WHAT IS CLAIMED IS:

1. An ex vivo method for enhancing genome editing efficiency, the method comprising introducing, by electroporation, a programmable DNA modification system to a eukaryotic cell in the presence of a polyanionic polymer or salt thereof.

2. The method of claim 1, wherein genome editing efficiency is enhanced relative to an otherwise identical method in the absence of the polyanionic polymer or salt thereof.

3. The method of claim 2, wherein electroporation comprises combining the programmable DNA modification system, the eukaryotic cell, and the polyanionic polymer or salt thereof in an electroporation solution, and applying a voltage to the electroporation solution, thereby introducing the programmable DNA modification system to the eukaryotic cell.

4. The method of claim 3, wherein the eukaryotic cell is contacted with the polyanionic polymer or salt thereof prior to introduction of the programmable DNA modification system to the eukaryotic cell.

5. The method of claim 3 or 4, wherein the eukaryotic cell and the polyanionic polymer are incubated in the electroporation solution prior to combination with the programmable DNA modification system and/or prior to application of the voltage to the electroporation solution.

6. The method of any preceding claim, wherein the programmable DNA modification system is introduced to the eukaryotic cell in the presence of two or more polyanionic polymers or salts thereof.

7. The method of any preceding claim, wherein the introducing comprises a single electroporation step or multiple electroporation steps.

8. The method of any preceding claim, wherein the polyanionic polymer or salt thereof has an average molecular weight greater than about 5 kDa, greater than about 15 kDa, greater than about 25 kDa, greater than about 50 kDa, greater than about 75 kDa, greater than about 100 kDa, greater than about 150 kDa, greater than about 200 kDa, greater than about 250 kDa, greater than about 300 kDa, greater than about 350 kDa, greater than about 400 kDa, greater than about 450 kDa, or greater than about 500 kDa.

9. The method of any preceding claim, wherein the polyanionic polymer or salt thereof is a polysaccharide polymer, for example a sulfated polysaccharide polymer.

10. The method of any preceding claim, wherein

(i) the polyanionic polymer or salt thereof comprises one or more of carrageenan (*e.g.*, K-, I-, and/or L-carrageenans), cellulose (*e.g.*, carboxymethylcellulose), chondroitin, collagen, dextran, fucoidan, heparan, heparin, glucosamine, laminarin, pentosan, and combinations, derivatives, and/or salts thereof; or

(ii) the polyanionic polymer is a polysaccharide sulfate or a salt thereof, wherein the repeating saccharide unit includes at least one sulfate group, and comprising one or more of dextran sulfate, fucoidan sulfate, heparan sulfate, heparin sulfate, chondroitin sulfate, dermatan sulfate, and salts thereof.

11. The method of any preceding claim, wherein the polyanionic polymer or salt thereof comprises dextran sulfate or dextran sulfate sodium salt, or is dextran sulfate sodium salt.

12. The method of any preceding claim, wherein the programmable DNA modification system comprises a RNA-guided clustered regularly interspersed short palindromic repeats (CRISPR)/CRISPR-associated (Cas) (CRISPR-Cas) nuclease system, a CRISPR-Cas dual nickase system, a zinc finger nuclease (ZFN), a transcription activator-like effector nuclease (TALEN), a meganuclease, a fusion protein comprising a programmable DNA binding

domain linked to a nuclease domain, or a fusion protein comprising a programmable DNA binding domain linked to a non-nuclease domain.

13. The method of any preceding claim, wherein the programmable DNA modification system comprises a Cas protein and a guide RNA.

14. The method of claim 13, wherein the guide RNA comprises a crRNA and a tracrRNA.

15. The method of any preceding claim, wherein the programmable DNA modification system is a ribonucleoprotein complex comprising a Cas protein and a guide RNA.

16. The method of any one of claims 13 to 15, wherein the Cas protein is catalytically active, catalytically inactive, or a nickase.

17. The method of any preceding claim, wherein the programmable DNA modification system is a base editor for modifying a base within a nucleic acid sequence.

18. The method of any preceding claim, wherein the programmable DNA modification system comprises a type I, type II (*e.g.*, Cas9), type III, type V (*e.g.*, Cpf1), or type VI (*e.g.*, Cas13) Cas protein.

19. The method of any preceding claim, wherein the programmable DNA modification system comprises a Cas1 protein, a Cas2 protein, a Cas3 protein, a Cas4 protein, a Cas5 protein, a Cas6 protein, a Cas7 protein, a Cas8 protein, a Cas9 protein, a Cas10 protein, a Cas12(Cpf1) protein, or a Cas13 protein.

20. The method of any preceding claim, wherein the programmable DNA modification system comprises:
i) Cas9 or Cas12(Cpf1);

ii) Cas9, a gRNA, and optionally a donor polynucleotide; or
iii) Cas12(Cpf1), a gRNA, and optionally a donor polynucleotide.

21. The method of any one of claims 13 to 20, wherein the Cas protein comprises at least one amino acid mutation relative to a wild-type Cas protein or is a Cas9 protein comprising at least one amino acid mutation relative to a wild-type Cas9 protein.

22. The method of any one of claims 13 to 21, wherein the Cas protein further comprises at least one nuclear localization signal, at least one cell-penetrating domain, at least one marker domain, or a combination thereof.

23. The method of any one of claims 13 to 23, wherein the Cas protein further comprises one or two nuclear localization signal(s).

24. The method of any preceding claim, wherein the programmable DNA modification system is a CRISPR-Cas nuclease system comprising a Cas protein and a guide RNA, and optionally a donor polynucleotide.

25. The method of claim 24, wherein the guide RNA comprises a crRNA and a tracrRNA.

26. The method of claim 24 or 25, wherein the guide RNA is a single molecule or is two molecules.

27. The method of any one of claims 24 to 26, wherein the guide RNA is enzymatically synthesized.

28. The method of any one of claims 24 to 26, wherein the guide RNA comprises a crRNA and a tracrRNA, wherein the crRNA is chemically synthesized and the tracrRNA is enzymatically synthesized, or both the crRNA and the tracrRNA are enzymatically synthesized.

29. The method of any preceding claim, wherein the eukaryotic cell is a human cell, a non-human mammalian cell, a non-mammalian vertebrate cell, an invertebrate cell, a plant cell, or a single cell eukaryotic organism.

30. A eukaryotic cell, prepared in accordance with the method of any preceding claim.

31. A transfection composition comprising a programmable DNA modification system, a eukaryotic cell, and at least one polyanionic polymer or salt thereof.

32. The composition of claim 31, wherein the polyanionic polymer or salt thereof is a sulfated polysaccharide salt.

33. The composition of claim 31 or 32, wherein

(i) the polyanionic polymer or salt thereof comprises one or more of carrageenan (*e.g.*, K-, I-, and/or L-carrageenans), cellulose (*e.g.*, carboxymethylcellulose), chondroitin, collagen, dextran, fucoidan, heparan, heparin, glucosamine, laminarin, pentosan, and combinations, derivatives, and/or salts thereof; or

(ii) the polyanionic polymer is a polysaccharide sulfate or a salt thereof, wherein the repeating saccharide unit includes at least one sulfate group, and comprising one or more of dextran sulfate, fucoidan sulfate, heparan sulfate, heparin sulfate, chondroitin sulfate, dermatan sulfate, and salts thereof.

34. The composition of any one of claims 31 to 33, wherein the polyanionic polymer or salt thereof comprises dextran sulfate or dextran sulfate sodium salt, or is dextran sulfate sodium salt.

35. The composition of any one of claims 31 to 34, wherein the programmable DNA modification system comprises a RNA-guided clustered regularly interspersed short palindromic repeats (CRISPR)/CRISPR-associated (Cas) (CRISPR-Cas) nuclease system, a CRISPR-Cas dual nickase system, a zinc finger nuclease (ZFN), a transcription activator-like effector nuclease

(TALEN), a meganuclease, a fusion protein comprising a programmable DNA binding domain linked to a nuclease domain, or a fusion protein comprising a programmable DNA binding domain linked to a non-nuclease domain.

36. The composition of any one of claims 31 to 35, wherein the programmable DNA modification system comprises a Cas protein and a guide RNA.

37. The composition of claim 36, wherein the guide RNA comprises a crRNA and a tracrRNA.

38. The composition of any one of claims 31 to 37, wherein the programmable DNA modification system is a ribonucleoprotein complex comprising a Cas protein and a guide RNA, and optionally a donor polynucleotide.

39. The composition of any one of claims 36 to 38, wherein the Cas protein is catalytically active, catalytically inactive, or a nickase.

40. The composition of any one of claims 31 to 39, wherein the programmable DNA modification system is a base editor for modifying a base within a nucleic acid sequence.

41. The composition of any one of claims 31 to 40, wherein the programmable DNA modification system comprises a type I, type II (*e.g.*, Cas9), type III, type V (*e.g.*, Cpf1), or type VI (*e.g.*, Cas13) Cas protein.

42. The composition of any one of claims 31 to 41, wherein the programmable DNA modification system comprises a Cas1 protein, a Cas2 protein, a Cas3 protein, a Cas4 protein, a Cas5 protein, a Cas6 protein, a Cas7 protein, a Cas8 protein, a Cas9 protein, a Cas10 protein, a Cas12(Cpf1) protein, or a Cas13 protein.

43. The composition of any one of claims 31 to 42, wherein the programmable DNA modification system comprises:

i) Cas9 or Cas12(Cpf1);
ii) Cas9, a gRNA, and optionally a donor polynucleotide; or
iii) Cas12(Cpf1), a gRNA, and optionally a donor polynucleotide.

44. The composition of any one of claims 38 to 43, wherein the Cas protein comprises at least one amino acid mutation relative to a wild-type Cas protein or is a Cas9 protein comprising at least one amino acid mutation relative to a wild-type Cas9 protein.

45. The composition of any one of claims 38 to 44, wherein the Cas protein further comprises at least one nuclear localization signal, at least one cell-penetrating domain, at least one marker domain, or a combination thereof.

46. The composition of any one of claims 38 to 45, wherein the Cas protein further comprises one or two nuclear localization signal(s).

47. The composition of any one of claims 31 to 46, wherein the programmable DNA modification system is a CRISPR-Cas nuclease system comprising a Cas protein and a guide RNA, and optionally a donor polynucleotide.

48. The composition of claim 47, wherein the guide RNA comprises a crRNA and a tracrRNA.

49. The composition of claim 47 or 48, wherein the guide RNA is a single molecule or is two molecules.

50. The composition of any one of claims 47 to 49, wherein the guide RNA is enzymatically synthesized.

51. The composition of any one of claims 47 to 49, wherein the guide RNA comprises a crRNA and a tracrRNA, wherein the crRNA is chemically synthesized and the tracrRNA is enzymatically synthesized, or both the crRNA and the tracrRNA are enzymatically synthesized.

52. The composition of any one of claims 31 to 51, wherein the eukaryotic cell is a human cell, a non-human mammalian cell, a non-mammalian vertebrate cell, an invertebrate cell, a plant cell, or a single cell eukaryotic organism.

53. A transfection composition comprising a programmable DNA modification system, a eukaryotic cell, and two or more polyanionic polymers or salts thereof.

54. The composition of claim 53, wherein the two or more polyanionic polymers or salts thereof are sulfated polysaccharide salts.

55. The composition of claim 53 or 54, wherein

(i) the two or more polyanionic polymers or salts thereof are selected from one or more of carrageenan (*e.g.*, K-, I-, and/or L-carrageenans), cellulose (*e.g.*, carboxymethylcellulose), chondroitin, collagen, dextran, fucoidan, heparan, heparin, glucosamine, laminarin, pentosan, and combinations, derivatives, and/or salts thereof; or

(ii) the two or more polyanionic polymers or salts thereof are polysaccharide sulfates or salts thereof, wherein the repeating saccharide unit includes at least one sulfate group, and wherein the two or more polyanionic polymers or salts thereof are selected from dextran sulfate, fucoidan sulfate, heparan sulfate, heparin sulfate, chondroitin sulfate, dermatan sulfate, and salts thereof.

56. The composition of any one of claims 53 to 55, wherein at least one of the two or more polyanionic polymers or salts thereof comprises dextran sulfate or dextran sulfate sodium salt, or is dextran sulfate sodium salt and another of the two or more polyanionic polymers or salts thereof is selected from fucoidan sulfate, heparan sulfate, heparin sulfate, chondroitin sulfate, and dermatan sulfate.

57. The composition of any one of claims 53 to 56, wherein the programmable DNA modification system comprises a RNA-guided clustered regularly interspersed short palindromic repeats (CRISPR)/CRISPR-associated (Cas) (CRISPR-Cas) nuclease system, a CRISPR-Cas dual nickase system, a zinc finger nuclease (ZFN), a transcription activator-like effector nuclease (TALEN), a meganuclease, a fusion protein comprising a programmable DNA binding domain linked to a nuclease domain, or a fusion protein comprising a programmable DNA binding domain linked to a non-nuclease domain.

58. The composition of any one of claims 53 to 57, wherein the programmable DNA modification system comprises a Cas protein and a guide RNA.

59. The composition of claim 58, wherein the guide RNA comprises a crRNA and a tracrRNA.

60. The composition of any one of claims 53 to 59, wherein the programmable DNA modification system is a ribonucleoprotein complex comprising a Cas protein and a guide RNA, and optionally a donor polynucleotide.

61. The composition of any one of claims 58 to 60, wherein the Cas protein is catalytically active, catalytically inactive, or a nickase.

62. The composition of any one of claims 53 to 61, wherein the programmable DNA modification system is a base editor for modifying a base within a nucleic acid sequence.

63. The composition of any one of claims 53 to 62, wherein the programmable DNA modification system comprises a type I, type II (*e.g.*, Cas9), type III, type V (*e.g.*, Cpf1), or type VI (*e.g.*, Cas13) Cas protein.

64. The composition of any one of claims 53 to 63, wherein the programmable DNA modification system comprises a Cas1 protein, a Cas2 protein, a Cas3 protein, a Cas4 protein, a Cas5 protein, a Cas6 protein, a Cas7 protein, a

Cas8 protein, a Cas9 protein, a Cas10 protein, a Cas12(Cpf1) protein, or a Cas13 protein.

65. The composition of any one of claims 53 to 64, wherein the programmable DNA binding system comprises:
i) Cas9 or Cas12(Cpf1);
ii) Cas9, a gRNA, and optionally a donor polynucleotide; or
iii) Cas12(Cpf1), a gRNA, and optionally a donor polynucleotide.

66. The composition of any one of claims 60 to 65, wherein the Cas protein comprises at least one amino acid mutation relative to a wild-type Cas protein or is a Cas9 protein comprising at least one amino acid mutation relative to a wild-type Cas9 protein.

67. The composition of any one of claims 60 to 66, wherein the Cas protein further comprises at least one nuclear localization signal, at least one cell-penetrating domain, at least one marker domain, or a combination thereof.

68. The composition of any one of claims 60 to 67, wherein the Cas protein further comprises one or two nuclear localization signal(s).

69. The composition of any one of claims 53 to 68, wherein the programmable DNA modification system is a CRISPR-Cas nuclease system comprising a Cas protein and a guide RNA, and optionally a donor polynucleotide.

70. The composition of claim 69, wherein the guide RNA comprises a crRNA and a tracrRNA.

71. The composition of claim 69 or 70, wherein the guide RNA is a single molecule or is two molecules.

72. The composition of any one of claims 69 to 71, wherein the guide RNA is enzymatically synthesized.

73. The composition of any one of claims 69 to 71, wherein the guide RNA comprises a crRNA and a tracrRNA, wherein the crRNA is chemically synthesized and the tracrRNA is enzymatically synthesized, or both the crRNA and the tracrRNA are enzymatically synthesized.

74. The composition of any one of claims 53 to 73, wherein the eukaryotic cell is a human cell, a non-human mammalian cell, a non-mammalian vertebrate cell, an invertebrate cell, a plant cell, or a single cell eukaryotic organism.

75. A kit comprising a Cas protein, a solution including a polyanionic polymer or salt thereof, and one or more buffer solutions.

76. The kit of claim 75, wherein the one or more buffer solutions include a reconstitution solution and a dilution solution.

77. The kit of claim 75 or 76, wherein the solution including a polyanionic polymer or salt thereof comprises dextran sulfate.

78. The kit of claim 76 or 77, wherein the reconstitution solution comprises 50% glycerol and the dilution solution comprises 20 mM HEPES buffer (pH 7.5) and 20 mM NaCl.

79. The kit of claim 77 or 78, wherein the solution including a polyanionic polymer or salt thereof comprises 1 µg/µL dextran sulfate sodium salt in 2 mM HEPES buffer (pH 7.5) and 20 mM NaCl.