CLAIMS

~~1. A vortex mixer, the vortex mixer comprising:~~

~~a vortex mixing chamber having a first wall, a second wall, and a side wall connecting the first wall and the second wall;~~

~~at least two inlet ports configured along the side wall, each inlet port having an inlet channel connected thereto, said at least two inlet ports approximately equally spaced around the vortex mixing chamber and configured tangentially to the vortex mixing chamber; and~~

~~an exit port having an exit channel connected thereto, said exit port configured approximately at a radial center of the second wall, the exit channel extending from the exit port and away from the vortex mixing chamber.~~

~~2. The vortex mixer of claim 1, wherein the vortex mixing chamber is round and the side wall extends around the circumference of the first wall and the second wall.~~

~~3. The vortex mixer of claim 1, wherein each inlet channel receives fluid from a single source.~~

~~4. The vortex mixer of claim 1, wherein each inlet channel receives fluid from a different source.~~

~~5. The vortex mixer of claim 1, wherein the vortex mixer has four inlet ports.~~

~~6. The vortex mixer of claim 5, wherein a first two of the four inlet ports receive fluid from a first source and a second two of the four inlet ports receive fluid from a second source.~~

~~7. The vortex mixer of claim 6, wherein the first two inlet ports are configured opposite each other and the second two inlet ports are configured opposite each other, such that the first two inlet ports are about 180 degrees apart and the second two inlet ports are about 180 degrees apart, and each of the first two inlet ports is about 90 degrees from each of the second two inlet ports.~~

~~8. The vortex mixer of claim 5, wherein each of the four inlet ports receives fluid from a separate source.~~

19. A mixing system~~vortex mixer~~, ~~the vortex mixer~~ comprising:

a primary vortex mixer, the primary vortex mixer comprising:

a primary vortex mixing chamber having a first wall, a second wall, and a side wall connecting the first wall and the second wall;

at least two ~~primary~~ inlet ports configured along the side wall, each ~~primary~~ inlet port having ~~a primary~~ an inlet channel connected thereto, ~~said~~ the at least two ~~primary~~ inlet ports approximately equally spaced around the primary vortex mixing chamber and configured tangentially to the primary vortex mixing chamber;

an additional inlet port~~a secondary inlet port configured approximately at a radial center of the first wall having a secondary inlet channel connected thereto~~; and

an exit port having an exit channel connected thereto, said exit port configured approximately at a radial center of the second wall, the exit channel extending from the exit port and away from the primary vortex mixing chamber; and

a splitter having a first outlet, and a second outlet, the first outlet connected to a first of the at least two inlet ports of the primary vortex mixer, and the second outlet connected to a second of the at least two inlet ports of the primary vortex mixer.

2. The mixing system of claim 1, further comprising a secondary vortex mixer, the secondary vortex mixer comprising:

a secondary vortex mixing chamber having a first wall, a second wall, and a side wall connecting the first wall and the second wall;

at least two inlet ports configured along the side wall, each inlet port having an inlet channel connected thereto, the at least two inlet ports approximately equally spaced around the secondary vortex mixing chamber and configured tangentially to the secondary vortex mixing chamber; and

an exit port having an exit channel connected thereto, the exit port configured approximately at a radial center of the second wall, the exit channel extending from the exit port and away from the secondary vortex mixing chamber.

3. The mixing system of claim 2, wherein the additional inlet port of the primary vortex mixer is connected to the exit channel extending from the secondary vortex mixer exit port.

4. The mixing system of claim 2, wherein the splitter of the primary vortex mixer is configured at an end of the exit channel extending from the secondary vortex mixer exit port.

5. The mixing system of claim 1, wherein the primary vortex mixing chamber is round and the side wall extends around the circumference of the first wall and the second wall

6. The mixing system of claim 1, wherein the additional inlet port is configured at a radial center of the first wall of the primary vortex mixer.

7. The mixing system of claim 1, wherein the inlet channel connected to the first of the at least two inlet ports of the primary vortex mixer is perpendicular to the first outlet of the splitter and the inlet channel connected to the second of the at least two inlet ports of the primary vortex mixer is perpendicular to the second outlet of the splitter.

8. The mixing system of claim 1, wherein the additional inlet port is connected to an additional inlet channel.

9. The mixing system of claim 1, wherein the additional inlet channel includes a first section and a second section, the second section being connected to the additional inlet port.

10. The mixing system of claim 9, wherein the second section is approximately perpendicular to the first section.

11. The mixing system of claim 9, wherein the second section is approximately perpendicular to the (1) inlet channel connected to the first of the at least two inlet ports of the primary vortex mixer, and (2) the inlet channel connected to the second of the at least two inlet ports of the primary vortex mixer.

12. The mixing system of claim 2, wherein each inlet channel of the secondary vortex mixer receives fluid from a single source.

13. The mixing system of claim 2, wherein each inlet channel of the secondary vortex mixer receives fluid from a different source.

14. The mixing system of claim 2, wherein the secondary vortex mixer has four inlet ports.

15. The mixing system of claim 14, wherein a first two of the four inlet ports of the secondary vortex mixer receive fluid from a first source, and a second two of the four inlet ports of the secondary vortex mixer receive fluid from a second source.

16. A mixing system, comprising:

a primary vortex mixer, the primary vortex mixer comprising:

a primary vortex mixing chamber having a first wall, a second wall, and a side wall connecting the first wall and the second wall;

at least two inlet ports configured along the side wall, each inlet port having an inlet channel connected thereto, the at least two inlet ports approximately equally spaced around the primary vortex mixing chamber and configured tangentially to the primary vortex mixing chamber;

an additional inlet port configured approximately at a radial center of the first wall, the additional inlet port having an additional inlet channel connected thereto; and

an exit port having an exit channel connected thereto, the exit port configured approximately at a radial center of the second wall, the exit channel extending from the exit port and away from the primary vortex mixing chamber; and

a splitter having a first outlet, and a second outlet, the first outlet connected to a first of the at least two inlet ports of the primary vortex mixer, and the second outlet connected to a second of the at least two inlet ports of the primary vortex mixer.

17. The mixing system of claim 16, further comprising a secondary vortex mixer, the secondary vortex mixer comprising:

a secondary vortex mixing chamber having a first wall, a second wall, and a side wall connecting the first wall and the second wall;

four inlet ports configured along the side wall, each inlet port having an inlet channel connected thereto, the four inlet ports approximately equally spaced around the secondary

vortex mixing chamber and configured tangentially to the secondary vortex mixing chamber; and

an exit port having an exit channel connected thereto, the exit port configured approximately at a radial center of the second wall, the exit channel extending from the exit port and away from the secondary vortex mixing chamber.

18. The mixing system of claim 16, wherein the inlet channel connected to the first of the at least two inlet ports of the primary vortex mixer is perpendicular to the first outlet of the splitter and the inlet channel connected to the second of the at least two inlet ports of the primary vortex mixer is perpendicular to the second outlet of the splitter.

19. The vortex mixer of claim 17, wherein the four inlet channels of the secondary vortex mixer receives fluid from a single source.

20. The vortex mixer of claim 17, wherein each inlet channel of the secondary vortex mixer receives fluid from a different source.

21. The mixing system of claim 17, wherein a first two of the four inlet ports of the secondary vortex mixer receive fluid from a first source, and a second two of the four inlet ports of the secondary vortex mixer receive fluid from a second source.

22. The mixing system of claim 17, wherein the splitter of the primary vortex mixer is configured at an end of the exit channel extending from the secondary vortex mixer exit port.

~~10. The vortex mixer of claim 9, wherein the vortex mixing chamber is round and the side wall extends around the circumference of the first wall and the second wall.~~

~~11. The vortex mixer of claim 9, wherein each inlet channel receives fluid from a single source.~~

~~12. The vortex mixer of claim 9, wherein each inlet channel receives fluid from a different source.~~

~~13. The vortex mixer of claim 9, wherein the vortex mixer has four primary inlet ports.~~

~~14. The vortex mixer of claim 13, wherein a first two of the four primary inlet ports receive fluid from a first source, a second two of the four primary inlet ports receive fluid from a second source and the secondary inlet port receives fluid from a third source.~~

~~15. The vortex mixer of claim 14, wherein the first two primary inlet ports are configured opposite each other and the second two primary inlet ports are configured opposite each other, such that the first two primary inlet ports are about 180 degrees apart and the second two primary inlet ports are about 180 degrees apart, and each of the first two primary inlet ports is about 90 degrees from each of the second two primary inlet ports.~~

~~16. The vortex mixer of claim 13, wherein each of the four primary inlet ports receives fluid from a separate source.~~

~~17. A mixing method comprising:~~

~~receiving, at a first vortex mixing chamber and from at least two inlet ports, a first fluid;~~

~~receiving, at the first vortex mixing chamber and from at least two inlet ports, a second fluid;~~

~~mixing the first fluid and the second fluid in the first vortex mixing chamber to form a first outflow fluid;~~

~~outflowing the first outflow fluid into a first exit channel;~~

~~splitting the first outflow fluid into at least two channels via a splitter;~~

~~receiving, at a second vortex mixing chamber, the first outflow fluid from at least two inlet ports connected to the at least two channels;~~

~~receiving, at the second vortex mixing chamber, a third fluid;~~

~~mixing the outflow fluid and the third fluid in the second vortex mixing chamber to form a second outflow fluid; and~~

~~outflowing the second outflow fluid into a second exit channel.~~

~~18. The mixing method of claim 17, wherein the first fluid comprises a buffer and the second fluid comprises a lipid mixture, and wherein the first outflow fluid comprises empty nanoparticles.~~

~~19. The mixing method of claim 18, wherein the third fluid comprises nucleic acid, and wherein the second outflow fluid comprises nucleic acid-holding nanoparticles.~~

~~20. The mixing method of claim 19, wherein the nucleic acid integrates into the nanoparticles by at least one of hydrophobic interaction and charged interaction.~~

~~21. The mixing method of claim 19, wherein formation of empty nanoparticles in the initial vortex mixing chamber prior to the nucleic acid being received in the second vortex mixing chamber prevents direct exposure of the nucleic acid to the buffer before it is mixed with the lipid mixture.~~

~~22. The mixing method of claim 21, wherein preventing direct exposure of the nucleic acid to the buffer prevents at least one of acidification and degradation of the nucleic acid.~~

~~23. The mixing method of claim 22, wherein the nucleic acid is RNA.~~