

WHAT IS CLAIMED IS:

1. An AAV capsid protein comprising an amino acid sequence that comprises at least four contiguous amino acids from the sequence STTLYSP (SEQ ID NO:1) or FVVGQSY (SEQ ID NO:2).
2. The AAV capsid protein of claim 1, comprising an amino acid sequence that comprises at least five contiguous amino acids from the sequence STTLYSP (SEQ ID NO:1) or FVVGQSY (SEQ ID NO:2).
3. The AAV capsid protein of claim 1, comprising an amino acid sequence that comprises at least six contiguous amino acids from the sequence STTLYSP (SEQ ID NO:1) or FVVGQSY (SEQ ID NO:2).
4. The AAV capsid protein of claims 1-3, wherein the AAV is AAV9.
5. The AAV capsid protein of claims 1-4, comprising AAV9 VP1.
6. The AAV capsid protein of claim 5, wherein the sequence is inserted in a position corresponding to amino acids 588 and 589 of SEQ ID NO:6.
7. A nucleic acid encoding the AAV capsid protein of claims 1-6.
8. An AAV comprising the capsid protein of claims 1-6, and preferably not comprising a wild type VP1, VP2, or VP3 capsid protein.
9. The AAV of claim 8, further comprising a transgene, preferably a therapeutic transgene.
10. A ex vivo or in vitro method of delivering a transgene to a cell, the method comprising contacting the cell with the AAV of claims 1-9.
11. A library construct AAV comprising:
 - (i) a sequence encoding a Cre recombinase driven by a promoter;

- (ii) a sequence encoding an AAV9 capsid protein with a heptamer peptide inserted between the sequences encoding amino acids (aa) 588-589 of the capsid, driven by a promoter, downstream of the Cre cassette.
12. The library construct AAV of claim 11, wherein the heptamer comprises a random heptamer peptide or a pre-selected heptamer peptide.
13. A library comprising a plurality of the library constructs of claim 11 or 12.
14. The library of claim 13, wherein the library comprises library constructs having sequences encoding all possible variants of the heptamer.
15. A method of identifying an engineered capsid that mediates transgene expression in a pre-selected cell type, the method comprising:
- (a) administering the library of claims 13 or 14 to a non-human model animal, preferably a mammal, wherein the cells of the model animal express a loxP-flanked STOP cassette upstream of a reporter sequence;
 - (b) isolating cells of the pre-selected cell type;
 - (c) selecting cells in which the reporter sequence is expressed;
 - (d) isolating at least part of the library construct, preferably a part comprising the heptamer, from the selected cells in which the reporter sequence is expressed from step (c); and
 - (e) determining identity of the heptamers in the library constructs isolated in step (d), wherein the heptamers that are isolated can mediate transgene expression in the pre-selected cell type.
16. The method of claim 15, wherein the reporter sequence encodes a fluorescent reporter protein.
17. The method of claim 15, wherein the model animal is transgenic for the loxP-flanked STOP cassette upstream of a reporter sequence, or wherein the loxP-flanked STOP cassette upstream of a reporter sequence can be expressed from a second construct.

18. The method of claim 15, wherein determining identity of the heptamers in the library constructs comprises using DNA sequencing analysis.
19. The method of claim 15, further comprising before and/or after step (e):
using PCR to amplify sequences comprising the heptamer sequences, optionally comprising full capsid sequences, from the library constructs isolated in step (d);
cloning the amplified sequences back to a second set of library vectors;
repackaging the second set of library vectors; and
performing steps (a)-(d) or (a)-(e) on the second set of library vectors.
20. Use of the AAV of claim 9 in the manufacture of a medicament for the treatment of any one of : Alzheimer's Disease; Parkinson's Disease; X-linked Adrenoleukodystrophy; Canavan's ; Niemann Pick; Spinal muscular atrophy; Huntington's Disease; Connexin-26; Usher Type 3A; Usher Type 2D; Hair cell-related hearing loss; Hair cell-related hearing loss (DFNB7/11); Inner hair cell-related hearing loss (DFNB9); Usher Type 1F; Usher Type 1B; Retinitis pigmentosa (RP; non-syndromic); Leber congenital amaurosis; Leber Hereditary Optic Neuropathy; Usher Syndrome (RP; syndromic with deafness); Duchenne Muscular Dystrophy; Allograft vasculopathy; and Hemophilia A and B in a subject, wherein the AAV is to be administered to a cell of the subject.
21. The use of claim 20, wherein the cell is a neuron (optionally a dorsal root ganglion neuron or spiral ganglion neuron), astrocyte, cardiomyocyte, or myocyte, astrocyte, glial cell, inner hair cell, outer hair cell, supporting cell, fibrocyte of the inner ear, photoreceptors, interneurons, retinal ganglion, or retinal pigment epithelium.
22. The use of claim 20 or 21 wherein the cell is in a living subject.
23. The use of any one of claims 20-22 wherein the cell is a mammalian cell.

24. The use of any one of claims 20-23 wherein the cell is in a tissue selected from the brain, spinal cord, dorsal root ganglion, heart, inner ear, eye, or muscle, and a combination thereof.
25. The use of any one of claims 20-24 wherein the cell is in the brain of the subject, and the AAV is to be administered by parenteral delivery; intracerebral; or intrathecal delivery.
26. The use of claim 25 wherein the intrathecal delivery is via lumbar injection, cisternal magna injection, or intraparenchymal injection.
27. The use of any one of claims 20-26 wherein the AAV is delivered by parenteral delivery, preferably via intravenous, intraarterial, subcutaneous, intraperitoneal, or intramuscular delivery.
28. The use of any one of claims 20-24 wherein the cell is in the eye of the subject, and the AAV is to be administered by subretinal or intravitreal injection.
29. The use of any one of claims 20-24 wherein the cell is in the inner ear of the subject, and the AAV is to be administered to the cochlea through application over or through the round window membrane, through a surgically drilled cochleostomy adjacent to the round window, a fenestra in the bony oval window, or a semicircular canal.