CLAIMS

1. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface; and

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of a glucose transporter protein as compared to normal oxygen conditions.

2. A method according to Claim 1, in which the glucose transporter protein is GLUT1.

3. A method according to Claim 2, in which the significantly increased expression of the GLUT1 is approximately ten-fold.

4. A method according to Claim 1, in which the low oxygen conditions comprise approximately 5% oxygen.

5. A method according to Claim 1, further comprising exposing the seeded cells to the flow of culture media.

6. A method according to Claim 1, in which the stem cells are human pluripotent stem cells.

7. A method according to Claim 6, in which the human pluripotent stem cells are induced human pluripotent stem cells.

8. A method according to Claim 1, in which the low oxygen conditions are maintained for longer than one day.

9. A method according to Claim 1, in which the BMVECs are co-cultured with astrocytes and pericytes.

10. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface; and

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of an insulin receptor protein as compared to normal oxygen conditions.

11. A method according to Claim 10, in which the significantly increased expression of the insulin receptor protein is approximately two-fold.

12. A method according to Claim 10, in which the significantly increased expression of the insulin transporter protein is approximately three-fold**.**

13. A method according to Claim 10, in which the low oxygen conditions are maintained for longer than one day.

14. A method according to Claim 10, in which the BMVECs are co-cultured with astrocytes and pericytes.

15. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface;

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of a caveolin-1 protein as compared to normal oxygen conditions.

16. A method according to Claim 15, in which the significantly increased expression of the caveolin-1 protein is approximately two-fold**.**

17. A method according to Claim 15, in which the low oxygen conditions are maintained for longer than one day.

18. A method according to Claim 15, in which the BMVECs are co-cultured with astrocytes and pericytes.

19. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface; and

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of a clathrin heavy chain 1 protein as compared to normal oxygen conditions.

20. A method according to Claim 19, in which the significantly increased expression of the clathrin heavy chain 1 protein is approximately two-fold.

21. A method according to Claim 19, in which the low oxygen conditions are maintained for longer than one day.

22. A method according to Claim 19, in which the BMVECs are co-cultured with astrocytes and pericytes.

23. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface; and

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of a multi drug resistance protein as compared to normal oxygen conditions.

24. A method according to Claim 23, in which the multi drug resistance protein is ABCC1.

25. A method according to Claim 24, in which the significantly increased expression of the ABCC1 is approximately two-fold.

26. A method according to Claim 23, in which the multi drug resistance protein is BCRP.

27. A method according to Claim 26, in which the significantly increased expression of the BCRP is approximately twenty-two fold.

28. A method according to Claim 23, in which the low oxygen conditions are maintained for longer than one day.

29. A method according to Claim 23, in which the BMVECs are co-cultured with astrocytes and pericytes.

30. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane having a top surface and a bottom surface,

(b) seeding stem cells on the bottom surface; and

(c) culturing the seeded stem cells under low oxygen conditions that support maturation and differentiation of brain microvascular endothelial cells (BMVECs), in which the BMVECs have significantly increased expression of a transmembrane efflux pump protein as compared to normal oxygen conditions.

31. A method according to Claim 30, in which the transmembrane efflux pump protein is ABCB.

32. A method according to Claim 16, in which the significantly increased expression of the ABCB is approximately ten-fold.

33. A method according to Claim 30, in which the low oxygen conditions are maintained for longer than one day.

34. A method according to Claim 30, in which the seeded stem cells are co-cultured with astrocytes and pericytes.