CLAIMS

1. A bacterial cell packaging system for packaging a reporter nucleic acid molecule into a non-replicative transduction particle (NRTP) for introduction into a bacterial cell, the packaging system comprising a host cell, comprising:

   - a bacteriophage genome comprising a first gene comprising a disruption, wherein in the absence of the disruption the first gene encodes a first essential component of a packaging-related enzymatic activity and comprises a first packaging initiation site sequence, wherein the packaging-related enzymatic activity recognizes the first packaging initiation site, wherein the disruption prevents recognition of the first packaging initiation site sequence by the essential packaging-related enzymatic activity, and wherein the disruption reduces the level of the essential packaging-related enzymatic activity; and

   - a reporter nucleic acid molecule comprising a reporter gene, a second gene encoding the first component of the essential packaging-related enzymatic activity, and a third gene encoding a second component of the essential packaging-related enzymatic activity, wherein the second gene comprises the non-disrupted first packaging initiation site sequence, wherein the first packaging initiation site sequence is configured to facilitate packaging of a replicon of the reporter nucleic acid molecule into the NRTP.

~~2.~~ The bacterial cell packaging system of claim 1, wherein the bacteriophage comprises a plurality of disrupted genes, wherein in the absence of the disruptions, each encodes an essential component of the packaging-related enzymatic activity and.

~~3.~~2. ~~The bacterial cell packaging system of claim 2,~~ wherein each of the plurality of disrupted genes on the bacteriophage is complemented by a functional, non-disrupted gene encoded by the reporter nucleic acid molecule.

~~4.~~3. The bacterial cell packaging system of any one of claims 1 to 2, wherein the disruption is via deletion, insertion, mutation, or replacement.

~~5.~~4. The bacterial cell packaging system of any one of claims 1 to 3, wherein the packaging-related enzymatic activity is a terminase activity.

~~6.~~ 5. The bacterial cell packaging system of any one of claims 1 to 4, wherein the second gene and the third gene are each terminase genes and .

~~7. The bacterial cell packaging system of claim 6, wherein the second gene is a pacA gene and wherein the third gene is a pacB gene.~~

~~8. The bacterial cell packaging system of claim 6, wherein the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:1.~~

~~9. The bacterial cell packaging system of claim 6, wherein the second gene is a terA gene and the third gene is a terB gene.~~

~~10. The bacterial cell packaging system of claim 6, wherein the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:6.~~

~~11. The bacterial cell packaging system of claim 6, wherein the second gene is a terS gene and wherein the third gene is a terL gene.~~

~~12. The bacterial cell packaging system of claim 6, wherein the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:4.~~

~~13.~~6. ~~The bacterial cell packaging system of claim 1,~~ wherein the second gene and the third gene are operably linked to a conditional promoter.

~~14. The bacterial cell packaging system of claim 13, wherein the conditional promoter comprises the sequence of SEQ ID NO: 9.~~

~~15.~~7. The bacterial cell packaging system of claim ~~13~~5, wherein the conditional promoter is a native promoter of a terminase gene of the bacteriophage genome.

~~16.~~8. The bacterial cell packaging system of any one of claims 5 or ~~6~~13, wherein expression of the second gene or the third gene is inhibited in the absence of activation of the lytic cycle of the bacteriophage, and wherein expression of the second gene or the third gene is activated upon activation of the lytic cycle of the bacteriophage.

~~17.~~9. The bacterial cell packaging system of claims 5 to ~~7~~13, wherein the second gene and the third gene are terminase genes native to the bacteriophage genome, and wherein the conditional promoter is a native promoter of the terminase genes.

~~18.~~10. The bacterial cell packaging system of any one of claims 1 to 8, wherein the bacteriophage genome comprises a reporter gene encoding a detectable marker or a selectable marker and wherein the reporter gene is operatively linked to a constitutive promoter.

~~19.~~11. The bacterial cell packaging system of claim ~~18~~9, wherein the bacteriophage genome further comprises an antibiotic resistance gene.

~~20. The bacterial cell packaging system of claim 18 or 19, wherein the reporter gene encodes a detectable marker or a selectable marker.~~

~~21.~~12. The bacterial cell packaging system of claims ~~18~~9 or 10~~9~~, wherein the reporter gene is selected from the group consisting of: enzymes mediating luminescence reactions (luxA, luxB, luxAB, luc, ruc, nluc), enzymes mediating colorimetric reactions (lacZ, HRP), fluorescent proteins (GFP, eGFP, YFP, RFP, CFP, BFP, mCherry, near-infrared fluorescent proteins), affinity peptides (His-tag, 3X-FLAG), and selectable markers (ampC, tet(M), CAT, erm).

~~22. The bacterial cell packaging system of claim 18 or 19, wherein the reporter gene disrupts a terminase gene.~~

~~23.~~13. The bacterial cell packaging system of claim 10~~9~~, wherein the antibiotic resistance gene is a kanamycin resistance gene.

~~24. The bacterial cell packaging system of claim 18 or 19, wherein the reporter gene is operatively linked to a constitutive promoter.~~

~~25. The bacterial cell packaging system of claim 24, wherein the constitutive promoter is Pblast.~~

~~26.~~14. The bacterial cell packaging system of any one of claims 1 to 12, wherein the disruption comprises an insertion into or replacement of the first packaging initiation site sequence with a gene encoding a selectable marker and wherein the gene encoding the selectable marker is operatively linked to a constitutive promoter.

~~27. The bacterial cell packaging system of claim 26, wherein the gene encoding the selectable marker is operatively linked to a constitutive promoter.~~

~~28.~~15. The bacterial cell packaging system of any one of claims 1 to 13, wherein the disruption comprises an insertion into or replacement of the first packaging initiation site sequence with a gene encoding a detectable marker.

~~29. The bacterial cell packaging system of claim 28, wherein the gene encoding the detectable marker is selected from the group consisting of: luxA, luxB, and luxAB.~~

~~30. The bacterial cell packaging system of claim 28 or 29, wherein the gene encoding the detectable marker is operatively linked to a constitutive promoter.~~

~~31. The bacterial cell packaging system of claim 30, wherein the constitutive promoter is Pblast.~~

~~32. The bacterial cell packaging system of claim 1, wherein the first gene comprises a pacA gene locus, and wherein the disruption comprises a luxAB gene and a kan gene inserted into the pacA gene locus.~~

~~33. The bacterial cell packaging system of claim 1, wherein the bacteriophage genome comprises SEQ ID NO: 12.~~

~~34.~~16. The bacterial cell packaging system of any one of claims 1 to 14, wherein the reporter nucleic acid molecule comprises an origin of replication.

~~35.~~17. The bacterial cell packaging system of any one of claims 1 to 15, wherein the replicon of the reporter nucleic acid molecule comprises a concatamer amenable to packaging into the non-replicative transduction particle.

~~36.~~18. The bacterial cell packaging system of any one of claims 1 to 16, wherein the non-disrupted first packaging initiation site sequence comprises a concatamer junction.

~~37. The bacterial cell packaging system of claim 1, wherein the replicon is an Enterobacteriaceae bacteriophage P1 lytic replicon.~~

~~38. The bacterial cell packaging system of claim 1, wherein the replicon comprises a C1 repressor-controlled P53 promoter, a promoter P53 antisense, a repL gene, and an in-frame deletion of a kilA gene.~~

~~39. The bacterial cell packaging system of claim 1, wherein the replicon comprises the sequence of SEQ ID NO:2.~~

~~40. The bacterial cell packaging system of claim 1, wherein the replicon is a pBHR1 replicon or a derivative of the pBHR1 replicon.~~

~~41. The bacterial cell packaging system of claim 1, wherein the replicon comprises the sequence of SEQ ID NO:3.~~

~~42. The bacterial cell packaging system of claim 1, wherein the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:4.~~

~~43. The bacterial cell packaging system of claim 1, wherein the replicon of the reporter nucleic acid molecule is derived from a S. aureus pT181 plasmid origin of replication.~~

~~44. The bacterial cell packaging system of claim 1, wherein the replicon of the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:5.~~

~~45. The bacterial cell packaging system of claim 1, wherein the reporter nucleic acid molecule comprises the sequence comprises the sequence of SEQ ID NO:6.~~

~~46. The bacterial cell packaging system of claim 1, wherein the replicon of the reporter nucleic acid molecule is derived from an Enterococcus repB plasmid origin of replication.~~

~~47. The bacterial cell packaging system of claim 1, wherein the replicon of the reporter nucleic acid molecule comprises the sequence of SEQ ID NO:7.~~

~~48. The bacterial cell packaging system of claim 1, wherein the replicon of the reporter nucleic acid molecule is derived from an Enterococcus pDL278 plasmid origin of replication.~~

~~49. The bacterial cell packaging system of claim 1, wherein the replicon of the nucleic acid molecule comprises the sequence of SEQ ID NO:8.~~

~~50. The bacterial cell packaging system of claim 1, wherein the non-disrupted first packaging initiation site sequence comprises a pac-site.~~

~~51. The bacterial cell packaging system of claim 1, wherein the non-disrupted first packaging initiation site sequence comprises a cos-site.~~

~~52.~~ 18. The bacterial cell packaging system of any one of claims 1 to 17, wherein the bacteriophage genome comprises an Enterobacteriaceae bacteriophage P1, or ~~.~~

~~53. The bacterial cell packaging system of claim 1, wherein the bacteriophage genome comprises~~ an S. aureus bacteriophage φ80α or a bacteriophage φ11~~.~~, or

~~54. The bacterial cell packaging system of claim 1, wherein the bacteriophage genome comprises~~ an E. faecalis bacteriophage φEF11.

~~55. The bacterial cell packaging system of claim 1, wherein the bacterial cell comprises an E. coli cell.~~

~~56. The bacterial cell packaging system of claim 1, wherein the bacterial cell comprises an S. aureus cell.~~

~~57. The bacterial cell packaging system of claim 1, wherein the bacterial cell comprises an E. faecalis cell.~~

~~58. The bacterial cell packaging system of claim 1, wherein the bacterial cell comprises a Gram-negative cell.~~

~~59. The bacterial cell packaging system of claim 1, wherein the bacterial cell comprises a Gram-positive cell.~~

~~60. The bacterial cell packaging system of claim 1, wherein the reporter gene encodes a detectable marker or a selectable marker.~~

~~61. The bacterial cell packaging system of claim 1, wherein the reporter gene is selected from the group consisting of enzymes mediating luminescence reactions (luxA, luxB, luxAB, luc, ruc, nluc), enzymes mediating colorimetric reactions (lacZ, HRP), fluorescent proteins (GFP, eGFP, YFP, RPP, CFP, BFP, mCherry, near-infrared fluorescent proteins), affinity peptides (His-tag, 3X-FLAG), and selectable markers (ampC, tet(M), CAT, erm).~~

~~62. The bacterial cell packaging system of claim 1, wherein the reporter nucleic acid molecule comprises an aptamer.~~

~~63.~~19. The bacterial cell packaging system of any one of claims 1 to 18, wherein the reporter nucleic acid molecule comprises a nucleic acid transcript sequence that is complementary to a second sequence in the reporter nucleic acid molecule.

~~64. The bacterial cell packaging system of claim 63, wherein the nucleic acid transcript sequence is complementary to a cellular transcript.~~

~~65. The bacterial cell packaging system of claim 63, wherein the nucleic acid transcript~~

~~sequence comprises a cis-repressing sequence.~~

~~66. The bacterial cell packaging system of claim 1, wherein the reporter nucleic acid molecule is operatively linked to a promoter.~~

~~67. The bacterial cell packaging system of claim 66, wherein the promoter is selected for contributing to reactivity of a reporter molecule expressed from the reporter nucleic acid molecule in the bacterial cell.~~

~~68.~~20. The bacterial cell packaging system of any one of claims 1 to 19~~-67~~, wherein the replicon of the reporter nucleic acid molecule comprises a nucleic acid transcript sequence that is complementary to a second sequence in the replica of the reporter nucleic acid molecule.

~~69.~~21. A method for packaging a reporter nucleic acid molecule into a non-replicative transduction particle, comprising:

- providing conditions to the bacterial cell packaging system of any of the claims 1 to 20~~-68~~ that induce a lytic phase of the bacteriophage genome to produce non- replicative transduction particles packaged with the reporter nucleic acid molecule; and
- collecting the non-replicative transduction particle comprising the reporter nucleic acid molecule.

~~70.~~22. The method of claim 21~~69~~, wherein the non-replicative transduction particle does not contain a replicated bacteriophage genome.

~~71.~~23. The method of any one of claims ~~69~~21 to 22, wherein the non-replicative transduction particle comprises a portion of the bacteriophage genome due to recombination with the reporter nucleic acid molecule, and wherein the portion of the bacteriophage genome comprises the reporter gene.

~~72.~~24. A composition comprising the non-replicative transduction particle comprising a replicon of the reporter nucleic acid molecule produced from the method of any one of claims 21 to 23~~69-71~~.

~~73. A bacterial cell packaging system for packaging a nucleic acid molecule into a non- replicative transduction particle, the bacterial cell, comprising:~~

a bacteriophage genome comprising a first packaging initiation site sequence, wherein the first packaging initiation site sequence is disrupted by a gene encoding a reporter; and

a reporter nucleic acid molecule comprising a second packaging initiation site sequence facilitating packaging of a replicon of the reporter nucleic acid molecule into the non-replicative transduction particle, wherein the reporter nucleic acid molecule forms a replicon configured to be packaged into the non-replicative transduction particle.

74. A bacterial cell packaging system for packaging a reporter nucleic acid molecule into a non-replicative transduction particle (NRTP) for introduction into a cell, the packaging system comprising a host cell, comprising:

- a bacteriophage genome comprising a first pair of terminase genes, wherein at least one of the first pair of terminase genes is disrupted, rendering the disrupted terminase gene non-functional; and
- a reporter nucleic acid molecule comprising a reporter gene and a second pair of terminase genes that complement the first pair of terminase genes, wherein each of the second pair of terminase genes are functional, and wherein the second pair of terminase genes facilitate packaging of a replicon of the reporter nucleic acid molecule into the NRTP.

75. A bacterial cell packaging system for packaging a reporter nucleic acid molecule into a non-replicative transduction particle (NRTP) for introduction into a cell, the packaging system comprising a host cell, comprising:

- a bacteriophage genome comprising a first pair of terminase genes, wherein at only one of the first pair of terminase genes is disrupted, rendering the disrupted terminase gene non-functional; and

a reporter nucleic acid molecule comprising a reporter gene and a second terminase gene that complements the first terminase gene, wherein the second terminase gene is functional, and wherein the second terminase gene facilitates packaging of a replicon of the reporter nucleic acid molecule into the NRTP.