CLAIMS

1. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane comprising a first surface and a second surface;

(b) seeding induced motor neuron cells on the first surface and skeletal muscle cells on the second surface so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells under conditions such that a neuromuscular junction forms.

2. A method according to Claim 1, in which the culturing induces the skeletal muscle cells to differentiate into the myofibers.

3. A method according to Claim 1, in which the culturing of seeded cells is for more than ten days.

4. A method according to Claim 1, in which the induced motor neuron cells are derived from induced pluripotent stem cells from a human.

5. A method according to Claim 4, in which the human is diagnosed with a CNS disorder.

6. A method according to Claim 1, further comprising the step of (e) assessing the health and/or integrity of the neuromuscular junction.

7. A method according to Claim 1, further comprising the step of (e) electrically stimulating the motor neurons and/or the skeletal muscle cells.

8. A microfluidic device comprising

(a) a membrane, the membrane comprising a top surface and a bottom surface; and

(b) induced motor neuron cells on the top surface and skeletal muscle cells on the bottom surface.

9. A device according to Claim 8, in which the induced motor neuron cells are derived from induced pluripotent stem cells from a human.

10. A device according to Claim 9, in which the human is diagnosed with a CNS disorder.

11. A device according to Claim 10, in which the CNS disorder is ALS.

12. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane comprising a top side and a bottom side;

(b) seeding neurons on the top side and non-neuronal cells on the bottom side so as to create seeded cells;

(c) exposing at least some of the seeded cells to a flow of culture fluid for a period of time; and

(d) culturing the seeded cells under conditions such that at least a portion of the neuron has transmigrated the membrane in which contact is made with some of the non-neuronal cells.

13. A method according to Claim 12, in which the seeded cells further comprise endothelial cells.

14. A method according to Claim 12 , in which the culture fluid comprises blood or blood components.

15. A method according to Claim 12 , in which the neurons comprise neuronal terminal bulbs and the contact is made between the bulbs and the non-neuronal cells.

16. A method according to Claim 12 , in which the non-neuronal cells are muscle cells.

17. A method according to Claim 16, in which the muscle cells are skeletal muscle cells.

18. A method according to Claim 16, in which the muscle cells are smooth muscle cells.

19. A method according to Claim 16, in which the muscle cells are cardiac muscle cells.

20. A method according to Claim 12 , in which the non-neuronal cells are selected from the group consisting of intestinal epithelial cells, lung epithelial cells and skin epithelial cells.

21. A method according to Claim 12 , in which the neurons are motor neurons.

22 A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel;

(b) seeding induced motor neuron cells in the top channel and skeletal muscle cells in the bottom channel so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells such that a neuromuscular junction forms, exhibiting spontaneous bursts of neuronal activity, within the microfluidic device.

23. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel;

(b) seeding induced motor neuron cells in the top channel and skeletal muscle cells in the bottom channel so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells such that a neuromuscular junction forms, comprising action potential spikes having an amplitude, duration and frequency, within the microfluidic device.

24. A method according to Claim 1, the neuromuscular junction comprising a terminal bulb of a motor neuron transmigrating the membrane and contacting the skeletal muscle cells.

25. A method according to Claim 22, the neuromuscular junction comprising a terminal bulb transmigrating the membrane and contacting the skeletal muscle cells.

26. A method according to Claim 23, the neuromuscular junction comprising a terminal bulb transmigrating the membrane and contacting the skeletal muscle cells.

CLAIMS

1. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel and comprising a first surface facing the top channel and a second surface facing the bottom channel;

(b) seeding induced motor neuron cells on the first surface and skeletal muscle cells on the second surface so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells under conditions such that a neuromuscular junction forms.

2. A method according to Claim 1, in which the culturing induces the skeletal muscle cells to differentiate into the myofibers.

3. A method according to Claim 1, in which the culturing of seeded cells is for more than ten days.

4. A method according to Claim 1, in which the induced motor neuron cells are derived from induced pluripotent stem cells from a human.

5. A method according to Claim 4, in which the human is diagnosed with a CNS disorder.

6. A method according to Claim 1, further comprising the step of (e) assessing the health and/or integrity of the neuromuscular junction.

7. A method according to Claim 1, further comprising the step of (e) electrically stimulating the motor neurons and/or the skeletal muscle cells.

8. A microfluidic device comprising

(a) a membrane separating a top channel and a bottom channel, the membrane comprising a top surface facing the top channel and a bottom surface facing the bottom channel, the membrane comprising polydimethylsiloxane; and

(b) induced motor neuron cells on the top surface and skeletal muscle cells on the bottom surface.

9. A device according to Claim 8, in which the induced motor neuron cells are derived from induced pluripotent stem cells from a human.

10. A device according to Claim 9, in which the human is diagnosed with a CNS disorder.

11. A device according to Claim 10, in which the CNS disorder is ALS.

12. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel and comprising a top side facing the top channel and a bottom side facing the bottom channel;

(b) seeding neurons on the top side and muscle cells on the bottom side so as to create seeded cells;

(c) exposing at least some of the seeded cells to a flow of culture fluid for a period of time; and

(d) culturing the seeded cells under conditions such that a neuromuscular junction forms, and at least a portion of the neuron has transmigrated the membrane in which contact is made with some of the muscle cells.

13. A method according to Claim 12, in which the seeded cells further comprise endothelial cells.

14. A method according to Claim 12 , in which the culture fluid comprises blood or blood components.

15. A method according to Claim 12 , in which the neurons comprise neuronal terminal bulbs and the contact is made between the bulbs and the muscle cells.

16. A method according to Claim 12, in which the muscle cells are skeletal muscle cells.

17. A method according to Claim 12, in which the muscle cells are smooth muscle cells.

18. A method according to Claim 12, in which the muscle cells are cardiac muscle cells.

19. A method according to Claim 12 , in which the neurons are motor neurons.

20 A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel and comprising a first surface facing the top channel and a second surface facing the bottom channel;

(b) seeding induced motor neuron cells in the top channel on the first surface and skeletal muscle cells in the bottom channel on the second surface so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells such that a neuromuscular junction forms, exhibiting spontaneous bursts of neuronal activity, within the microfluidic device.

21. A method of culturing cells, comprising:

(a) providing a microfluidic device comprising a membrane, the membrane separating a top channel and a bottom channel and comprising a first surface facing the top channel and a second surface facing the bottom channel;

(b) seeding induced motor neuron cells in the top channel on the first surface and skeletal muscle cells in the bottom channel on the second surface so as to create seeded cells;

(c) exposing the seeded cells to a flow of culture media for a period of time; and

(d) culturing the seeded cells such that a neuromuscular junction forms, comprising action potential spikes having an amplitude, duration and frequency, within the microfluidic device.

22. A method according to Claim 1, the neuromuscular junction comprising a terminal bulb of a motor neuron transmigrating the membrane and contacting the skeletal muscle cells.

23. A method according to Claim 20, the neuromuscular junction comprising a terminal bulb transmigrating the membrane and contacting the skeletal muscle cells.

24. A method according to Claim 21, the neuromuscular junction comprising a terminal bulb transmigrating the membrane and contacting the skeletal muscle cells.