CLAIMS

1. A syringe comprising:

a syringe body having an inlet and interior walls defining a lumen having a longitudinal axis and a diameter;

a piston located in the lumen of the syringe body, the piston having a top and a bottom, the bottom of the piston together with the interior walls defining a working volume, the piston comprising a cavity, wherein the piston is movable along the longitudinal axis to change the working volume;

an insert located at a desired position in the lumen, the insert narrowing the lumen and being configured to prevent retraction of the piston beyond the desired position; and

a removable pull rod configured to removably couple to the piston, the removable pull rod comprising a tip configured to couple with the cavity of the piston and move the piston inside syringe body when a force is applied at the removable pull rod, and to allow decoupling from the piston when the piston engages the insert at the desired position.

2. The syringe of claim 1, wherein the tip is conical in shape having a narrow end configured to enter the cavity in the piston and a base end configured to couple the piston to the tip.

3. The syringe of claim 2, wherein the base end of the tip has a chamfered, spherical, or fillet edge configured to facilitate retraction of the tip from the cavity of the piston.

4. The syringe of claim 2, wherein the base end of the tip does not include a sharp edge having a 90 degree angle between adjacent surfaces.

5. The syringe of claim 2, wherein the piston is made of a compliant material.

6. The syringe of claim 5, wherein the cavity is cylindrical in shape and sized to provide a friction fit between the tip of the removable pull rod and the piston.

7. The syringe of claim 5, wherein the cavity is sized to receive the tip and tightly fit around the tip such that the piston is retractable by the removable pull rod.

8. The syringe of claim 2, wherein the base end comprises a base portion configured to taper away from the narrow end.

9. The syringe of claim 8, wherein the cavity of the piston is configured to cover the base portion of the tip.

10. The syringe of claim 9, wherein the piston is made of a compliant material, wherein the cavity of the piston sized smaller than a size of the tip and is configured to conform to a shape of the tip of the removable pull rod, wherein when the piston receives the removable pull rod, the cavity of the piston expands around the tip thereby coupling the removable pull rod and the piston.

11. The syringe of claim 1, wherein the insert comprises a hollow cylinder defining an internal channel, wherein the internal channel is larger than an outside diameter of the removable pull rod and is configured to allow the removable pull rod to movably extend through the internal channel and move along the longitudinal axis, and to remove the removable pull rod from the syringe when decoupled from the piston.

12. The syringe of claim 1, wherein the insert is removably inserted at a distal end of the syringe opposite the inlet.

13. The syringe of claim 1, wherein the insert is fixedly attached at a distal end of the syringe at the desired position in the lumen.

14. The syringe of claim 1, wherein the piston is disposed at a proximal end of the syringe configured to receive the fluid, and the desired position is at a distal end of the syringe indicative of a desired amount of the fluid to be filled in the syringe.

15. The syringe of claim 14, wherein the cavity extends partially toward the bottom of the piston but does not extend through the bottom of the piston.

16. The syringe of claim 1, wherein the piston is disposed axially in the syringe body, and the cavity is formed at a center of the piston and extends axially.

17. A method of aspirating a syringe, the syringe comprising a piston and a removable pull rod, the method comprising:

inserting the removable pull rod from a distal end of the syringe into a lumen defined by interior walls of the syringe to couple with the piston;

retracting the removable pull rod to retract the piston from a proximal end of the lumen toward the distal end causing a fluid to enter the syringe via an inlet in the proximal end;

preventing further retraction of the piston via an insert positioned within the lumen; and

removing the removable pull rod from the piston.

18. The method of claim 17, wherein inserting the removable pull rod comprises:

aligning a tip of the removable pull rod with a cavity of the piston; and

pushing the tip into the cavity until the removable pull rod is coupled with the piston,

wherein the tip is configured to couple with the cavity of the piston to move inside syringe body when a force is applied at the removable pull rod, and is configured to decouple from the piston when the piston engages with the insert.

19. The method of claim 18, wherein removing the removable pull rod comprises further retracting the removable pull rod while the piston is engaged with the insert, thereby removing the tip of the removable pull rod from the cavity of the piston such that the piston stays inserted in the syringe, while the removable pull rod is completely detached from the piston.

20. The method of claim 17, further comprising:

securing the insert at a desired position in the lumen, the desired position corresponding to an amount of fluid to be filled in the syringe.

21. A system comprising:

a syringe, comprising:

a syringe body having interior walls defining a lumen having a longitudinal axis;

a removable pull rod comprising a tip;

a piston located in the lumen of the syringe body, the piston together with the interior walls defining a working volume configured to hold fluid, the piston comprising a cavity configured to engage with the tip of the removable pull rod, wherein the piston is movable along the longitudinal axis to change the working volume; and

an insert narrowing the lumen to prevent retraction of the piston beyond a desired position;

a feedline configured to deliver droplets from the syringe for developing a solution for a test or a therapy; and

a syringe receptacle, the syringe receptacle configured to receive the syringe and fluidically couple the syringe to the feedline.

22. The system of claim 21, wherein the receptacle and the syringe are coupled by a snapping mechanism disposed at a distal end of the syringe.

23. The system of claim 21, wherein the receptacle and the syringe are coupled by screw-type mechanism, wherein the syringe includes threads formed at a proximal end on an outer surface of the syringe, and the receptacle includes corresponding threads at an interior portion of the receptacle.

24. The system of claim 21, wherein the receptacle includes a rubber septum to be penetrated by a needle attached at a proximal end of the syringe such that a tip of the needle enters the feedline to supply droplets into the feedline.

25. The system of claim 21, wherein the receptacle includes a plurality of hollow chambers, each chamber configured to receive one syringe.

26. The system of claim 25, wherein one or more hollow chambers of the receptacle are configured to receive one or more syringes of different sizes.

27. The system of claim 26, wherein the feedline has an inlet and an outlet, the receptacle being connected between the inlet and the outlet, wherein the inlet receives sterilized air, vacuum, or buffer from a pump and the outlet delivers fluids from the plurality of syringes in the receptacle.

28. The system of claim 27, further comprising:

a delivery mechanism configured to inject, at a specified time and a specified amount, fluid from one or more syringes in the receptacle.

29. The system of claim 21, wherein the tip is conical or spherical in shape having a narrow end configured to enter the cavity in the piston and a base end configured to couple the piston to the tip.

30. The system of claim 29, wherein the base end of the tip has a chamfered or fillet edge configured to facilitate retraction of the tip from the cavity of the piston.

31. The system of claim 29, wherein the piston is made of a compliant material.

32. The system of claim 31, wherein the cavity is cylindrical or spherical in shape and sized to provide a friction fit between the tip of the removable pull rod and the piston.

33. The system of claim 29, wherein the base end comprises a base portion configured to taper away from the narrow end.

34. The system of claim 33, wherein the cavity of the piston is configured to cover the base portion of the tip.

35. The system of claim 34, wherein the piston is made of a compliant material, wherein the cavity of the piston sized smaller than a size of the tip and is configured to conform to a shape of the tip of the removable pull rod, wherein when the piston receives the removable pull rod, the cavity of the piston expands around the tip thereby coupling the removable pull rod and the piston.

36. The system of claim 21, wherein the insert comprises a hollow cylinder defining an internal channel, wherein the internal channel is larger than an outside diameter of the removable pull rod and is configured to allow the removable pull rod to movably extend

through the internal channel and move along the longitudinal axis, and to remove the removable pull rod from the syringe when decoupled from the piston.