of claim 2, comprising two cistrons.

4. The nucleic acid of claim 2, comprising three cistrons.

5. The nucleic acid of claim 2, comprising four cistrons.

6. The nucleic acid of claim 4, wherein the first cistron comprises CD55; the second cistron comprises CD47; and the third cistron comprises THBD.

7. The nucleic acid of anyone of claims 2-5, wherein one cistron comprises CD46, CD55, and CD47.

8. The nucleic acid of any one of claims 1-7, wherein the ubiquitous promoter is a CAG promoter, an eF1a1 promoter, or a combination thereof.

9. The nucleic acid of any one of claims 1-8, comprising an insulator.

10. The nucleic acid of any one of claims 1-8, comprising a terminator.

11. The nucleic acid of any one of claims 1-10, comprising one or more additional transgenes selected from the group consisting of tissue factor pathway inhibitor (TFPI), CD39, major histocompatibility complex class 1, E (HLA-E), Beta-2-microglobulin, programmed cell death 1 ligand 1 (PD-L1), and Fas ligand (FasL).

12. A cell expressing the nucleic acid of any one of claims 1-11.

13. The cell of claim 12, comprising inactivation of one or more carbohydrate antigen genes.

14. The cell of claim 13, wherein the carbohydrate antigen genes are selected from the group consisting of glycoprotein α-galactosyltransferase 1 (GGTA), β1,4 N-acetylgalactosaminyltransferase 2
(B4GalNT2), cytidine monophosphate-N-acetylneuraminic acid hydroxylase (CMAH), or a combination thereof.

15. The cell of any one of claims 12-14, wherein the cell is a PERV-free cell.

16. The cell of any one of claims 12-15, wherein the cell is a porcine cell.

17. A tissue comprising the cell of any one of claims 12-16.

18. An organ comprising the tissue of claim 17.