CLAIMS:

1. A homo-bivalent linker compound comprising Structure 1:

(X)-<--->-▢-<--->-(X) (Structure 1)

wherein,

(X) is a function group, optionally (X) is a maleimide, azide, alkyne, activated carboxyl or amine;

each <---> is independently a spacer group, which may be present or absent, optionally, each <---> is independently alkyl, alkoxy, cyclyl, heterocyclyl, aryl, heteroaryl, or substituted versions thereof.; and

▢ is a linking group comprising at least one amide bond, optionally, ▢ comprises 1, 2, 3, or more than 3 amide bonds.

2. The homo-bivalent linker compound of claim 1, wherein each spacer group <---> that is present in the compound is, independently, C_{1-10} alkyl, C_{1-10} alkoxy, 5-10 membered aryl, 5-10 membered heteroaryl, 5-10 membered heterocyclyl, (C_{1-10} alkyl)-(5-10 membered aryl), (C_{1-10} alkyl)-(5-10 membered heteroaryl), or (C_{1-10} alkyl)-(5-10 membered heterocyclyl); optionally each spacer group <---> that is present in the compound is, independently, C_2 to C_6 alkyl, ethylene glycol, triethylene glycol, or 1,4-phenylene.

3. The homo-bivalent linker compound of claim 1, wherein the linking group ▢ comprises 1, 2, or 3 amide bonds; optionally wherein the linking group ▢ comprises at least one amide bond formed from the linkage of two amino acids.

4. The homo-bivalent linker compound of claim 3, wherein the linking group ▢ comprises:

(i) one amide bond formed from the linkage of two amino acids;

(ii) two amide bonds formed from the linkage of three amino acids; or

(iii) three amide bonds formed from the linkage of four amino acids.

5. The homo-bivalent linker compound of any of claims 1 to 4, wherein each of the amide bonds is, independently, a eupeptide bond or an isopeptide bond.

6. The homo-bivalent linker compound of any of claims 3 to 5, wherein at least one amino acid is Glycine, Alanine, Proline, Valine, Lysine, Aspartic Acid, Citrulline, and Beta-alanine.

7. The homo-bivalent linker compound of any of claims 1 to 6, wherein the linking group ▢ comprises Structure 2:

$$R\text{-}A_a\text{-}B_b\text{-}C_c\text{-}D_d\text{-}R' \qquad \text{Structure 2}$$

wherein:

R is H, or is absent;

R' is OH, or is absent;

each of a, b, c, and d is independently 0 or 1, with the proviso that the sum of a + b + c + d is greater than or equal to 2; and

each of A, B, C and D independently comprises Structure 3:

$$[N▲①\text{-}(CH◐②)_w\text{-}(CH◑③)_x\text{-}(CH◒④)_y\text{-}(CH◓⑤)_z\text{-}CO\text{-}▼] \qquad \text{(Structure 3)}$$

wherein:

each of w, x, y, and z are independently 0 or 1, with the proviso that the sum of w + x + y + z is greater than or equal to 1;

each ▲ is independently H, H_2, alkyl, alkoxy, alkyl carboxy, alkyl carboxamide, alkyl amino, alkyl sulfate, aryl, aryl carboxy, aryl carboxamide, aryl amino, aryl sulfate, or is absent;

each of ①, ②, ③, ④, and ⑤ is independently present or absent, and if present designates a terminus of a cyclic group as follows:

① designates the N in N▲① as a terminus;

② designates the C in $(CH◐②)_w$ as a terminus;

③ designates the C in $(CH◑③)_x$ as a terminus;

④ designates the C in $(CH◒④)_y$ as a terminus; and

⑤ designates the C in $(CH◓⑤)_z$ as a terminus;

with the proviso that each Structure 3 independently contains zero, one or two cyclic groups, the termini of each cyclic group being selected from:

① as a first terminus and ②, ③, ④, or ⑤ as a second terminus;

♲₂ as a first terminus and ♲₃, ♲₄, or ♲₅ as a second terminus;

♲₃ as a first terminus and ♲₄ or ♲₅ as a second terminus; or

♲₄ as a first terminus and ♲₅ as a second terminus;

with the further proviso that:

if ♲₂ is present, then ◐ is absent;

if ♲₃ is present, then ◑ is absent;

if ♲₄ is present, then ◒ is absent;

if ♲₅ is present, then ◓ is absent;

each cyclic group that is present in Structure 3 further comprises, in addition to its respective termini, a middle section between the termini, Y; and each Y is independently alkyl, alkoxy, alkyl carboxy, alkyl carboxamide, alkyl amino, or alkyl sulfate;

each of ◐, ◑, ◒, and ◓ are independently present or absent, and if present are H, OH, alkyl, alkyl carboxy, alkyl carboxamide, alkyl amino, alkoxy, thioalkyl, alkylthioalkyl, aryl, or heteroaryl;

each of ◐, ◑, ◒, and ◓ are, where present, optionally bonded to a functional end group X, with or without an intervening spacer group ---;

each ▼ is independently OH, alkyl, alkoxy, alkyl carboxy, alkyl carboxamide, alkyl amino, alkyl sulfate, aryl, aryl carboxy, aryl carboxamide, aryl amino, aryl sulfate, or is absent;

with the proviso that homo-bivalent linker compound contains a total of only two functional end groups X, in keeping with the compound being a homo-bivalent linker compound; and

Structure 2 optionally comprises at least one amide bond that is optionally formed from the linkage of two amino acids.

8. The homo-bivalent linker compound of claim 7, wherein X is maleimide, azide, alkyne, activated carboxyl or amine.

9. The homo-bivalent linker compound of claim 7 or 8, wherein each spacer group --- is, independently, alkyl, alkoxy, cyclyl, heterocyclyl, aryl, heteroaryl, or substituted versions thereof; optionally, wherein each spacer group --- is, independently, C1-10 alkyl, C1-10 alkoxy, 5-10 membered aryl, 5-10 membered heteroaryl, 5-10 membered heterocyclyl, (C1-10 alkyl)-(5-10 membered aryl), (C1-10 alkyl)-(5-10 membered heteroaryl), or (C1-10 alkyl)-(5-10 membered heterocyclyl); or optionally, wherein each spacer group --- is, independently, C2 to C6 alkyl, ethylene glycol, triethylene glycol, or 1,4-phenylene.

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10. The homo-bivalent linker compound of any of claims 7 to 9, wherein at least one amide bond is a eupeptide bond. an isopeptide bond, or formed from the joining of two amino acids.

11. The homo-bivalent linker compound of claim 10, wherein each of the amino acids is independently naturally occurring or non-naturally occurring; optionally, wherein each of the amino acids is independently an alpha, beta, gamma, or delta amino acid.

12. The homo-bivalent linker compound of claim 10, wherein at least one of the amino acids is an alpha amino acid or a proteogenic amino acid; or wherein each of the amino acids is an alpha amino acid or a proteogenic amino acid.

13. A multi-conjugate comprising two or more biological moieties joined together by covalent bonds, wherein at least one covalent bond within the multi-conjugate is formed by reaction with a linker compound of any of claims 1 to 12; optionally, wherein each of the biological moieties is joined to another biological moiety by a linker compound of any of claims 1 to 12.

14. The multi-conjugate of claim 13, wherein the multi-conjugate comprises two, three, four, five, or six biological moieties.

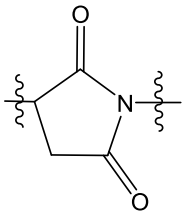
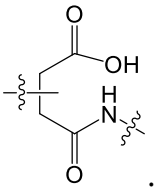
15. The multi-conjugate of claim 13 or 14, wherein each biological moiety is, independently, a nucleic acid, peptide, protein, lipid, carbohydrate, carboxylic acid, vitamin, steroid, lignin, small molecule, organometallic compound, or a derivative of any of the foregoing.

16. The multi-conjugate of any of claims 13 to 15, wherein at least two biological moieties are oligonucleotides; optionally the at least two oligonucleotides are adjacent one another in the multi-conjugate; and optionally each of the oligonucleotides is 15-30, 17-27, 19-26, or 20-25 nucleotides in length.

17. The multi-conjugate of any of claims 13 to 16, wherein at least one of the biological moieties is a double-stranded RNA; optionally an siRNA, a saRNA, or a miRNA; optionally, wherein each of the biological moieties is a double-stranded siRNA.

18. The multi-conjugate of any of claims 13 to 17, wherein at least one of the biological moieties is a single-stranded RNA, optionally an antisense oligonucleotide.

19. The multi-conjugate of any of claims 13 to 18, wherein at least one biological moiety is a protein, a peptide, or a derivative thereof.

20. The multi-conjugate of any of claims 13 to 19, having one or more covalent bonds formed by reaction with a homo-bivalent linker compound having maleimide functional groups, each of which, upon reaction, is independently  or .

21. A compound comprising a homo-bivalent linker of any of claims 1 to 12 substituted on one end by a biological moiety, wherein the other end of the homo-bivalent linker is unsubstituted, and wherein the compound is at least 75%, 80, 85, 90, 95, 96, 97, 98, 99, or 100 % pure; optionally, the biological moiety is a nucleic acid, peptide, protein, lipid, carbohydrate, carboxylic acid, vitamin, steroid, lignin, small molecule, organometallic compound, or a derivative of any of the foregoing.

22. A pharmaceutical composition comprising the multi-conjugate of any of claims 13 to 20.

23. Use of an effective amount of the multi-conjugate of any of claims 13 to 20 for the manufacture of a medicament for treating a subject in need of treatment to ameliorate, cure, or prevent the onset of a disease or disorder.

24. Use of an effective amount of a multi-conjugate according to any of claims 13 to 20 for the manufacture of a medicament for modulating gene expression in a cell, wherein the multi-conjugate comprises at least one biological moiety that has the effect of modulating gene expression.

25. The use of claim 24, wherein the at least one biological moiety silences or reduces gene expression; optionally, wherein the at least one biological moiety is siRNA, miRNA, or an antisense oligonucleotide.

26. The use of claim 24, wherein the at least one biological moeity activates or increases gene expression; optionally wherein the at least one biological moiety is saRNA.

27. Use of a multi-conjugate according to any of claims 13 to 20 for the manufacture of a medicament for delivering two or more biological moeities to a cell per internalization event.

28. The use of any of claims 23-27, wherein the multi-conjugate comprises 3 or more biological moieties in a predetermined stoichiometric ratio.

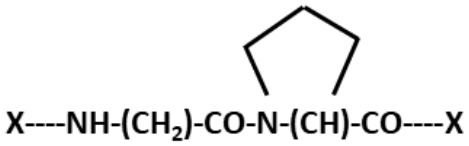
29. Use of an effective amount of a pharmaceutical composition comprising an active pharmaceutical ingredient joined by a covalent bond formed by reaction with a linker compound of any of claims 1 to 12 for the manufacture of a medicament for treating a disease or condition in a subject.

30. A homo-bivalent linker compound comprising:

(a) X----NH-(CH_2)-CO-NH-(CH_2)-CO----X (Structure 4);

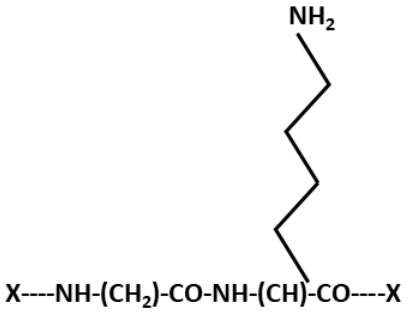
(b) X----NH-(CH_2)-CO-NH-(CHMethyl)-CO----X (Structure 5);

(c)

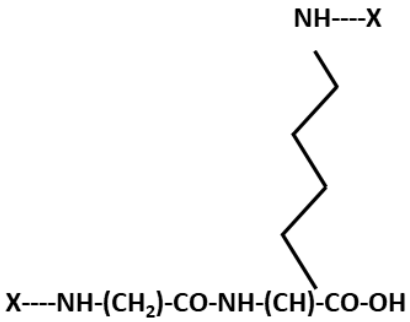


(Structure 6);

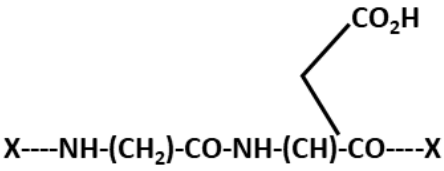
(d) X----NH-(CH_2)-CO-NH-(CH-isopropyl)-CO----X (Structure 7);



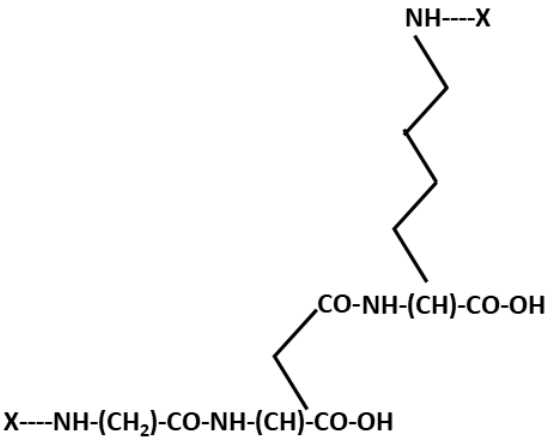
(e) (Structure 8);



(f) (Structure 9);

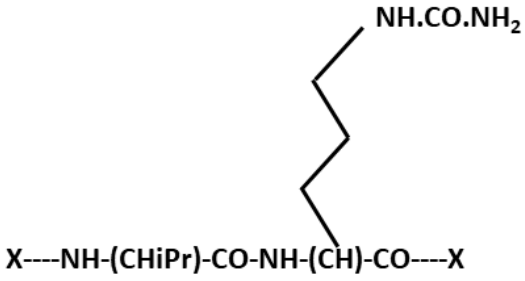


(g) (Structure 10);

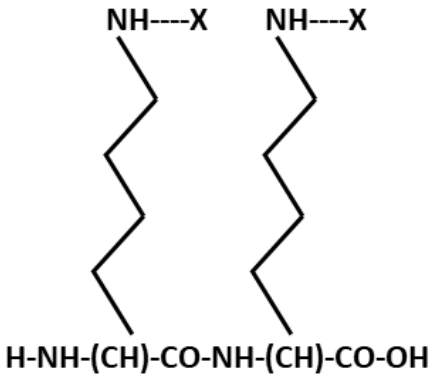


(h) (Structure 11);

(i) X----NH-(CH_2)-CO-NH-(CH_2)-(CH_2)-CO----X (Structure 12);



(j) (Structure 13); or

(k) 

(Structure 14).