CLAIMS

1. A variant adeno-associated virus (AAV) capsid polypeptide having at least 95% sequence identity to SEQ ID NO: 2, wherein the variant AAV capsid polypeptide comprises any one of the following combinations:

a) an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1;

b) a valine at a position corresponding to T593 as compared to SEQ ID NO: 1,
an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1, and
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1;

c) a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1,
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1, and
an alanine at a position corresponding to I601 as compared to SEQ ID NO: 1; or

d) a valine at a position corresponding to T593 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1.

2. The variant AAV capsid polypeptide of claim 1,
when the variant AAV capsid polypeptide comprises

a) an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1,

further comprising:

a valine at a position corresponding to Q579 as compared to SEQ ID NO: 1, and/or
a valine at a position corresponding to T593 as compared to SEQ ID NO: 1.

3. The variant AAV capsid polypeptide of claim 1,
when the variant AAV capsid polypeptide comprises

a) an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1,

further comprising:

a valine at a position corresponding to Q579 as compared to SEQ ID NO: 1;
an isoleucine at a position corresponding to Q592 as compared to SEQ ID NO: 1;
a valine at a position corresponding to T593 as compared to SEQ ID NO: 1; and
an alanine at a position corresponding to 1601 as compared to SEQ ID NO: 1.

4. The variant AAV capsid polypeptide of claim 2 or 3, comprising the mutation set of any one of SEQ ID NOs: 2, 14, 16, 18, 19, 21, 23, 24, 31, 34, 37, 38, 62, 98 and 128.

5. The variant AAV capsid polypeptide of claim 2 or 3, comprising the amino acid sequence of any one of SEQ ID NOs: 2, 14, 16, 18, 19, 21, 23, 24, 31, 34, 37, 38, 62, 72, 98 and 128.

6. The variant AAV capsid polypeptide of claim 1,
when the variant AAV capsid polypeptide comprises
a) an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1,
further comprising:
an alanine at a position corresponding to 1601 as compared to SEQ ID NO: 1.

7. The variant AAV capsid polypeptide of claim 1,
when the variant AAV capsid polypeptide comprises
a) an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1,
further comprising:
a valine at a position corresponding to Q579 as compared to SEQ ID NO: 1;
an isoleucine at a position corresponding to Q592 as compared to SEQ ID NO: 1;
a valine at a position corresponding to T593 as compared to SEQ ID NO: 1; and
an alanine at a position corresponding to 1601 as compared to SEQ ID NO: 1.

8. The variant AAV capsid polypeptide of claim 1,

when the variant AAV capsid polypeptide comprises

b) a valine at a position corresponding to T593 as compared to SEQ ID NO: 1,
an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1, and
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1,

further comprising:

a serine at a position corresponding to N598 as compared to SEQ ID NO: 1.

9. The variant AAV capsid polypeptide of claim 8, which comprises the mutation set of any one of SEQ ID NOs: 39, 51, 67, 70, 90, 100, and 130.

10. The variant AAV capsid polypeptide of claim 8, which comprises the amino acid sequence of any one of SEQ ID NOs: 39, 51, 66, 67, 70, 90, 100, and 130.

11. The variant AAV capsid polypeptide of claim 1,

when the variant AAV capsid polypeptide comprises

c) a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1,
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1, and
an alanine at a position corresponding to I601 as compared to SEQ ID NO: 1,

further comprising:

an alanine at a position corresponding to W595 as compared to SEQ ID NO: 1.

12. The variant AAV capsid polypeptide of claim 1,
when the variant AAV capsid polypeptide comprises

c) a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1,
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1, and
an alanine at a position corresponding to I601 as compared to SEQ ID NO: 1,

further comprising:

a valine at a position corresponding to T593 as compared to SEQ ID NO: 1.

13. The variant AAV capsid polypeptide of claim 12, further comprising:
an isoleucine at a position corresponding to Q592 as compared to SEQ ID NO: 1.

14. The variant AAV capsid polypeptide of claim 1,

when the variant AAV capsid polypeptide comprises

c) a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1,
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1, and
an alanine at a position corresponding to I601 as compared to SEQ ID NO: 1,

further comprising:

a valine at a position corresponding to Q579 as compared to SEQ ID NO: 1.

15. The variant AAV capsid polypeptide of claim 14, further comprising:
a valine at a position corresponding to T593 as compared to SEQ ID NO: 1.

16. The variant AAV capsid polypeptide of any one of claims 9 to 15, which comprises the mutation set of any one of SEQ ID NOs: 15, 17, 20, 22, 26, 27, and 33.

17. The variant AAV capsid polypeptide of any one of claims 9 to 15, which comprises the amino acid sequence of any one of SEQ ID NOs: 15, 17, 20, 22, 26, 27, 33, and 35.

18. The variant AAV capsid polypeptide of claim 1,

when the variant AAV capsid polypeptide comprises

d) a valine at a position corresponding to T593 as compared to SEQ ID NO: 1,
a leucine at a position corresponding to V596 as compared to SEQ ID NO: 1, and
a serine at a position corresponding to N598 as compared to SEQ ID NO: 1,

further comprising:

a valine at a position corresponding to Q579 as compared to SEQ ID NO: 1, and/or
a position corresponding to Q592 as compared to SEQ ID NO: 1.

19. The variant AAV capsid polypeptide of any one of claims 1 to 18, which has at least 96% sequence identity to SEQ ID NO: 2.

20. The variant AAV capsid polypeptide of any one of claims 1 to 18, which has at least 98% sequence identity to SEQ ID NO: 2.

21. The variant AAV capsid polypeptide of any one of claims 1 to 18, which has at least 99% sequence identity to SEQ ID NO: 2.

22. A nucleic acid molecule encoding the variant AAV capsid polypeptide of claims 1 to 18.

23. A recombinant AAV virus particle comprising the variant AAV capsid polypeptide of claims 1 to 18.

24. The recombinant AAV virus particle of claim 23, further comprising:

a nucleic acid molecule comprising a promoter operably linked to a heterologous transgene.

25. The recombinant AAV virus particle of claim 23, further comprising:

a minigene having AAV inverted terminal repeats and a transgene comprising a heterologous gene operably linked to regulatory sequences which direct expression of the heterologous gene in a host cell.

26. An isolated host cell comprising the variant AAV capsid polypeptide of claim 1 to 18.

27. A variant AAV capsid polypeptide comprising the amino acid sequence of SEQ ID NO: 2.

28. A recombinant AAV comprising:

(a) an AAV capsid comprising AAV capsid polypeptides, each having an amino acid sequence consisting of the amino acid sequence of SEQ ID NO: 2, and

(b) a minigene having AAV inverted terminal repeats and a transgene comprising a heterologous gene operably linked to regulatory sequences which direct expression of the heterologous gene in a host cell.

29. A nucleic acid molecule encoding a variant AAV capsid polypeptide comprising the amino acid sequence of SEQ ID NO: 2.

30. An isolated host cell comprising a nucleic acid molecule encoding a variant AAV capsid polypeptide comprising the amino acid sequence of SEQ ID NO: 2.