What is claimed is:

1. A system for labeling nucleic acid molecules in a sample comprising:
a set of oligonucleotides comprising a plurality of barcodes, each barcode comprising a stretch of contiguous bases comprising:

(i) a sample barcode comprising a pre-determined number of sample index positions comprising one or more specific nucleotides, wherein the location of sample index positions varies between samples; and

(ii) a molecular barcode comprising molecular index positions comprising a nucleotide that differs from the nucleotides at sample index positions,
wherein sample index positions are interspersed among molecular index positions.

2. The system of claim 1, wherein the pre-determined number of sample barcode positions varies among different sample barcodes.

3. The system of claim 1, wherein the barcode comprises about 10 to about 35 nucleotides.

4. The system of claim 1, wherein the barcode comprises about 12 to about 25 nucleotides.

5. The system of claim 1, wherein the sample barcode comprises 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, or 20 sample index positions, or a combination thereof.

6. The system of claim 1, wherein the sample barcode comprises about 4 to about 12 sample index positions.

7. The system of claim 1, wherein the molecular barcode comprises about 5 to about 25 molecular index positions.

8. The system of claim 1, wherein the molecular barcode comprises about 5 to about 15 molecular index positions.

9. The system of claim 1, wherein sample index position nucleotides and molecular index position nucleotides are selected from:

(A) the sample index position nucleotide is A and the molecular index position nucleotide is C, G, T, or a combination thereof;

(B) the sample index position nucleotide is T and the molecular index position nucleotide is C, G, A, or a combination thereof;

(C) the sample index position nucleotide is C and the molecular index position nucleotide is G, A, T, or a combination thereof;

(D) the sample index position nucleotide is G and the molecular index position nucleotide is C, A, T, or a combination thereof;

(E) the sample index position nucleotide is A, T, or a combination thereof and the molecular index position nucleotide is C, G, or a combination thereof;

(F) the sample index position nucleotide is A, C, or a combination thereof and the molecular index position nucleotide is T, G, or a combination thereof;

(G) the sample index position nucleotide is A, G, or a combination thereof and the molecular index position nucleotide is T, C, or a combination thereof;

(H) the sample index position nucleotide is T, C, or a combination thereof and the molecular index position nucleotide is A, G, or a combination thereof;

(I) the sample index position nucleotide is T, G, or a combination thereof and the molecular index position nucleotide is A, C, or a combination thereof; or

(J) the sample index position nucleotide is G, C, or a combination thereof and the molecular index position nucleotide is A, T, or a combination thereof.

10. The system of claim 1, wherein each barcode comprises one or more additional index barcodes comprising index positions.

11. The system of claim 10, wherein the one or more additional index barcode is a cellular barcode, a barcode that provides a measure of DNA length of an unrepaired end, or both a cellular barcode and a barcode that provides a measure of DNA length of an unrepaired end.

12. The system of claim 1, wherein each oligonucleotide in the set of oligonucleotides further comprises non-barcode positions comprising sites for hybridization, sites for sequence primer binding, sites for amplification, or any combination thereof.

13. A set of oligonucleotides for labeling nucleic acid molecules in a sample comprising a plurality of barcodes, each barcode comprising:

(i) a sample barcode comprising a pre-determined number of sample index positions comprising one or more specific nucleotides, wherein the location of sample index positions varies between samples; and

(ii) a molecular barcode comprising molecular index positions comprising a nucleotide that differs from the nucleotides at sample index positions,

wherein sample index positions and molecular index positions are interspersed in a stretch of contiguous bases.

14. The set of oligonucleotides of claim 13, wherein the pre-determined number of sample barcode positions varies among different sample barcodes.

15. The set of oligonucleotides of claim 13, wherein the barcode comprises about 10 to about 35 nucleotides.

16. The set of oligonucleotides of claim 13, wherein the barcode comprises about 12 to about 25 nucleotides.

17. The set of oligonucleotides of claim 13, wherein the sample barcode comprises 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, or 20 sample index positions, or a combination thereof.

18. The set of oligonucleotides of claim 13, wherein the sample barcode comprises about 4 to about 12 sample index positions.

19. The set of oligonucleotides of claim 13, wherein the molecular barcode comprises about 5 to about 25 molecular index positions.

20. The set of oligonucleotides of claim 13, wherein the molecular barcode comprises about 5 to about 15 molecular index positions.

21. The set of oligonucleotides of claim 13, wherein sample index position nucleotides and molecular index position nucleotides are selected from:

(A) the sample index position nucleotide is A and the molecular index position nucleotide is C, G, T, or a combination thereof;

(B) the sample index position nucleotide is T and the molecular index position nucleotide is C, G, A, or a combination thereof;

(C) the sample index position nucleotide is C and the molecular index position nucleotide is G, A, T, or a combination thereof;

(D) the sample index position nucleotide is G and the molecular index position nucleotide is C, A, T, or a combination thereof;

(E) the sample index position nucleotide is A, T, or a combination thereof and the molecular index position nucleotide is C, G, or a combination thereof;

(F) the sample index position nucleotide is A, C, or a combination thereof and the molecular index position nucleotide is T, G, or a combination thereof;

(G) the sample index position nucleotide is A, G, or a combination thereof and the molecular index position nucleotide is T, C, or a combination thereof;

(H) the sample index position nucleotide is T, C, or a combination thereof and the molecular index position nucleotide is A, G, or a combination thereof;

(I) the sample index position nucleotide is T, G, or a combination thereof and the molecular index position nucleotide is A, C, or a combination thereof; or

(J) the sample index position nucleotide is G, C, or a combination thereof and the molecular index position nucleotide is A, T, or a combination thereof.

22. The set of oligonucleotides of claim 13, wherein each barcode comprises one or more additional index barcodes comprising index positions.

23. The set of oligonucleotides of claim 22, wherein the one or more additional index barcode is a cellular barcode, a barcode that provides a measure of DNA length of an unrepaired end, or both a cellular barcode and a barcode that provides a measure of DNA length of an unrepaired end.

24. The set of oligonucleotides of claim 13, wherein each oligonucleotide in the set of oligonucleotides further comprises non-barcode positions comprising sites for hybridization, sites for sequence primer binding, sites for amplification, or any combination thereof.