WHAT IS CLAIMED IS:

1. A method for transfecting cells with at least one nucleic acid sequence comprising:

(a) contacting cells with at least one nucleic acid formulated with a solution comprising polyethylenimine (PEI);

(b) incubating or culturing the cells with the nucleic acid and polyethylenimine (PEI) solution;

(c) adding an enhancing agent at the time of or immediately after step (a) or up to but less than 3 hours after step (a) to produce a mixture; and

(d) incubating said mixture of step (c) thereby transfecting the cells with the nucleic acid sequence.

2. A method for making cells that produce recombinant adeno-associated viral (rAAV) vector, comprising the steps:

(a) providing a PEI/plasmid mixture of components (i), (ii) and (iii):

(i) one or more plasmids comprising nucleic acids encoding AAV packaging proteins and/or nucleic acids encoding helper proteins;

(ii) a plasmid comprising a transgene that encodes a protein or is transcribed into a transcript of interest; and

(iii) a polyethylenimine (PEI) solution,

(b) contacting cells with the plasmid/PEI mixture of step (a) to produce a plasmid/PEI cell culture;

(c) adding an enhancing agent to the plasmid/PEI cell culture to produce a second mixture; and

(d) incubating said second mixture of step (c) thereby making transfected cells that produce recombinant rAAV vector.

3. A method for making cells that produce recombinant adeno-associated viral (rAAV) vector, comprising the steps:

(a) providing a PEI/plasmid mixture of components (i), (ii) and (iii):

(i) one or more plasmids comprising nucleic acids encoding AAV packaging proteins and/or nucleic acids encoding helper proteins;

(ii) a plasmid comprising a transgene that encodes a protein or is transcribed into a transcript of interest; and

(iii) a polyethylenimine (PEI) solution,

(b) contacting cells with the plasmid/PEI mixture of step (a) to produce a plasmid/PEI cell culture;

(c) adding valproic acid, a salt or a derivative thereof to the plasmid/PEI cell culture to produce a second mixture; and

(d) incubating said second mixture of step (c) thereby making transfected cells that produce recombinant rAAV vector.

4. The method of any of claims 1 – 3, further comprising step (e) harvesting said transfected cells produced in step (d) and/or culture medium from the transfected cells produced in step (d) to produce a cell and/or culture medium harvest.

5. The method of any of claims 1 – 3, further comprising step (e) culturing, expanding, isolating or selecting for cells that have been transfected with the nucleic acid or plasmids.

6. The method of claim 2 or 3, further comprising step (e) isolating and/or purifying recombinant AAV vector from the transfected cells produced in step (d) and/or culture medium and/or from the transfected cells produced in step (d).

7. The method of claim 5, further comprising step (f) isolating and/or purifying recombinant AAV vector from the transfected cells and/or culture medium harvest produced in step (e).

8. The method of claim 1, wherein the nucleic acid sequence(s) comprises a vector and/or a plasmid.

9. The method of claim 8, wherein the nucleic acid sequence(s) comprises a viral vector and/or viral plasmid.

10. The method of claim 9, wherein the viral vector or viral plasmid comprises a lenti-viral vector or plasmid, or an adeno-associated viral (AAV) vector or plasmid.

11. The method of any of claims 8 – 9, wherein the vector comprises a transgene that encodes a protein or is transcribed into a transcript of interest.

12. The method of any of claims 1 – 11, wherein the transgene encodes a wild-type, or functional variant blood clotting factor, apoE2, TPP1, argininosuccinate synthase, copper transporting ATPase 2, acid alpha-glucosidase, β-Glucocerebrosidase, α-galactosidase or C1 inhibitor serine protease inhibitor.

13. The method of claim 12, wherein the wild-type, or functional variant blood clotting factor is Factor VII, Factor VIII, or Factor IX.

14. The method of any of claims 1, 2 and 4 – 13, wherein the enhancing agent is valproic acid, a salt or derivative thereof.

15. The method of any of claims 1, 2 and 4 - 14, wherein the enhancing agent is added prior to step (a), at the time of step (a) or immediately after step (a) or up to but less than 3 hours after step (a).

16. The method of any of claims 1, 2 and 4 – 15, wherein the enhancing agent is added two or more times after steps (a) or (b).

17. The method of claim 15, wherein the enhancing agent is first added at the time of or immediately after step (a) or up to but less than 3 hours after step (a) and added again 12-72 hours after steps (a) or (b), or added again 12-48 hours after steps (a) or (b), or added again 12-24 hours after steps (a) or (b).

18. The method of any of claims 2 – 17, wherein said plasmids (i) and (ii) are in a molar ratio range of about 1:0.01 to about 1:100, or are in a molar ratio range of about 100:1 to about

1:0.01, and wherein the mixture of components (i), (ii) and (iii) has optionally been incubated for a period of time from about 10 seconds to about 4 hours prior to step (b).

19. The method of any of claims 1 – 18, wherein said nucleic acid or plasmids are in PEI: nucleic acid or PEI:plasmid weight ratio in the range of about 0.1:1 to about 5:1, or in a PEI:nucleic acid or PEI:plasmid weight ratio in the range of about 5:1 to about 0.1:1.

20. The method of any of claims 1-19, further comprising adding Free PEI to the cells prior to, at the time of or after steps (a) or (b), or prior to or at the time of or after step (c); or further comprising adding Free PEI to the cells at the time of or after steps (a) or (b), or at the time of or after step (c).

21. The method of any of claims 1-20, wherein said Free PEI is added so that the PEI:nucleic acid or PEI:plasmid weight ratio is in the range of about 0.1:1 to about 5:1, or is in the range of about 5:1 to about 0.1:1.

22. The method of any of claims 1-20, wherein the PEI in the PEI:nucleic acid and/or PEI:plasmid and/or Free PEI comprises linear polyethylenimine; or a hydrolyzed linear polyethylenimine; or a hydrolyzed linear polyethylenimine with a molecular weight in the range of about 4,000 to about 160,000 and/or in the range of about 2,500 to about 250,000 molecular weight in free base form.

23. The method of any of claims 1-22, wherein the molar ratio of nitrogen (N) in the Total PEI to phosphate (P) in nucleic acid:PEI and/or plasmid:PEI is in the range of about 1:1 to about 50:1 (N:P).

24. The method of any of claims 20-23, wherein the amount of Free PEI is about 10% to about 90% of the Total PEI; or wherein the amount of Free PEI is about 0.1 μg/mL to about 10 μg/mL.

25. The method of any of claims 1-24, wherein the PEI solution and/or Free PEI comprises a solution having a pH from about 7.0 to about 8.0.

26. The method of any of claims 1 and 3-24, wherein said nucleic acid sequence and PEI have been incubated from about 10 seconds to about 4 hours with each other prior to step (a).

27. The method of any of claims 1 and 4-25, wherein said nucleic acid sequence and PEI have been incubated from about 1 minute to about 30 minutes with each other prior to step (a).

28. The method of any of claims 3-27, wherein the mixture of components (i), (ii) and (iii) are incubated together for about 10 seconds to about 4 hours prior to step (b); or wherein the incubating of step (d) is for at least about 4 hours.

29. The method of any of claims 1-28, wherein the cells comprise mammalian cells; or wherein the cells are human embryonic kidney (HEK) or Chinese hamster ovary (CHO) cells; or wherein the cells comprise Human Embryonic Kidney (HEK) 293 cells; or wherein said cells are HEK 293E, HEK 293F or HEK 293T cells.

30. The method of any of claims 1-29, wherein the cells are stably or transiently transfected; or wherein the cells are in suspension culture; or wherein the cells are adherent; or wherein said cells are grown or maintained in a serum-free culture medium.

31. The method of any of claims 1-30, wherein said cells are at a density in the range of about 1×10^5 cells/mL to about 1×10^8 cells/mL when contacted with said nucleic acid sequence or said plasmid/PEI mixture and/or when contacted with said Free PEI.

32. The method of any of claims 1-31, wherein viability of said cells when contacted with said nucleic acid sequence or plasmid/PEI mixture or with said Free PEI is about 60% or

greater than 60%, or wherein said cells are in log phase growth when contacted with said nucleic acid sequence or plasmid/PEI mixture.

33. The method of any of claims 1-32, wherein the total amount of nucleic acid sequence or plasmids is in the range of about 0.1 μg to about 15 μg per mL of cells.

34. The method of any of claims 2-32, wherein the molar ratio of the plasmid comprising the transgene to the one or more plasmids comprising nucleic acids encoding AAV packaging proteins and/or nucleic acids encoding helper proteins is from about 1:5 to about 1:1, or is from about 1:1 to about 5:1.

35. The method of any of claims 2-34, wherein said one or more plasmids comprises a first plasmid comprising the nucleic acids encoding AAV packaging proteins and a second plasmid comprising the nucleic acids encoding helper proteins.

36. The method of claim 35, wherein the molar ratio of the plasmid comprising the transgene to the first plasmid comprising the nucleic acids encoding AAV packaging proteins to the second plasmid comprising the nucleic acids encoding helper proteins is in the range of about 1-5:1:1, or 1:1-5:1, or 1:1:1-5.

37. The method of any of claims 2-36, wherein the encoded AAV packaging proteins comprise AAV rep and/or AAV cap.

38. The method of any of claims 2-37, wherein the encoded helper proteins comprise adenovirus E2 and/or E4, VARNA proteins, and/or non-AAV helper proteins.

39. The method of any of claims 2-37, wherein the recombinant AAV vector comprises any of AAV serotypes 1-12, an AAV VP1, VP2 and/or VP3 capsid protein, or a modified or variant AAV VP1, VP2 and/or VP3 capsid protein, or wild-type AAV VP1, VP2 and/or VP3 capsid protein.

40. The method of any of claims 2-39, wherein the adeno-associated viral (AAV) vector comprises a capsid VP1, VP2 and/or VP3 protein sequence or inverted terminal repeat sequence having 70% or more sequence identity to a capsid protein sequence or to an inverted terminal repeat (ITR) sequence of any capsid protein sequence or ITR selected from AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, and AAV10 serotypes; or wherein the adeno-associated viral (AAV) vector comprises a capsid VP1, VP2 and/or VP3 protein sequence having 70% or more sequence identity to a capsid protein sequence selected from SEQ ID NO:1 and SEQ ID NO:2.

41. The method of any of claims 2-40, wherein the AAV vector comprises an AAV serotype or an AAV pseudotype, wherein said AAV pseudotype comprises an AAV capsid serotype different from the ITR serotype; or wherein the AAV vector comprises a capsid VP1, VP2 and/or VP3 protein or inverted terminal repeat of any serotype selected from AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, AAV10, SEQ ID NO:1 and SEQ ID NO:2; or wherein the AAV vector further comprises an intron, an expression control element, one or more adeno-associated virus (AAV) inverted terminal repeats (ITRs) and/or a filler polynucleotide sequence.

42. The method of claim 41, wherein the intron is within or flanks the nucleic acid that encodes a protein or is transcribed into a transcript of interest, or wherein the expression control element is operably linked to nucleic acid that encodes a protein or is transcribed into a transcript of interest, or wherein the AAV ITR(s) flanks the 5’ or 3’ terminus of nucleic acid that encodes a protein or is transcribed into a transcript of interest, or wherein the filler polynucleotide sequence flanks the 5’ or 3’terminus of nucleic acid that encodes a protein or is transcribed into a transcript of interest.

43. The method of any of claims 1-42, wherein the cells are subcultured to a reduced cell density prior to contact with said nucleic acid sequence or plasmid/PEI mixture.

44. The method of any of claims 1-43, wherein the cells are contacted with said nucleic acid sequence or plasmid/PEI mixture between a period of 2 days to 5 days after subculture.

45. The method of any of claims 1-44, wherein the amount of nucleic acid sequence or plasmids introduced into said transfected cells is at least 50% greater with the step of adding Free PEI to the cell culture compared to without adding Free PEI to the cell culture; or wherein the amount of nucleic acid sequence or plasmids introduced into said transfected cells is at least 50% greater with the step of adding the enhancing agent, valproic acid, salt or derivative thereof compared to without adding the enhancing agent, valproic acid, salt or derivative thereof.

46. The method of any of claims 2-45, wherein the amount of recombinant AAV vector produced is at least 50% or greater with the step of adding Free PEI to the plasmid/PEI cell culture compared to without adding Free PEI to the plasmid/PEI cell culture; or wherein the amount of recombinant AAV vector produced is 1-5, 5-8, 8-10 or 10-20 fold greater with the step of adding Free PEI to the plasmid/PEI cell culture compared to without adding Free PEI to the plasmid/PEI cell culture; or wherein the amount of recombinant AAV vector produced is 1-5, 5-8, 8-10 or 10-15 fold greater with the step of adding the enhancing agent, valproic acid, salt or derivative thereof compared to without adding the enhancing agent, valproic acid, salt or derivative thereof to the plasmid/PEI cell culture.

47. The method of any of claims 1, 2 or 4-46, wherein the enhancing agent comprises or consists of valproic acid, a salt or a derivative thereof; isobutyric acid, a salt or a derivative thereof; or isovaleric acid, a salt or a derivative thereof.

48. The method of any of claims 1-47, wherein after step (c) the enhancing agent, valproic acid, salt or derivative thereof is at a concentration from about 0.1mM to about 25mM.