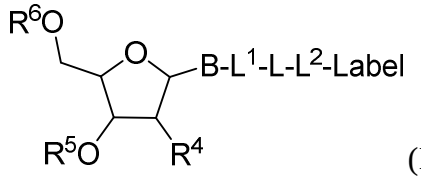
WHAT IS CLAIMED IS:

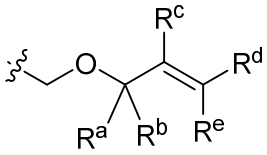
1. A nucleoside or nucleotide comprising a nucleobase attached to a detectable label via a cleavable linker, wherein the nucleoside or nucleotide has the structure of Formula (I):



(I)

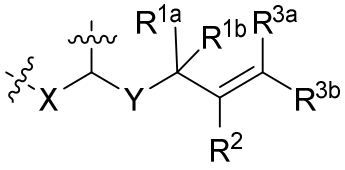
wherein B is the nucleobase;

R^4 is H or OH;

R^5 is 

, and each of R^a, R^b, R^c, R^d and R^e is independently H, halogen or substituted or unsubstituted C_1-C_6 alkyl;

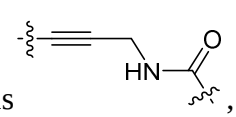
R^6 is H, a hydroxy protecting group, or a reactive phosphorous containing group, or -OR^6 is monophosphate, diphosphate, triphosphate, thiophosphate, or a phosphate ester analog;

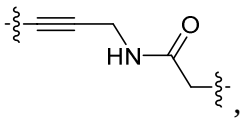
L is 

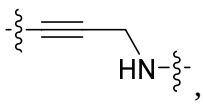
;

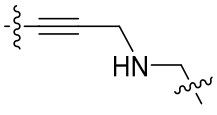
each of X and Y is independently O or S;

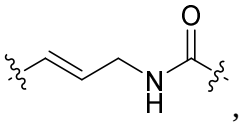
each of R^{1a}, R^{1b}, R^2, R^{3a} and R^{3b} is independently H, halogen, or unsubstituted C_1-C_6 alkyl; and

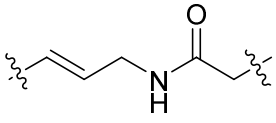
wherein L^1 is 

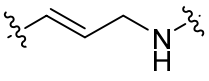
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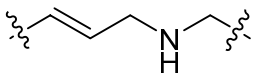
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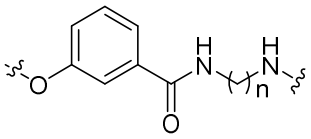
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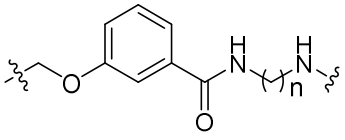
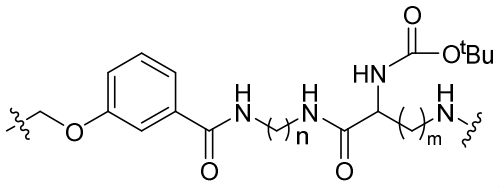
, 

, 

, or 

;

wherein L^2 is present, and L^2 is ,

, or , wherein each of m and n is independently an integer of 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 and the phenyl moiety is substituted or unsubstituted; and

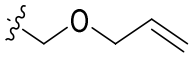
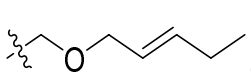
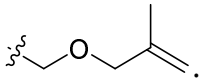
wherein the label is a fluorescent dye..

2. The nucleoside or nucleotide of claim 1, wherein each of X and Y is O.

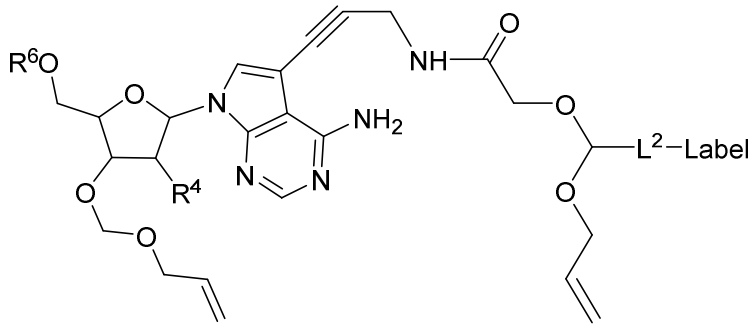
3. The nucleoside or nucleotide of claim 1, wherein each of R^{1a}, R^{1b}, R^2, R^{3a} and R^{3b} is H.

4. The nucleoside or nucleotide of claim 1, wherein at least one of R^{1a}, R^{1b}, R^2, R^{3a} and R^{3b} is halogen or unsubstituted C_1-C_6 alkyl.

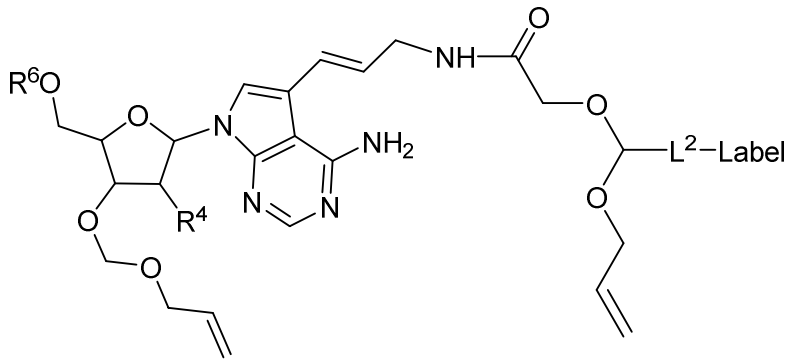
5. The nucleoside or nucleotide of claim 1, wherein B is a purine, a deaza purine, or a pyrimidine.

6. The nucleoside or nucleotide of claim 1, wherein R^5 is ,  or .

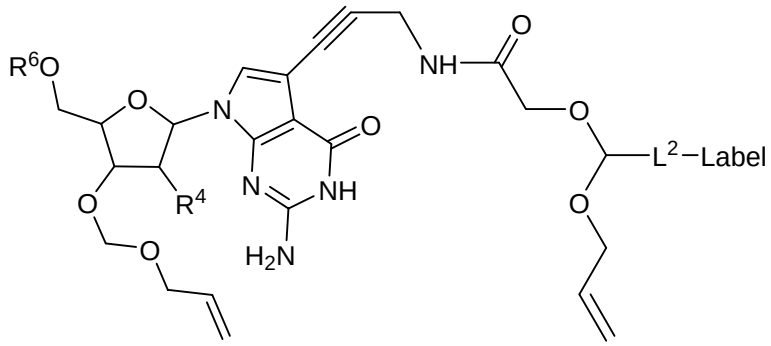
7. The nucleoside or nucleotide of claim 1, comprising the structure of Formula (Ia), (Ia′), (Ib), (Ic), (Ic′) or (Id):



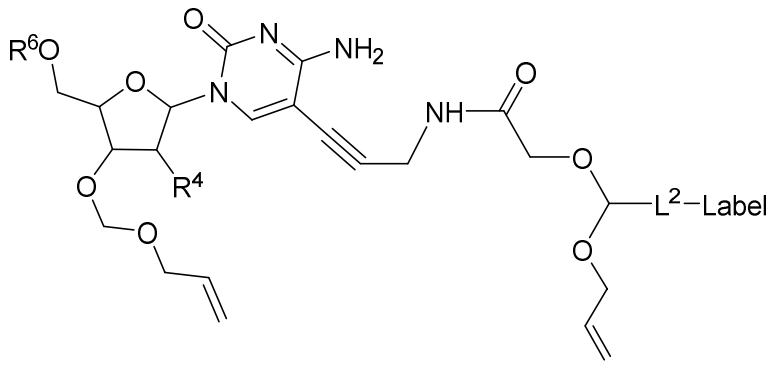
(Ia),



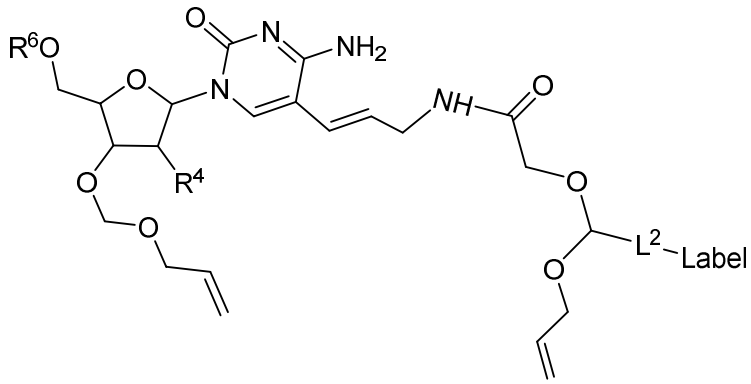
(Ia′),



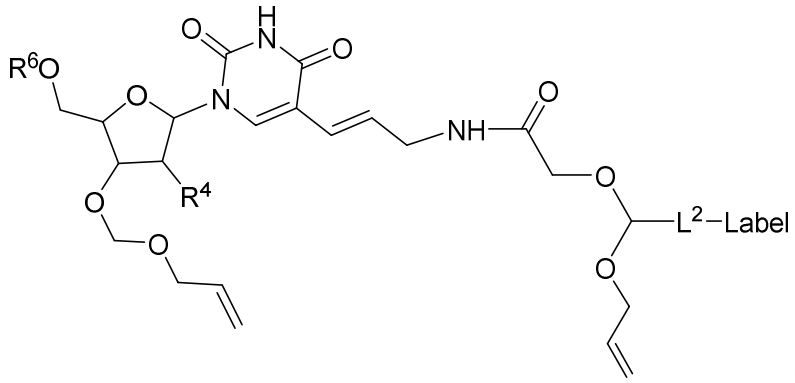
(Ib),



(Ic),



(Ic′) or



(Id).

8. The nucleoside or nucleotide of claim 1, wherein n is 5.

9. The nucleoside or nucleotide of claim 1, wherein m is 4.

10. The nucleoside or nucleotide of claim 1, wherein R^4 is H and $-OR^6$ is a triphosphate.

11. An oligonucleotide or polynucleotide comprising the nucleotide of claim 10.

12. The oligonucleotide or polynucleotide of claim 11, wherein the oligonucleotide or polynucleotide is hybridized to a template polynucleotide.

13. The oligonucleotide or polynucleotide of claim 12, wherein the template polynucleotide is immobilized on a solid support.

14. The oligonucleotide or polynucleotide of claim 13, wherein the solid support comprises an array of a plurality of immobilized template polynucleotides.

15. A method of preparing a growing polynucleotide complementary to a target single-stranded polynucleotide in a sequencing reaction, comprising incorporating a nucleotide of claim 10 into a growing complementary polynucleotide, wherein the incorporation of the nucleotide prevents the introduction of any subsequent nucleotide into the growing complementary polynucleotide.

16. A method of determining the sequence of a target single-stranded polynucleotide, comprising:

(a) incorporating the nucleotide of claim 10 into a copy polynucleotide strand complementary to at least a portion of the target polynucleotide strand;

(b) detecting the identity of the nucleotide incorporated into the copy polynucleotide strand; and

(c) chemically removing the detectable label and the 3′-OH blocking group from the nucleotide incorporated into the copy polynucleotide strand.

17. The method of claim 16, further comprising (d) using a post-cleavage washing solution to wash the chemically removed label and the 3′-OH blocking group away from the copy polynucleotide strand.

18. The method of claim 17, further comprising repeating steps (a) to (d) until a sequence of at least a portion of the target polynucleotide strand is determined.

19. The method of claim 18, wherein the steps (a) to (d) is repeated at least 50 times, at least 100 times, or at least 150 times.

20. The method of claim 16, wherein step (c) comprises contacting the incorporated nucleotide with a cleavage solution comprising a palladium catalyst.

21. The method of claim 20, wherein the palladium catalyst is a palladium (0) catalyst generated *in situ* from a palladium complex and a water-soluble phosphine.

22. The method of claim 21, wherein the palladium complex comprises $[Pd(Allyl)Cl]_2$, Na_2PdCl_4, [Pd(Allyl)(THP)]Cl, $[Pd(Allyl)(THP)_2]Cl$, $Pd(CH_3CN)_2Cl_2$, $Pd(OAc)_2$, $Pd(PPh_3)_4$, $Pd(dba)_2$, $Pd(Acac)_2$, $PdCl_2(COD)$, or $Pd(TFA)_2$, or combinations thereof.

23. The method of claim 22, wherein the palladium complex comprises $[Pd(Allyl)Cl]_2$ or Na_2PdCl_4.

24. The method of claim 20, wherein the detectable label and the 3′-OH blocking group from the nucleotide incorporated into the copy polynucleotide strand are removed in a single chemical reaction.

25. The method of claim 20, wherein the cleavage solution further comprises one or more buffer reagents selected from the group consisting of a primary amine, a secondary amine, a tertiary amine, a carbonate salt, a phosphate salt, and a borate salt, and combinations thereof.

26. The method of claim 25, wherein the buffer reagents in the cleavage solution are selected from the group consisting of ethanolamine (EA), tris(hydroxymethyl)aminomethane (Tris), glycine, a carbonate salt, a phosphate salt, a borate salt, dimethylethanolamine (DMEA), diethylethanolamine (DEEA), N,N,N′,N′-tetramethylethylenediamine (TEMED), and N,N,N′,N′-tetraethylethylenediamine (TEEDA), 2-piperidine ethanol, and combinations thereof.

27. The method of claim 20, wherein step (a) comprises contacting the nucleotide with the copy polynucleotide strand in an incorporation solution comprising a polymerase, at least one palladium scavenger, and one or more buffering agents.

28. The method of claim 27, wherein the buffering agents in the incorporation solution comprise a primary amine, a secondary amine, a tertiary amine, a natural amino acid, or a non-natural amino acid, or combinations thereof.

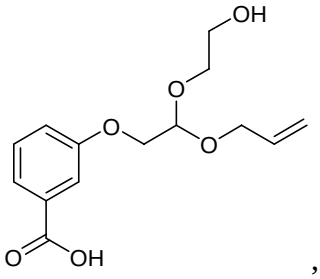
29. The method of claim 28, wherein the buffering agents in the incorporation solution comprise ethanolamine or glycine, or a combination thereof.

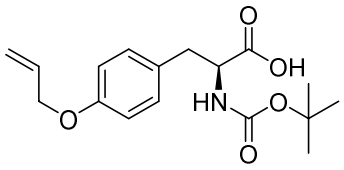
30. The method of claim 27, wherein the palladium scavenger in the incorporation solution comprises one or more allyl moieties independently selected from the group consisting of –O-allyl, –S-allyl, –NR-allyl, and $–N^{+}RR'$-allyl,

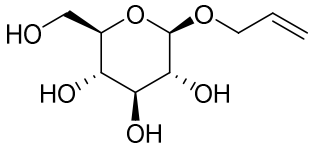
wherein R is H, unsubstituted or substituted C_1-C_6 alkyl, unsubstituted or substituted C_2-C_6 alkenyl, unsubstituted or substituted C_2-C_6 alkynyl, unsubstituted or substituted C_6-C_{10} aryl, unsubstituted or substituted 5 to 10 membered heteroaryl, unsubstituted or substituted C_3-C_{10} carbocyclyl, or unsubstituted or substituted 5 to 10 membered heterocyclyl; and

R′ is H, unsubstituted C_1-C_6 alkyl or substituted C_1-C_6 alkyl.

31. The method of claim 30, wherein the palladium scavenger in the incorporation solution is:



,


, or


.

32. The method of claim 20, wherein the post-cleavage washing solution comprises one or more palladium scavengers.

33. The method of claim 32, wherein the one or more palladium scavengers in the post cleavage solution comprises an isocyanoacetate (ICNA) salt, ethyl isocyanoacetate, methyl isocyanoacetate, cysteine or a salt thereof, L-cysteine or a salt thereof, *N*-acetyl-L-cysteine, potassium ethylxanthogenate, potassium isopropyl xanthate, glutathione, lipoic acid, ethylenediaminetetraacetic acid (EDTA), iminodiacetic acid, nitrilodiacetic acid, trimercapto-S-triazine, dimethyldithiocarbamate, dithiothreitol, mercaptoethanol, allyl alcohol, propargyl alcohol, thiol, tertiary amine and/or tertiary phosphine, or combinations thereof.

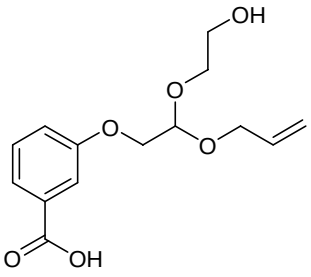
34. The method of claim 16, wherein the target single-stranded polynucleotide is formed by chemically cleaving a complementary strand from a double stranded polynucleotide.

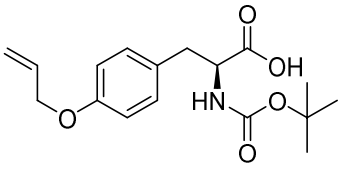
35. The method of claim 34, wherein the chemically cleavage of the complementary strand is performed under the same reaction condition as chemically removing the detectable label and the 3′-OH blocking group from the nucleotide incorporated into the copy polynucleotide strand.

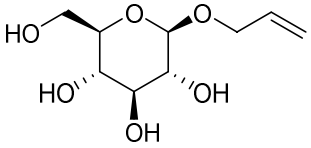
36. A kit comprising one or more nucleotides of claim 10.

37. The kit of claim 36, further comprising an enzyme, at least one Pd(0) scavenger, and one or more buffering agents.

38. The kit of claim 37, wherein the enzyme is a DNA polymerase, a terminal deoxynucleotidyl transferase, or a reverse transcriptase.

39. The kit of claim 37, wherein the at least one Pd(0) scavenger is 

, 

, or 

.

40. The kit of claim 36, further comprising a palladium catalyst.

41. The kit of claim 40, wherein the palladium catalyst is a Pd(0) catalyst generated *in situ* from a Pd(II) complex and one or more water soluble phosphines.

42. The kit of claim 41, wherein the Pd(II) complex is $[Pd(Allyl)Cl]_2$ or Na_2PdCl_4.

43. The kit of claim 41, further comprising one or more Pd(II) scavengers.

44. The kit of claim 43, wherein the one or more Pd(II) scavenger are selected from the group consisting of isocyanoacetate (ICNA) salt, ethyl isocyanoacetate, methyl isocyanoacetate, cysteine or a salt thereof, L-cysteine or a salt thereof, *N*-acetyl-L-cysteine, potassium ethylxanthogenate, potassium isopropyl xanthate, glutathione, lipoic acid, ethylenediaminetetraacetic acid (EDTA), iminodiacetic acid, nitrilodiacetic acid, trimercapto-S-

triazine, dimethyldithiocarbamate, dithiothreitol, mercaptoethanol, allyl alcohol, propargyl alcohol, thiol, tertiary amine and/or tertiary phosphine, or combinations thereof.

45. The nucleoside or nucleotide of claim 8 wherein R^4 is H and $-OR^6$ is a triphosphate.

46. An oligonucleotide or polynucleotide comprising the nucleotide of claim 45.

47. A kit comprising one or more nucleotides of claim 45.

48. The kit of claim 47, further comprising a DNA polymerase, at least one Pd(0) scavenger, and one or more buffering agents.