THAT WHICH IS CLAIMED IS:

1. A method for manipulating cells using a fluidized bed, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber comprising an inlet and an outlet;

flowing a first stream containing a first media and cells into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

forming a fluidized bed of cells in the chamber, wherein the forces substantially immobilize the cells in the fluidized bed by the summation of vector forces acting on the cells;

collecting the first media substantially without cells passing through the outlet of the chamber; then

manipulating the cells in the fluidized bed, wherein said manipulating is selected from the group consisting of removing, concentrating, diluting, exchanging media, harvesting, transferring, dispensing, transfecting, electroporating, separating, extracting, isolating, selecting, purifying, coating, binding, physically modifying, and altering the environment; and thereafter

removing the cells from the fluidized bed, wherein removing the cells comprises:

flowing a second stream into the chamber through the outlet, wherein flowing the second stream acts to create a force at least partially in the same direction as the centrifugal force field; and

collecting the cells passing through the inlet of the chamber.

2. The method of claim 1, the method further comprising:

providing the first stream from a cell culture system prior to flowing the first stream into the chamber,

exchanging the media; and

delivering the cells and exchanged media to the cell culture system after removing the cells from the fluidized bed.

3. The method of Claim 1, wherein manipulating the cells comprises transfecting the cells, and wherein transfecting the cells comprises circulating a transfection stream

containing a transfection reagent complex through the fluidized bed of cells one or more times.

4. The method of Claim 1, wherein manipulating the cells comprises electroporating the cells, and wherein electroporating the cells comprises:

applying an electric current to the fluidized bed of cells; and

altering the permeability of the cells.

5. The method of Claim 4, wherein electroporating the cells further comprises:

flowing a charged molecule stream containing charged molecules into the chamber through the inlet before, concurrently with, and/or after applying the electric current; and

incorporating the charged molecules into the cells.

6. A method for manipulating particles using a fluidized bed, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber comprising an inlet and an outlet;

flowing a first stream containing a first media and particles into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

forming a fluidized bed of particles in the chamber, wherein the forces substantially immobilize the particles in the fluidized bed by the summation of vector forces acting on the particles;

collecting the first media substantially without particles passing through the outlet of the chamber; then

manipulating the particles in the fluidized bed, wherein said manipulating is selected from the group consisting of removing, concentrating, diluting, exchanging media, harvesting, transferring, dispensing, transfecting, electroporating, separating, extracting, isolating, selecting, purifying, coating, binding, physically modifying, and altering the environment; and thereafter

removing the particles from the fluidized bed, wherein removing the particles comprises:

flowing a second stream into the chamber through the outlet, wherein flowing the second stream acts to create a force at least partially in the same direction as the centrifugal force field; and

collecting the particles passing through the inlet of the chamber.

7. The method of Claim 6, wherein manipulating the particles comprises concentrating the particles, wherein concentrating the particles comprises receiving the particles in a concentrated particles harvest container after removing the particles.

8. The method of Claim 6, wherein manipulating the particles comprises exchanging the media, and wherein exchanging the media comprises:

flowing a new media stream comprising a second media into the chamber through the inlet; and

replacing at least some of the first media in the fluidized bed with the second media.

9. The method of Claim 6, wherein manipulating the particles comprises harvesting the particles, and wherein harvesting the particles comprises receiving the particles in a particle harvest container after removing the particles.

10. The method of Claim 6, wherein manipulating the particles comprises dispensing the particles, and wherein dispensing the particles comprises receiving a measured amount of particles in one or more dispensed cell containers after removing the particles.

11. The method of Claim 6, wherein the particles comprise a mixed population of particles, wherein manipulating the particles comprises separating the mixed population of particles, and wherein separating the mixed population of particles comprises:

removing at least some of the mixed population of particles from the fluidized bed; and

collecting the at least some of the mixed population of particles passing through the outlet of the chamber.

12. The method of Claim 11, wherein removing at least some of the mixed population of particles comprises altering the centrifugal force field and/or the force of the first stream.

13. The method of Claim 11, wherein the mixed population of particles are separated by size, density, and/or shape.

14. The method of Claim 6, wherein manipulating the particles comprises coating the particles, and wherein coating the particles comprises:

flowing a coating stream containing a coating material into the chamber through the inlet; and

coating the particles retained in the fluidized bed with the coating material.

15. A method for separating a mixed population of particles, the method comprising:

rotating a chamber about an axis, the chamber having an inlet and an outlet;

substantially immobilizing an affinity matrix in the chamber;

flowing a first stream containing a first media and a mixed population of particles comprising target particles and non-target particles into the chamber through the inlet;

retaining target particles in the affinity matrix in the chamber; and

collecting the first media and non-target particles passing through the outlet of the chamber.

16. The method of Claim 15, further comprising:

flowing a second stream containing an elution media into the chamber through the inlet;

releasing the target particles from the affinity matrix; and

collecting the target particles passing through the outlet of the chamber.

17. A method for associating particles with scaffolding material, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

flowing a first stream containing a first media and scaffolding material into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

forming a fluidized bed of the scaffolding material in the chamber, wherein the forces substantially immobilize the scaffolding material in the fluidized bed by the summation of vector forces acting on the scaffolding material;

flowing a second stream containing a second media and particles into the chamber through the inlet, and

retaining at least some of the particles with the scaffolding material.

18. A method for removing particles from scaffolding material, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

flowing a first stream containing a first media and scaffolding material comprising particles into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

forming a fluidized bed of the scaffolding material in the chamber, wherein the forces substantially immobilize the scaffolding material in the fluidized bed by the summation of vector forces acting on the scaffolding material;

flowing a second stream containing a dissociation reagent into the chamber through the inlet;

removing particles from the scaffolding material; and

collecting the removed particles passing through the outlet of the chamber.

19. The method of any one of Claims 6-18, wherein the particles are cells.

20. A method for fractionating biomaterials, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

flowing a first stream containing a first media and a mixture of biomaterials into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

selectively precipitating biomaterials from the first stream;

forming a fluidized bed of the precipitated biomaterials in the chamber, wherein the forces substantially immobilize the precipitated biomaterials in the fluidized bed by the summation of vector forces acting on the precipitated biomaterials; then

collecting the first media and the non-precipitated biomaterials passing through the outlet of the chamber; and thereafter

removing the precipitated biomaterials from the fluidized bed, wherein removing the precipitated biomaterials comprises:

flowing a second stream into the chamber through the outlet, wherein flowing the second stream acts to create a force at least partially in the same direction as the centrifugal force field; and

collecting the precipitated biomaterials passing through the inlet of the chamber.

21. The method of Claim 20, wherein the biomaterial is protein.

22. A system for manipulating particles, comprising:

a chamber rotatable about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

a bioreactor containing a first fluid and particles;

at least one pump in fluid communication with the rotating chamber and the bioreactor;

a fluid manifold in fluid communication with the rotating chamber, wherein the manifold includes a plurality of spaced apart valves that are automatically selectively closed and opened during use;

a controller in communication with the at least one pump and the valves, wherein the controller directs: (i) the valves to open and close, (ii) the flow rates of the at least one pump, (iii) the rotational speed of the rotating chamber, and (iv) a flow velocity of a first stream containing the first fluid and particles from the bioreactor into the chamber through the inlet,

wherein in operation, the flow velocity of the first stream from the bioreactor into the chamber through the inlet acts to create a force which opposes the centrifugal force, thereby forming a fluidized bed of particles in the chamber, wherein the forces substantially immobilize the particles in the fluidized bed by the summation of vector forces acting on the particles.

23. The system of Claim 22, wherein the controller further directs a flow velocity of a second stream containing a second fluid into the chamber through the outlet,

wherein in operation, the flow velocity of the second stream into the chamber through the outlet acts to create a force at least partially in the same direction as the centrifugal force field, thereby removing the particles from the fluidized bed.

24. The system of Claim 23, wherein in operation, the particles are collected through the inlet of the chamber and returned to the bioreactor after being removed from the fluidized bed.

25. The system of Claim 24, wherein the at least one pump comprises a bi-directional pump.

26. A system for manipulating particles, comprising:

a chamber rotatable about an axis to create a centrifugal force, the chamber comprising spaced apart inlet and outlet ports sized and configured to apply a fluid force to particles therein;

a primary pump in fluid communication with the chamber and a fluid source;

a fluid manifold in fluid communication with the chamber, wherein the manifold includes a plurality of spaced apart valves that are automatically selectively closed and opened during use;

a fluid buffer wash source in communication with the manifold;

a secondary pump in fluid communication with the fluid buffer wash source and the manifold, wherein the secondary pump has active on and off periods, and wherein in an active on period, the secondary pump has a higher flow rate than the primary pump, wherein the secondary pump resides proximate the fluid buffer wash source attached to a first arm of the manifold, and wherein a second arm of the manifold has opposing first and second end portions arranged so that the second arm extends around the secondary pump with the first end portion attached above the secondary pump and the second end portion attached to the first arm below the secondary pump, and wherein the second arm includes a first one of the valves; and

a controller in communication with the primary pump, the secondary pump and the valves, wherein the controller directs: (i) the opening and closing of the valves, (ii) the flow rates of the primary and secondary pumps, (iii) the rotational speed of the chamber to create a centrifugal force of between about 75-500 x *g*, (iv) an average flow velocity of the fluid from the fluid source through the chamber at between about 20-300 mm/min,

wherein in operation, the system has a wash cycle that flushes defined segments of the manifold with buffer from the buffer wash source after initial loading of the chamber with target media to thereby cleanse dead legs in the manifold.

27. The system of Claim 26, wherein the manifold includes an input flow path that extends between the chamber and a bioreactor, the input flow path having a bioreactor valve positioned proximate the bioreactor, and wherein the first arm of the manifold merges into the input flow path upstream of the bioreactor valve and includes two serially spaced apart valves therebetween, such that, in the buffer wash cycle, the two serially spaced apart valves and the bioreactor valve are open when the secondary pump is on and the first valve in the second arm is closed, so that a dead leg at the bioreactor valve is flushed.

28. The system of Claim 27, wherein the manifold includes a second flow path that extends between the chamber and the first arm of the manifold with a waste line extending to a waste container upstream of the second arm of the manifold with a waste valve in the waste line, the second flow path including a second flow path valve that resides upstream of the second arm of the manifold, wherein, in the buffer wash cycle, after the dead leg at the bioreactor is flushed, the bioreactor valve is closed, and the second flow path valve is open to flush a dead leg associated with the secondary flow path valve.

29. The system of any one of Claims 22-28, wherein the particles are cells.

30. The method of any one of Claims 1-21 or system of any one of Claims 22-28, wherein the axis is a substantially horizontal axis.

31. The method of any one of Claims 1-21 or system of any one of Claims 22-28, wherein the axis is a substantially vertical axis.

THAT WHICH IS CLAIMED IS:

1. A method for manipulating particles using a fluidized bed, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber comprising an inlet and an outlet;

flowing a first stream containing a first media and particles into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

forming a fluidized bed of particles in the chamber, wherein the forces substantially immobilize the particles in the fluidized bed by the summation of vector forces acting on the particles;

collecting the first media substantially without particles passing through the outlet of the chamber; then

manipulating the particles in the fluidized bed, wherein said manipulating is selected from the group consisting of removing, concentrating, diluting, exchanging media, harvesting, transferring, dispensing, transfecting, electroporating, separating, extracting, isolating, selecting, purifying, coating, binding, physically modifying, and altering the environment; and thereafter

removing the particles from the fluidized bed, wherein removing the particles comprises:

flowing a second stream into the chamber through the outlet, wherein flowing the second stream acts to create a force at least partially in the same direction as the centrifugal force field; and

collecting the particles passing through the inlet of the chamber.

2. The method of claim 1, wherein the particles are cells, the method further comprising:

providing the first stream from a cell culture system prior to flowing the first stream into the chamber,

exchanging the media; and

delivering the cells and exchanged media to the cell culture system after removing the cells from the fluidized bed.

3. The method of claim 1, wherein the particles are cells, wherein manipulating the cells comprises transfecting the cells, and wherein transfecting the cells comprises circulating a transfection stream containing a transfection reagent complex through the fluidized bed of cells one or more times.

4. The method of claim 1, wherein the particles are cells, wherein manipulating the cells comprises electroporating the cells, and wherein electroporating the cells comprises:

applying an electric current to the fluidized bed of cells; and

altering the permeability of the cells.

5. The method of claim 4, wherein electroporating the cells further comprises:

flowing a charged molecule stream containing charged molecules into the chamber through the inlet before, concurrently with, and/or after applying the electric current; and

incorporating the charged molecules into the cells.

6. The method of claim 1, wherein manipulating the particles comprises concentrating the particles, wherein concentrating the particles comprises receiving the particles in a concentrated particles harvest container after removing the particles.

7. The method of claim 1, wherein manipulating the particles comprises exchanging the media, and wherein exchanging the media comprises:

flowing a new media stream comprising a second media into the chamber through the inlet; and

replacing at least some of the first media in the fluidized bed with the second media.

8. The method of claim 1, wherein manipulating the particles comprises harvesting the particles, and wherein harvesting the particles comprises receiving the particles in a particle harvest container after removing the particles.

9. The method of claim 1, wherein manipulating the particles comprises dispensing the particles, and wherein dispensing the particles comprises receiving a measured amount of particles in one or more dispensed particle containers after removing the particles.

10. The method of claim 1, wherein the particles comprise a mixed population of particles, wherein manipulating the particles comprises separating the mixed population of particles, and wherein separating the mixed population of particles comprises:

removing at least some of the mixed population of particles from the fluidized bed; and

collecting the at least some of the mixed population of particles passing through the outlet of the chamber.

11. The method of claim 10, wherein removing at least some of the mixed population of particles comprises altering the centrifugal force field and/or the force of the first stream.

12. The method of claim 10, wherein the mixed population of particles are separated by size, density, and/or shape.

13. The method of claim 1, wherein manipulating the particles comprises coating the particles, and wherein coating the particles comprises:

flowing a coating stream containing a coating material into the chamber through the inlet; and

coating the particles retained in the fluidized bed with the coating material.

14. A method for fractionating biomaterials, the method comprising:

rotating a chamber about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

flowing a first stream containing a first media and a mixture of biomaterials into the chamber through the inlet, wherein flowing the first stream acts to create a force which opposes the centrifugal force;

selectively precipitating biomaterials from the first stream;

forming a fluidized bed of the precipitated biomaterials in the chamber, wherein the forces substantially immobilize the precipitated biomaterials in the fluidized bed by the summation of vector forces acting on the precipitated biomaterials; then

collecting the first media and the non-precipitated biomaterials passing through the outlet of the chamber; and thereafter

removing the precipitated biomaterials from the fluidized bed, wherein removing the precipitated biomaterials comprises:

flowing a second stream into the chamber through the outlet, wherein flowing the second stream acts to create a force at least partially in the same direction as the centrifugal force field; and

collecting the precipitated biomaterials passing through the inlet of the chamber.

15. The method of claim 14, wherein the biomaterial is protein.

16. A system for manipulating particles, comprising:

a chamber rotatable about an axis to create a centrifugal force field, the chamber having an inlet and an outlet;

a container containing a first fluid and particles;

at least one pump in fluid communication with the rotating chamber and the container;

a fluid manifold in fluid communication with the rotating chamber, wherein the manifold includes a plurality of spaced apart valves that are automatically selectively closed and opened during use;

a controller in communication with the at least one pump and the valves, wherein the controller directs: (i) the valves to open and close, (ii) the flow rates of the at least one pump, (iii) the rotational speed of the rotating chamber, (iv) a flow velocity of a first stream containing the first fluid and particles from the container into the chamber through the inlet, and (v) a flow velocity of a second stream containing a second fluid into the chamber through the outlet;

wherein in operation, the flow velocity of the first stream from the container into the chamber through the inlet acts to create a force which opposes the centrifugal force, thereby forming a fluidized bed of particles in the chamber, wherein the forces substantially immobilize the particles in the fluidized bed by the summation of vector forces acting on the particles and the flow velocity of the second stream into the chamber through the outlet acts to create a force at least partially in the same direction as the centrifugal force field, thereby removing particles from the fluidized bed.

17. The system of claim 16, wherein in operation, the particles are collected through the inlet of the chamber and returned to the container after being removed from the fluidized bed.

18. The system of claim 17, wherein the at least one pump comprises a bidirectional pump.

19. The method of any one of claims 1 to 15 or system of any one of claims 16 to 18, wherein the axis is a substantially horizontal axis.

20. The method of any one of claims 1 to 15 or system of any one of claims 16 to 18, wherein the axis is a substantially vertical axis.