

SUPPLEMENTAL DATA

Figure S1. Cyclin D1 induces specific miRNA clusters. (A-C). The miR-17-92 cluster and its paralogs were induced by endogenous cyclin D1 in MCF-7 cells. The fold change in expression (FC), is shown for each miRNA of the cluster together with the chromosomal location. (D) The oncomiR C19MC cluster, its chromosomal location, and the -fold induction by endogenous cyclin D are shown for each member of the cluster. (E, F) The miRNA let-7 family and its paralogs were induced by endogenous cyclin D1 in MCF-7 cells. The fold change in expression (FC) is shown for each miRNA of the cluster together with the chromosomal location.

Figure S2. miRNA examination in Hs578t cells. Using QRT-PCR to examine the expression of representative miRNAs in Hs578t cells treated with negative control or cyclin D1 siRNA, the results are shown as mean \pm SEM (n=3).

Figure S3. A list of 26 cyclin D1-regulated miRNAs that overlap with the breast cancer miRNA superset.

Figure S4. Expression of the cyclin D1-regulated miRNA signature within breast cancer miRNA superset compendium. Heatmap is shown with columns sorted according to the expression level of the cyclin D1 miRNA signature. Relative levels are shown with the color scale. Values of the expression for the cyclin D1-regulated miRNA signature are indicated by the scatterplot above the Heatmap.

Figure S5. Expression of the cyclin D1-regulated miRNA signature is associated with ER α -positive breast cancer. Expression of the cyclin D1-regulated miRNA signature within the breast cancer miRNA superset compendium is shown and scored for ER α status. The heatmap is shown with columns sorted according to the levels of expression for the cyclin D1-regulated miRNA signature. Values of the cyclin D1-mediated miRNA signature are

indicated by the scatterplot above the heatmap. Column color bars indicate the ER α status of the associated sample.

Figure S6. Expression of the cyclin D1-regulated miRNA signature is negatively correlated with the histological grade of poor prognosis (Grade 3). Expression of the cyclin D1-regulated miRNA signature within the breast cancer compendium is associated with tumor grades. Column color bars indicate the histological grade of the associated samples. Color indicates the histological grade of the associated set of tumors. Low expression of the cyclin D1-regulated miRNAs is correlated with poor prognosis (Grade 3) ($p = 0.007$) (Fig. 4D).

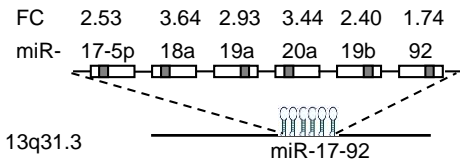
Figure S7. The cyclin D1-regulated miRNA (non-coding) signature and the molecular genetic (coding) subtype. Expression of cyclin D1-regulated miRNAs in the breast cancer compendium was scored by each tumor's coding genome subtype. The columns were sorted according to the cyclin D1-regulated miRNA signature. Column color bars indicate the molecular genetic (coding genome) subtype of the associated tumor.

Figure S8. Luciferase reporter assays indicate that overexpression of either miR-34 or miR-148a did not have effects on the mutated DKK1 3'UTR. Data is shown as mean \pm SEM ($n=3$).

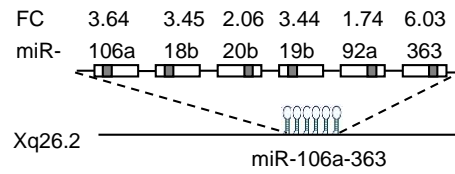
Figure S9. The induction of miR-34a and miR-148a/b by cyclin D1 in MCF-7 cells. The data is from the miRNA panel analysis in Figure 1D. Data is shown as mean \pm SEM ($n=3$).

Figure S10. A. RNA sequence analysis on WT and *Dicer*-knockout mouse embryonic stem (ES) cells indicated the regulation of miRNA by *Dicer*. B. miRNA expression analysis on cyclin D1 wild type and cyclin D1 deletion MCF-7 cells indicated the induction of miRNA expression by cyclin D1 in breast cancer cells.

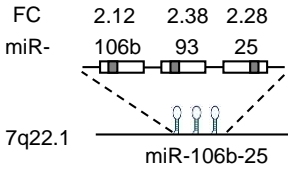
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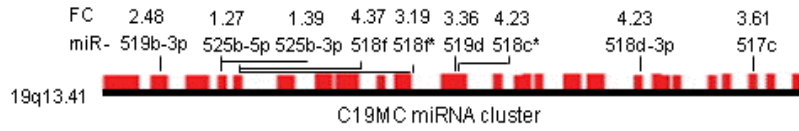
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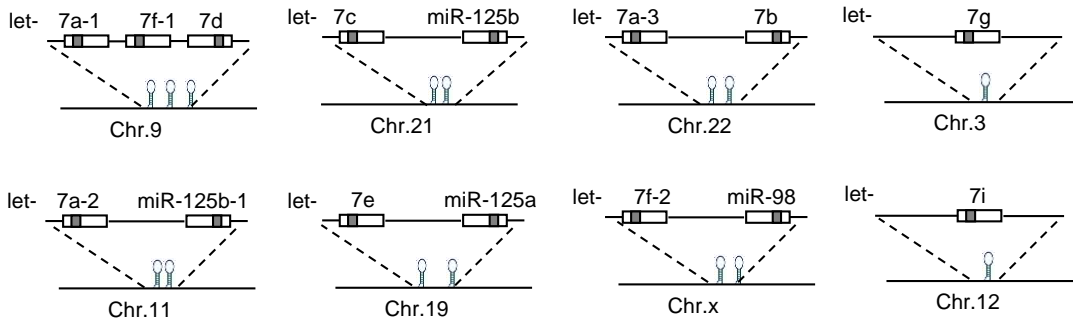
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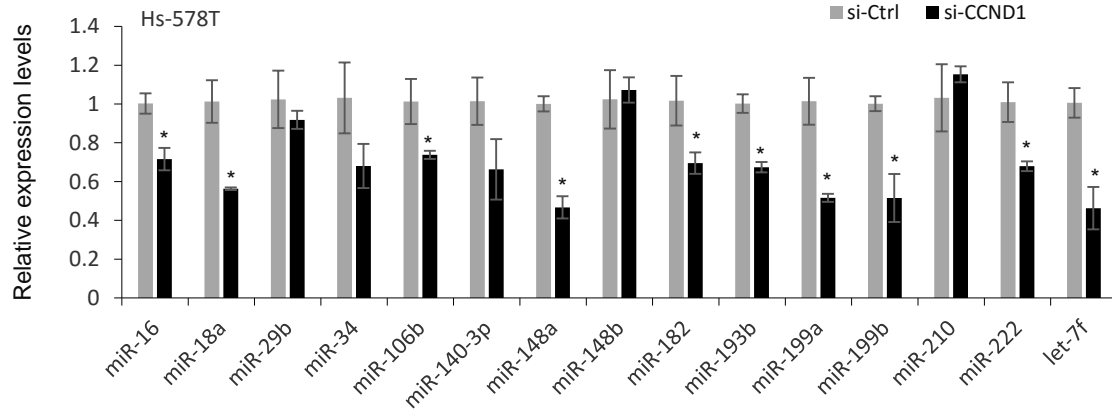
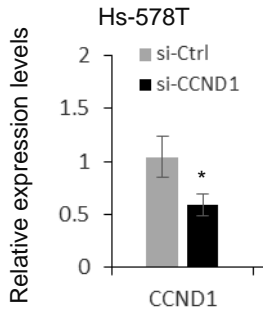


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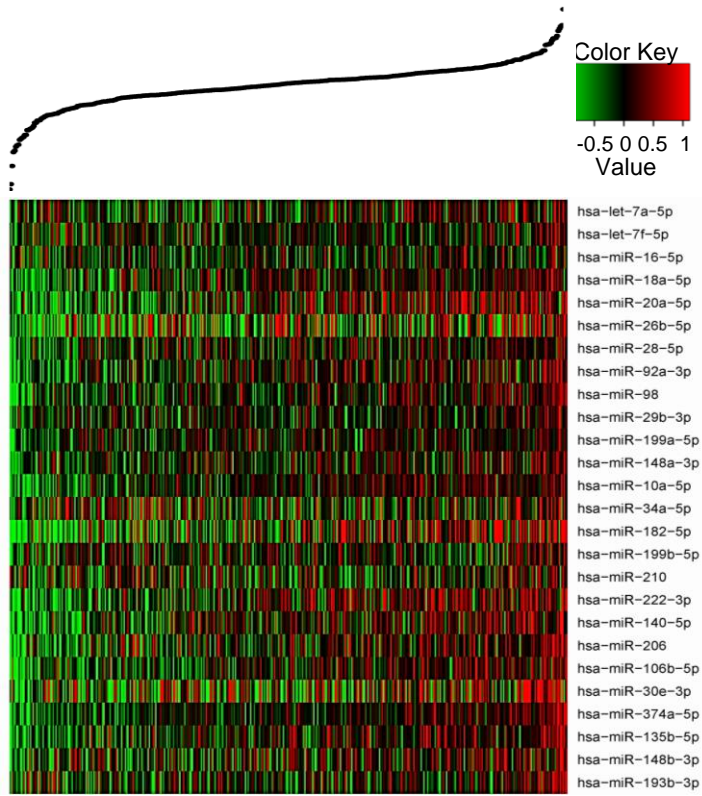


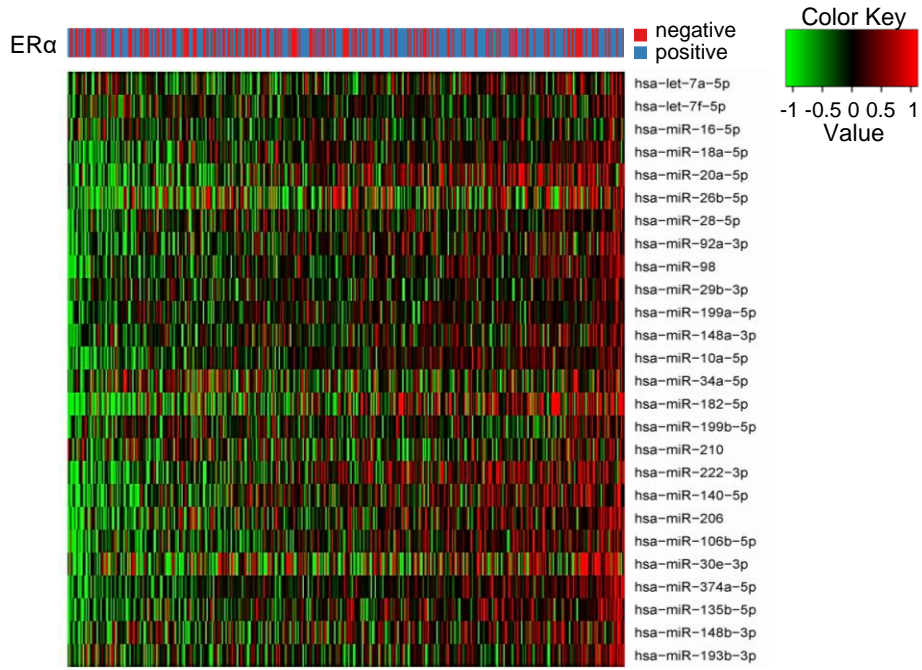
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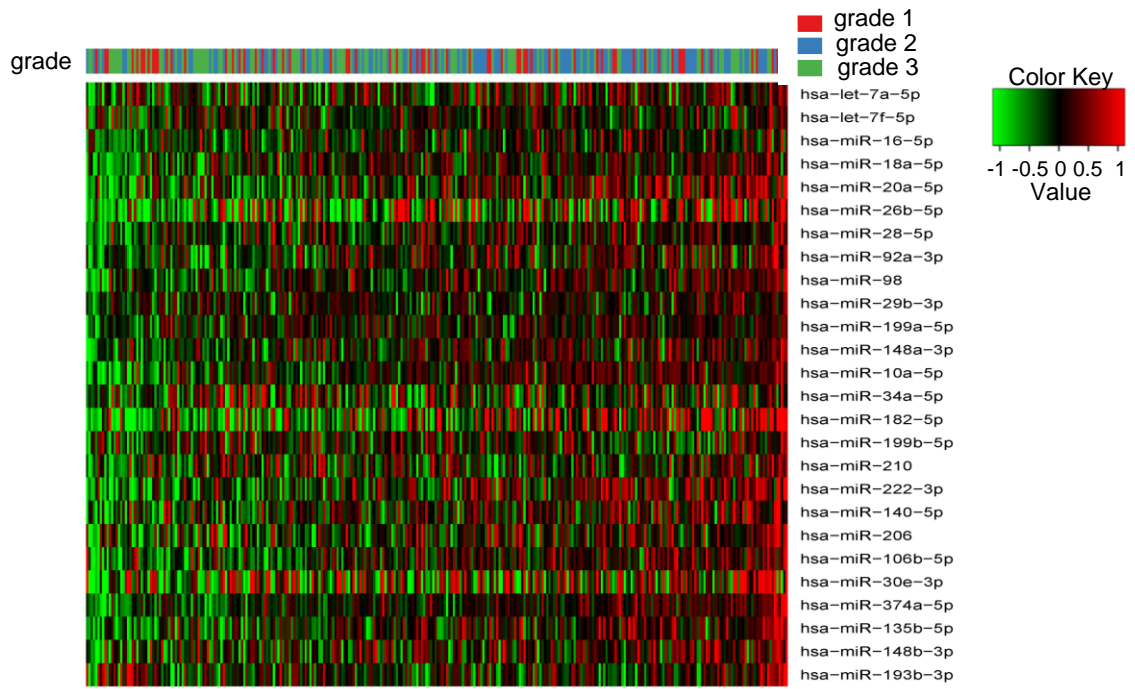
let-7 miRNA	7a	7b	7c	7d	7e	7f	7g	7i	miR-98	miR-125a	miR-125b
FC (CCND+/CCND-)	2.0	1.7	1.7	2.3	1.6	1.8	2.1	1.5	2.4	1.6	0.8

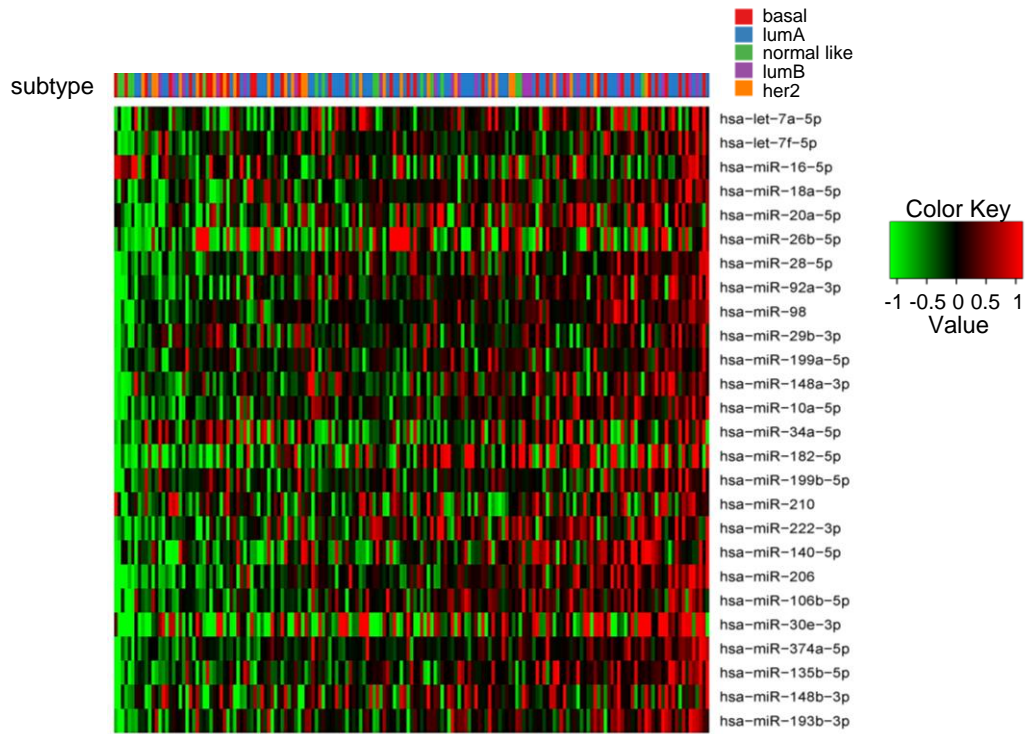


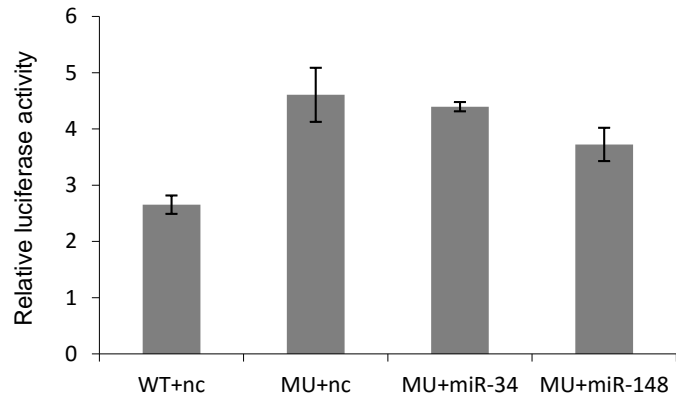
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hsa-let-7f-5p
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hsa-miR-18a-5p
hsa-miR-20a-5p
hsa-miR-26b-5p
hsa-miR-28-5p
hsa-miR-92a-3p
hsa-miR-98
hsa-miR-29b-3p
hsa-miR-199a-5p
hsa-miR-148a-3p
hsa-miR-10a-5p
hsa-miR-34a-5p
hsa-miR-182-5p
hsa-miR-199b-5p
hsa-miR-210
hsa-miR-222-3p
hsa-miR-140-5p
hsa-miR-206
hsa-miR-106b-5p
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hsa-miR-148b-3p
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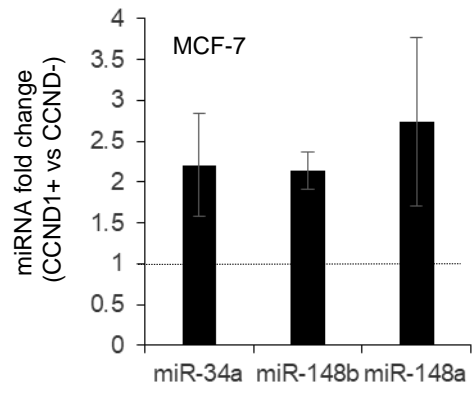




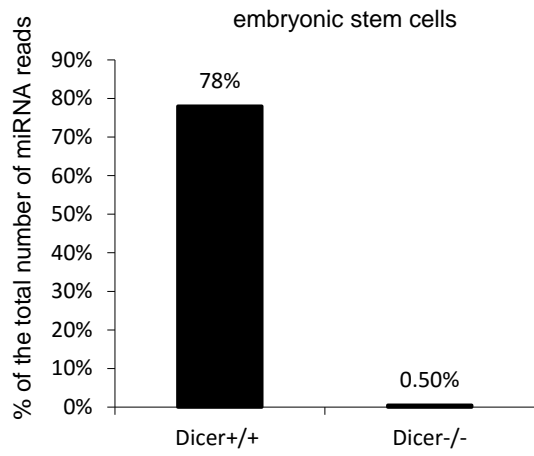




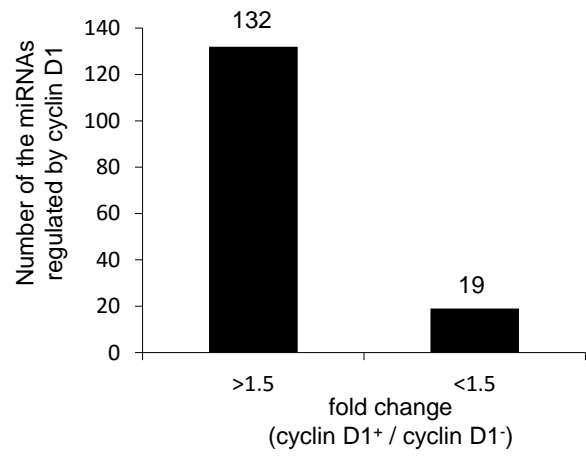




A



B



Supplemental Table 1: A compendium of 114 miRNAs that were associated with clinical information of breast cancer

miRNA ID	miRNA sequence
hsa-let-7a-5p	UGAGGUAGUAGGUUGUAUAGUU
hsa-let-7b-5p	UGAGGUAGUAGGUUGUGUGGUU
hsa-let-7c	UGAGGUAGUAGGUUGUAUGGUU
hsa-let-7d-5p	AGAGGUAGUAGGUUGCAUAGUU
hsa-let-7e-5p	UGAGGUAGGAGGUUGUAUAGUU
hsa-let-7f-5p	UGAGGUAGUAGAUUGUAUAGUU
hsa-miR-15a-5p	UAGCAGCACAUAAUGGUUUGUG
hsa-miR-16-5p	UAGCAGCACGUAAAUAUUGGCG
hsa-miR-18a-5p	UAAGGUGCAUCUAGUGCAGAUAG
hsa-miR-19a-3p	UGUGCAAAUCUAUGCAAAACUGA
hsa-miR-19b-3p	UGUGCAAAUCCAUGCAAAACUGA
hsa-miR-20a-5p	UAAAGUGCUUAUAGUGCAGGUAG
hsa-miR-21-5p	UAGCUUAUCAGACUGAUGUUGA
hsa-miR-23a-3p	AUCACAUUGCCAGGGAUUUCC
hsa-miR-24-3p	UGGCUCAGUUCAGCAGGAACAG
hsa-miR-25-3p	CAUUGCACUUGUCUCGGUCUGA
hsa-miR-26a-5p	UUCAAGUAAUCCAGGAUAGGCU
hsa-miR-26b-5p	UUCAAGUAAUUCAGGAUAGGU
hsa-miR-27a-3p	UUCACAGUGGCUAAGUUCGCG
hsa-miR-28-5p	AAGGAGCUCACAGUCUAUUGAG
hsa-miR-29a-3p	UAGCACCAUCUGAAAUCGGUUA
hsa-miR-30a-5p	UGUAAACAUCUCCGACUGGAAG
hsa-miR-30a-3p	CUUUCAGUCGGAUGUUUGCAGC
hsa-miR-33a-5p	GUGCAUUGUAGUUGCAUUGCA
hsa-miR-92a-3p	UAUUGCACUUGUCCCGGCCUGU
hsa-miR-93-5p	CAAAGUGCUGUUCGUGCAGGUAG
hsa-miR-96-5p	UUUGGCACUAGCACAUUUUUGCU
hsa-miR-98	UGAGGUAGUAAGUUGUAUUGUU
hsa-miR-99a-5p	AACCCGUAGAUCCGAUCUUGUG
hsa-miR-100-5p	AACCCGUAGAUCCGAACUUGUG
hsa-miR-101-3p	UACAGUACUGUGAUAAACUGAA
hsa-miR-29b-3p	UAGCACCAUUUGAAAUCAGUGUU
hsa-miR-107	AGCAGCAUUGUACAGGGCUAUCA
hsa-miR-196a-5p	UAGGUAGUUUCAUGUUGUUGGG
hsa-miR-197-3p	UUCACCACCUUCCACCCAGC
hsa-miR-199a-5p	CCCAGUGUUCAGACUACCUUGUC
hsa-miR-148a-3p	UCAGUGCACUACAGAACUUUGU
hsa-miR-30c-5p	UGUAAACAUCUACACUCUCAGC
hsa-miR-30d-5p	UGUAAACAUCUCCCGACUGGAAG

hsa-miR-7-5p	UGGAAGACUAGUGAUUUUGUUGU
hsa-miR-10a-5p	UACCCUGUAGAUCGAAUUUGUG
hsa-miR-10b-5p	UACCCUGUAGAACCGAAUUUGUG
hsa-miR-34a-5p	UGGCAGUGUCUUAGCUGGUUGU
hsa-miR-181a-5p	AACAUUCAACGCUGUCGGUGAGU
hsa-miR-181b-5p	AACAUUCAUUGCUGUCGGUGGGU
hsa-miR-181c-5p	AACAUUCAACCGUCGGUGAGU
hsa-miR-182-5p	UUUGGCAAUGGUAGAACUCACACU
hsa-miR-183-5p	UAUGGCACUGGUAGAAUUCACU
hsa-miR-199b-5p	CCCAGUGUUUAGACUAUCUGUUC
hsa-miR-203	GUGAAAUGUUUAGGACCACUAG
hsa-miR-205-5p	UCCUUCAUCCACCGGAGUCUG
hsa-miR-210	CUGUGCGUGUGACAGCGGCUGA
hsa-miR-214-3p	ACAGCAGGCACAGACAGGCAGU
hsa-miR-221-3p	AGCUACAUUGUCUGCUGGGUUUC
hsa-miR-222-3p	AGCUACAUCUGGCUACUGGGU
hsa-miR-224-5p	CAAGUCACUAGUGGUUCCGUU
hsa-miR-200b-3p	UAAUACUGCCUGGUAUUGAUGA
hsa-let-7g-5p	UGAGGUAGUAGUUUGUACAGUU
hsa-let-7i-5p	UGAGGUAGUAGUUUGUGCUGUU
hsa-miR-1	UGGAAUGUAAAGAAGUAUGUAU
hsa-miR-15b-5p	UAGCAGCACAUCAUGGUUUACA
hsa-miR-23b-3p	AUCACAUUGCCAGGGAUUACC
hsa-miR-30b-5p	UGUAAACAUCCUACACUCAGCU
hsa-miR-125b-5p	UCCCUGAGACCCUAACUUGUGA
hsa-miR-130a-3p	CAGUGCAAUGUUAAAAGGGCAU
hsa-miR-140-5p	CAGUGGUUUUACCCUAUGGUAG
hsa-miR-141-3p	UAACACUGUCUGGUAAGAUGG
hsa-miR-142-5p	CAUAAAGUAGAAAGCACUACU
hsa-miR-142-3p	UGUAGUGUUUCCUACUUUAUGGA
hsa-miR-143-3p	UGAGAUGAAGCACUGUAGCUC
hsa-miR-145-5p	GUCCAGUUUUCCCAGGAAUCCCU
hsa-miR-152	UCAGUGCAUGACAGAACUUGG
hsa-miR-9-5p	UCUUUGGUUAUCUAGCUGUAUGA
hsa-miR-9-3p	AUAAAGCUAGAUACCGAAAGU
hsa-miR-125a-5p	UCCCUGAGACCCUUUAACCGUGA
hsa-miR-126-5p	CAUUUUUACUUUUGGUACGCG
hsa-miR-126-3p	UCGUACCGUGAGUAAUAAUGCG
hsa-miR-146a-5p	UGAGAACUGAAUCCAUGGGUU
hsa-miR-149-5p	UCUGGCUCGGUGUCUUCACUCCC
hsa-miR-150-5p	UCUCCAACCCUUGUACCAGUG
hsa-miR-184	UGGACGGAGAACUGUAAGGGU
hsa-miR-185-5p	UGGAGAGAAAGGCAGUCCUGA

hsa-miR-193a-3p	AACUGGCCUACAAAGUCCCAGU
hsa-miR-195-5p	UAGCAGCACAGAAAUUUUGGC
hsa-miR-206	UGGAAUGUAAGGAAGUGUGUGG
hsa-miR-320a	AAAAGCUGGGUUGAGAGGGCGA
hsa-miR-200c-3p	UAAUACUGCCGGGUAAUGAUGGA
hsa-miR-155-5p	UUAAUGCUGAAUCGUGAUAGGGGU
hsa-miR-106b-5p	UAAAGUGCUGACAGUGCAGAU
hsa-miR-29c-3p	UAGCACCAUUUGAAAUCGGUUA
hsa-miR-200a-3p	UAACACUGUCUGGUAAACGAUGU
hsa-miR-34c-5p	AGGCAGUGUAGUUAGCUGAUUGC
hsa-miR-30e-5p	UGUAAACAUCUUGACUGGAAG
hsa-miR-30e-3p	CUUUCAGUCGGAUGUUUACAGC
hsa-miR-374a-5p	UUUAUAACAACCUGAUAAGUG
hsa-miR-375	UUUGUUCGUUCGGCUCGCGUGA
hsa-miR-382-5p	GAAGUUGUUCGUGGUGGAUUCG
hsa-miR-342-3p	UCUCACACAGAAAUCGCACCCGU
hsa-miR-135b-5p	UAUGGCUUUUCAUCCUAUGUGA
hsa-miR-148b-3p	UCAGUGCAUCACAGAACUUUGU
hsa-miR-331-3p	GCCCCUGGGCCUAUCCUAGAA
hsa-miR-339-5p	UCCCUGUCCUCCAGGAGCUCACG
hsa-miR-335-5p	UCAAGAGCAAUAACGAAAAAUGU
hsa-miR-133b	UUUGGUCCCCUUAACCAGCUA
hsa-miR-196b-5p	UAGGUAGUUUCCUGUUGUUGGG
hsa-miR-423-3p	AGCUCGGUCUGAGGCCCCUCAGU
hsa-miR-424-5p	CAGCAGCAAUUC AUGUUUUGAA
hsa-miR-429	UAAUACUGUCUGGUAAAACCGU
hsa-miR-449a	UGGCAGUGUAUUGUUAGCUGGU
hsa-miR-451a	AAACCGUUACCAUACUGAGUU
hsa-miR-146b-5p	UGAGAACUGAAUCCAUAGGCU
hsa-miR-193b-3p	AACUGGCCUCAAAGUCCCGCU
hsa-miR-497-5p	CAGCAGCACACUGUGGUUUUGU
hsa-miR-181d	AACAUUCAUUGUUGUCGGUGGGU

Supplemental Table 2: The cyclin D1 miRNA signature with 121 miRNAs that are upregulated at least 2-fold in *cyclin D1*⁺ vs. *cyclin D1*⁻ MCF-7 cells

miRNA ID	miRNA sequence
hsa-let-7a-5p	UGAGGUAGUAGGUUGUAUAGUU
hsa-let-7f-5p	UGAGGUAGUAGAUUGUAUAGUU
hsa-miR-16-5p	UAGCAGCACGUAAAUAUUGGCG
hsa-miR-18a-5p	UAAGGUGCAUCUAGUGCAGAUAG
hsa-miR-19b-2-5p	AGUUUUGCAGGUUUGCAUUUCA
hsa-miR-20a-5p	UAAAGUGCUUUAUAGUGCAGGUAG
hsa-miR-26b-5p	UUCAAGUAAUUCAGGAUAGGU
hsa-miR-28-5p	AAGGAGCUCACAGUCUAUUGAG
hsa-miR-92a-1-5p	AGGUUGGGAUCGGUUGCAAUGCU
hsa-miR-98	UGAGGUAGUAAGUUGUAUUGUU
hsa-miR-106a-5p	AAAAGUGCUUACAGUGCAGGUAG
hsa-miR-199a-5p	CCCAGUGUUCAGACUACCUGUUC
hsa-miR-10a-5p	UACCCUGUAGAUCCGAAUUUGUG
hsa-miR-34a-5p	UGGCAGUGUCUUAAGCUGGUUGU
hsa-miR-182-5p	UUUGGCAAUGGUAGAACUCACACU
hsa-miR-199b-5p	CCCAGUGUUUAGACUAUCUGUUC
hsa-miR-210	CUGUGCGUGUGACAGCGGCUGA
hsa-miR-211-5p	UUCCCUUUGUCAUCCUUCGCCU
hsa-miR-216a	UAAUCUCAGCUGGCAACUGUGA
hsa-miR-217	UACUGCAUCAGGAACUGAUUGGA
hsa-miR-122-5p	UGGAGUGUGACAAUGGUGUUUG
hsa-miR-128	UCACAGUGAACCGGUCUCUUU
hsa-miR-133a	UUUGGUCCCUUCAACCAGCUG
hsa-miR-140-5p	CAGUGGUUUUACCCUAUGGUAG
hsa-miR-153	UUGCAUAGUCACAAAAGUGAUC
hsa-miR-134	UGUGACUGGUUGACCAGAGGGG
hsa-miR-186-5p	CAAAGAAUUCUCCUUUUGGGCU
hsa-miR-206	UGGAAUGUAAGGAAGUGUGUGG
hsa-miR-106b-5p	UAAAGUGCUGACAGUGCAGAU
hsa-miR-296-5p	AGGGCCCCCUCAAUCCUGU
hsa-miR-363-5p	CGGGUGGAUCACGAUGCAAUUU
hsa-miR-372	AAAGUGCUGCGACAUUUGAGCGU
hsa-miR-373-5p	ACUCAAAAUGGGGGCGCUUUCC
hsa-miR-374a-5p	UUAUAAUACAACCUGAUAAGUG
hsa-miR-326	CCUCUGGGCCCUUCCUCCAG
hsa-miR-151a-5p	UCGAGGAGCUCACAGUCUAGU
hsa-miR-135b-5p	UAUGGCUUUUCAUUCUAUGUGA
hsa-miR-346	UGUCUGCCCGCAUGCCUGCCUCU
hsa-miR-18b-5p	UAAGGUGCAUCUAGUGCAGUUAG

hsa-miR-431-5p	UGUCUUGCAGGCCGUCAUGCA
hsa-miR-433	AUCAUGAUGGGCUCCUCGGUGU
hsa-miR-410	AAUAUAACACAGAUGGCCUGU
hsa-miR-492	AGGACCUGCGGGACAAGAUUCUU
hsa-miR-495	AAACAAACAUGGUGCACUUCUU
hsa-miR-518c-5p	UCUCUGGAGGGAAGCACUUUCUG
hsa-miR-519d	CAAAGUGCCUCCCUUUAGAGUG
hsa-miR-502-5p	AUCCUUGCUAUCUGGGUGCUA
hsa-miR-532-5p	CAUGCCUUGAGUGUAGGACCGU
hsa-miR-544a	AUUCUGCAUUUUUAGCAAGUUC
hsa-miR-567	AGUAUGUUCUCCAGGACAGAAC
hsa-miR-572	GUCCGCUCGGCGGUGGCCCA
hsa-miR-582-5p	UUACAGUUGUUAACCAGUUACU
hsa-miR-550a-5p	AGUGCCUGAGGGAGUAAGAGCCC
hsa-miR-596	AAGCCUGCCCGGCUCUCGGG
hsa-miR-602	GACACGGGCGACAGCUGCGGCC
hsa-miR-611	GCGAGGACCCUCGGGGUCUGAC
hsa-miR-622	ACAGUCUGCUGAGGUUGGAGC
hsa-miR-629-5p	UGGGUUUACGUUGGGAGAACU
hsa-miR-631	AGACCUGGCCCAGACCUCAGC
hsa-miR-33b-5p	GUGCAUUGCUGUUGCAUUGC
hsa-miR-651	UUUAGGAUAAGCUUGACUUUUG
hsa-miR-548d-5p	AAAAGUAAUUGUGGUUUUUGCC
hsa-miR-658	GGCGGAGGGAAGUAGGUCCGUUGGU
hsa-miR-421	AUCAACAGACAUUAAUUGGGCGC
hsa-miR-542-5p	UCGGGGAUCAUCAUGUCACGAGA
hsa-miR-668	UGUCACUCGGCUCGGCCACUAC
hsa-miR-298	AGCAGAAGCAGGGAGGUUCUCCCA
hsa-miR-891b	UGCAACUUACCUGAGUCAUUGA
hsa-miR-744-5p	UGC GG GCUAGGGCUAACAGCA
hsa-miR-877-5p	GUAGAGGAGAUGGCGCAGGG
hsa-miR-665	ACCAGGAGGCUGAGGCCCCU
hsa-miR-374b-5p	AUAUAAUACAACCUGCUAAGUG
hsa-miR-301b	CAGUGCAAUGAUUUGUCAAAAGC
hsa-miR-921	CUAGUGAGGGACAGAACCAGGAUUC
hsa-miR-509-3-5p	UACUGCAGACGUGGCAAUCAUG
hsa-miR-1182	GAGGGUCUUGGGAGGGAUGUGAC
hsa-miR-1237	UCCUUCUGCUCGGUCCCCCAG
hsa-miR-1238	CUUCCUCGUCUGUCUGCCCC
hsa-miR-1204	UCGUGGCCUGGUCUCCAUAU
hsa-let-7d-3p	CUAUACGACCUGCUGCCUUUCU
hsa-miR-18a-3p	ACUGCCCUAAGUGCUCUUCUGG
hsa-miR-92a-3p	UAUUGCACUUGUCCCGGCCUGU

hsa-miR-29b-3p	UAGCACCAUUUGAAAUCAGUGUU
hsa-miR-148a-3p	UCAGUGCACUACAGAACUUUGU
hsa-miR-30c-2-3p	CUGGGAGAAGGCUGUUUACUCU
hsa-miR-7-1-3p	CAACAAAUCACAGUCUGCCAUA
hsa-miR-187-3p	UCGUGUCUUGUGUUGCAGCCGG
hsa-miR-222-3p	AGCUACAUCUGGCUACUGGGU
hsa-miR-27b-3p	UUCACAGUGGCUAAGUUCUGC
hsa-miR-30b-3p	CUGGGAGGUGGAUGUUUACUUC
hsa-miR-140-3p	UACCACAGGGUAGAACCACGG
hsa-miR-144-3p	UACAGUAUAGAUGAUGUACU
hsa-miR-129-2-3p	AAGCCCUUACCCCAAAAAGCAU
hsa-miR-34c-3p	AAUCACUAACCACACGGCCAGG
hsa-miR-301a-3p	CAGUGCAAUAGUAUUGUCAAAAGC
hsa-miR-130b-3p	CAGUGCAAUGAUGAAAGGGCAU
hsa-miR-30e-3p	CUUUCAGUCGGAUGUUUACAGC
hsa-miR-363-3p	AAUUGCACGGUAUCCAUCUGUA
hsa-miR-302b-3p	UAAGUGCUUCCAUGUUUUAGUAG
hsa-miR-302c-3p	UAAGUGCUUCCAUGUUUCAGUGG
hsa-miR-148b-3p	UCAGUGCAUCACAGAACUUUGU
hsa-miR-483-3p	UCACUCCUCUCCUCCCGUCUU
hsa-miR-146b-3p	UGCCUGUGGACUCAGUUCUGG
hsa-miR-202-3p	AGAGGUUAGGGCAUGGGAA
hsa-miR-193b-3p	AACUGGCCCUCAAAGUCCCGCU
hsa-miR-523-3p	GAACGCGCUUCCCUUAGAGGGU
hsa-miR-518f-3p	GAAAGCGCUUCUCUUUAGAGG
hsa-miR-524-3p	GAAGGCGCUUCCCUUUGGAGU
hsa-miR-517a-3p	AUCGUGCAUCCCUUAGAGUGU
hsa-miR-517b-3p	AUCGUGCAUCCCUUAGAGUGU
hsa-miR-518a-3p	GAAAGCGCUUCCCUUUGCUGGA
hsa-miR-517c-3p	AUCGUGCAUCCCUUAGAGUGU
hsa-miR-505-3p	CGUCAACACUUGCUGGUUCCU
hsa-miR-506-3p	UAAGGCACCCUUCUGAGUAGA
hsa-miR-92b-3p	UAUUGCACUCGUCCCGGCCUCC
hsa-miR-551b-3p	GCGACCCAUACUUGGUUUCAG
hsa-miR-570-3p	CGAAAACAGCAAUUACCUUUGC
hsa-miR-615-3p	UCCGAGCCUGGGUCUCCUCUU
hsa-miR-766-3p	ACUCCAGCCCCACAGCCUCAGC
hsa-miR-888-3p	GACUGACACCUCUUUGGGUGAA
hsa-miR-374b-3p	CUUAGCAGGUUGUAUUAUCAUU