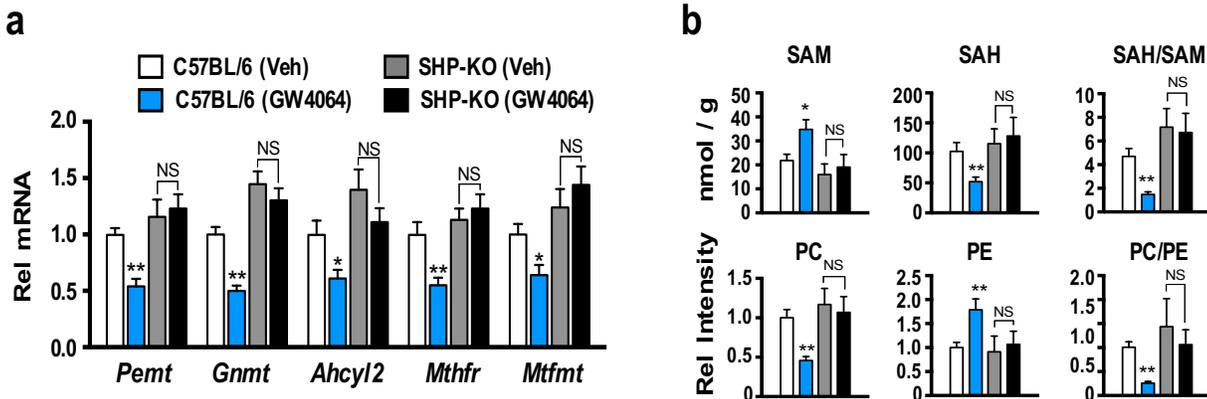
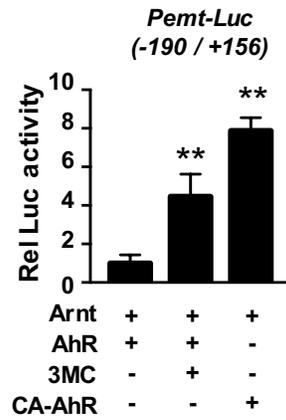


Supplementary Information

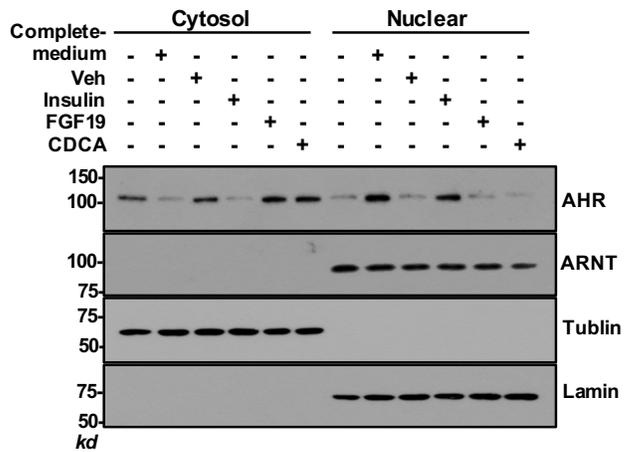
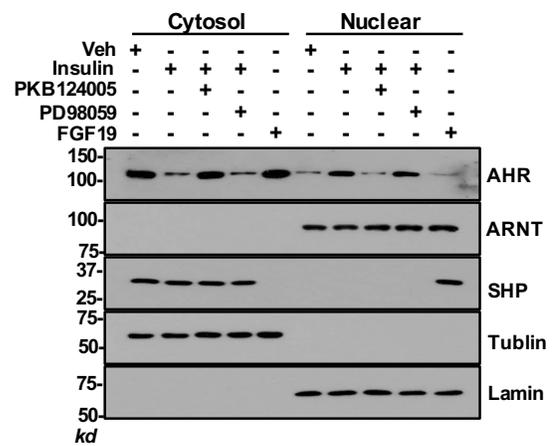
Supplementary Figures



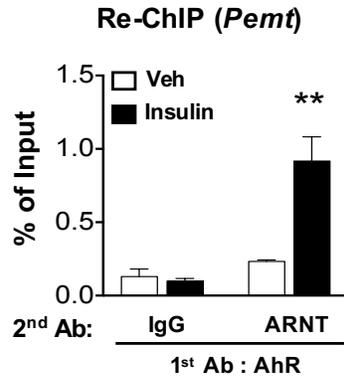
Supplementary Figure 1. (a-b) C57BL/6 mice and SHP-KO mice were fasted for 12 h and then, treated with GW4064 for 6 h. Livers were collected and mRNA levels of 1C cycle genes (a) or 1C cycle metabolites levels (b) were determined by q-RT-PCR or LC-MS, respectively. Means \pm SD are shown ($n=5$ mice), and statistical significance was measured by two-way ANOVA with the FDR post-test and $*P<0.05$, $**P<0.01$, and NS, not statistically significant.



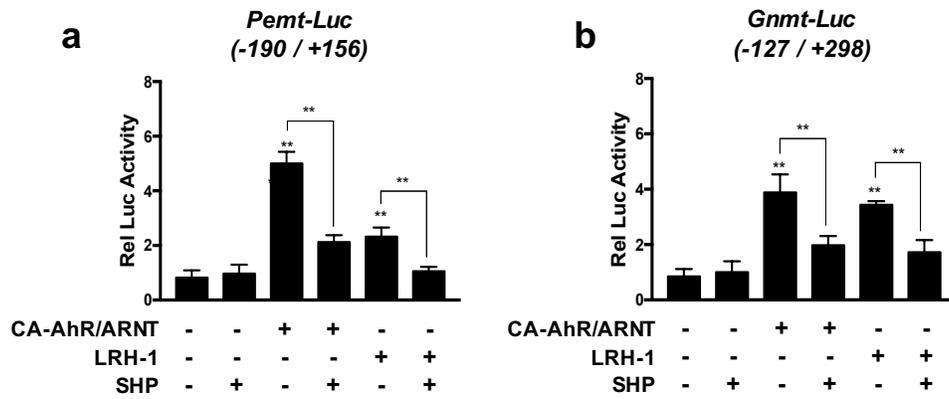
Supplementary Figure 2. Hepa1c1c7 cells were transfected with a *Pemt-luc* construct containing the WT AhR binding site in the *Pemt* promoter along with expression plasmids as indicated, treated with FGF19 for 2 h and luciferase activity was measured and normalized to β -galactosidase activity. Means \pm SD are shown (n=5), and statistical significance was measured using one-way ANOVA with the FDR post-test. *P<0.05, **P<0.01, and NS, not statistically significant.

a Subcellular localization (HepG2)**b Subcellular localization (HepG2)**

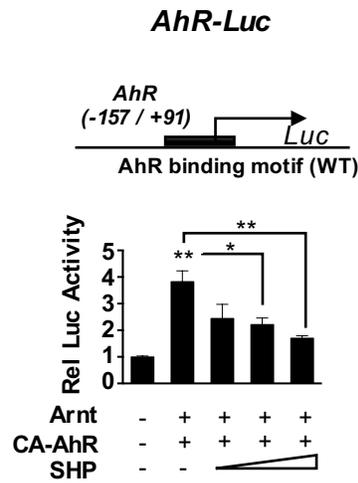
Supplementary Figure 3. (a) HepG2 cells were grown in low-glucose, serum-free media for 12 h and transferred for 15 min to complete medium or treated with insulin, FGF19, or CDCA for 15 min, then cells were harvested. (b) Cells were pre-treated with a PKB inhibitor, PKB124005, or an ERK inhibitor, PD98059, for 30 min prior to insulin treatment as indicated. Levels of AhR and SHP in the cytoplasmic and nuclear fractions were determined by IB. Full size immunoblots are in Supplementary Figure 13a.



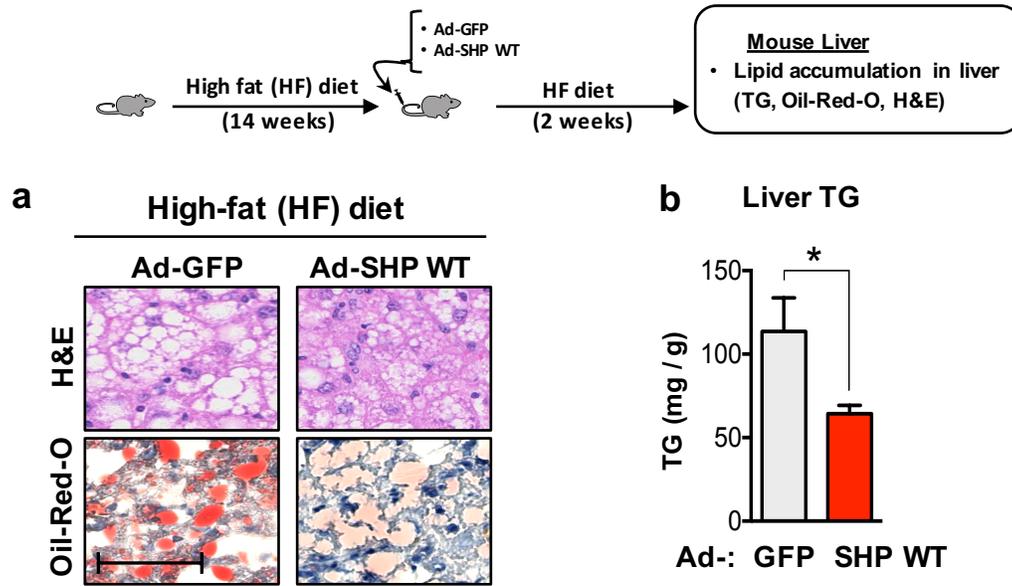
Supplementary Figure 4. Chromatin isolated from Hepa1c1c7 cells treated with insulin for 1 h was immunoprecipitated with AhR antibody, then eluted, and re-precipitated with ARNT antibody to examine the occupancy of ARNT in AhR-bound chromatin at the *Pemt* promoter. Means \pm SD are shown (n=5), and statistical significance was measured using two-way ANOVA with the FDR post-test. *P<0.05, **P<0.01, and NS, statistically not significant.



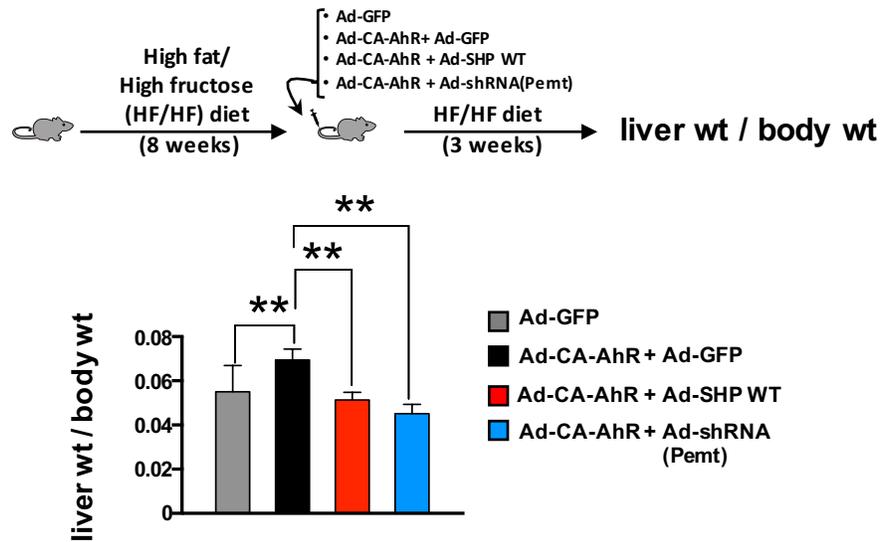
Supplementary Figure 5. Hepa1c1c7 cells were transfected with a *Pemt-luc* or *Gnmt-luc* promoter construct containing AhR binding sites along with expression plasmids as indicated. After 2 days, luciferase activities were measured. Means \pm SD are shown (n=5), and statistical significance was measured using one-way ANOVA with the FDR post-test. *P<0.05, **P<0.01, and NS, statistically not significant.



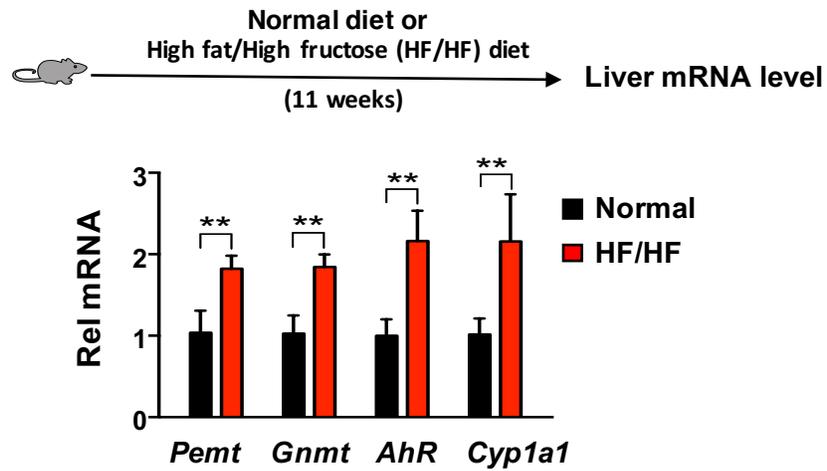
Supplementary Figure 6. Hepa1c1c7 cells were transfected with a *AhR-luc* construct containing the WT AhR binding site in the *AhR* promoter along with expression plasmids as indicated. After 2 days, cells were treated with FGF19 for 1 h, and luciferase activities were measured and normalized to β -galactosidase activity. Means \pm SD are shown (n=5), and statistical significance was measured using one-way ANOVA with the FDR post-test. *P<0.05, **P<0.01, and NS, statistically not significant.



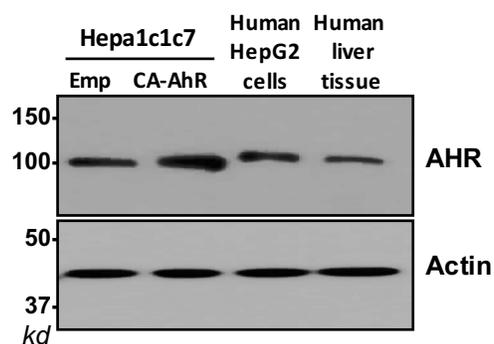
Supplementary Figure 7. Mice (n=5/group) were fed a high-fat diet for 14 weeks and Ad-GFP control or Ad-SHP were injected via the tail vein. Two weeks later (total = 16 weeks), livers were isolated. (a) Effects of SHP overexpression on lipid regulation in liver were determined by liver histology detected by Oil-Red-O staining and hematoxylin and eosin (H&E) staining. Scale bar: 100 μ M (b) Triglyceride (TG) levels in liver were measured. Means \pm SD are shown (n=5 mice), and statistical significance was measured using by the Student's t-test. *P<0.05, **P<0.01, and NS, statistically not significant.



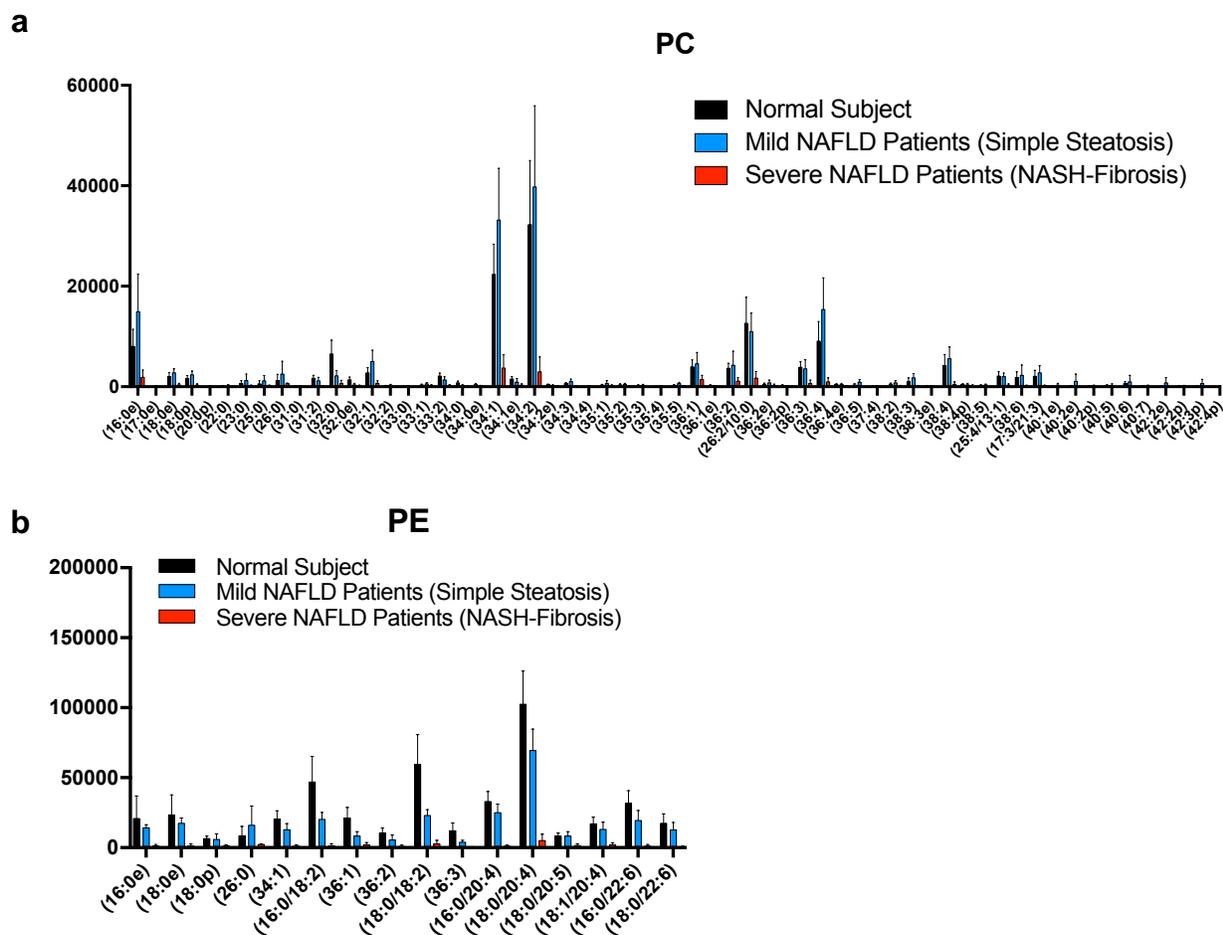
Supplementary Figure 8. Effects of expression of SHP or downregulation of *Pemt* on the CA-AhR-mediated increase in liver weight/body weight. Mice (n=5/group) were fed a HF/HF diet for 8 weeks, infected with the indicated adenovirus, and after 3 weeks, body and liver weights were measured. The ratio of liver weight/ body weight is plotted. Means +/- SD are shown (n=5 mice), and statistical significance was measured using one-way ANOVA with the FDR post-test. *P<0.05, **P<0.01, and NS, statistically not significant.



Supplementary Figure 9. Effects of a chronic HF/HF diet on hepatic expression of *Pemt*, *Gnm1*, *AhR*, and *Cyp1a1*. Mice (n=5/group) were fed either a normal chow diet (ND) or a high fat/high fructose (HF/HF) diet for 11 weeks, and then, mice were sacrificed and livers were collected. The mRNA levels of *Pemt*, *Gnm1*, *AhR*, and *Cyp1a1* were determined by q-RTPCR. Means \pm SD are shown (n=5 mice), and statistical significance was measured using the Student's t-test, *P<0.05, **P<0.01, and NS, statistically not significant.



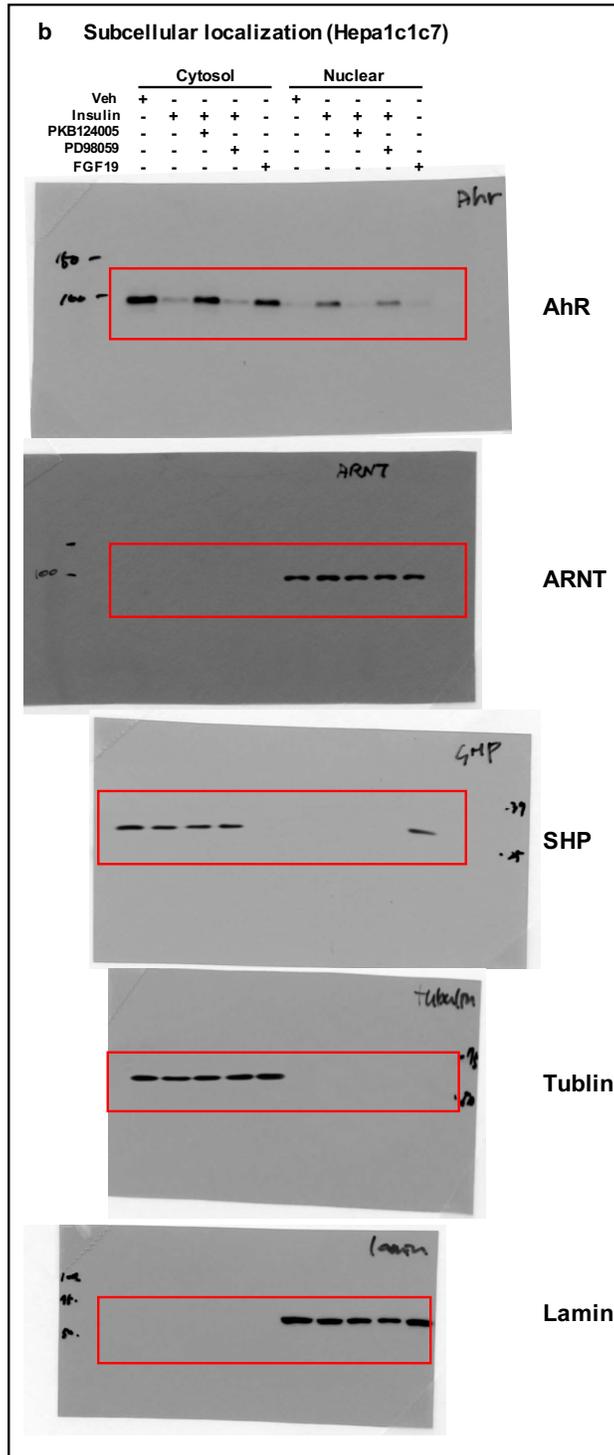
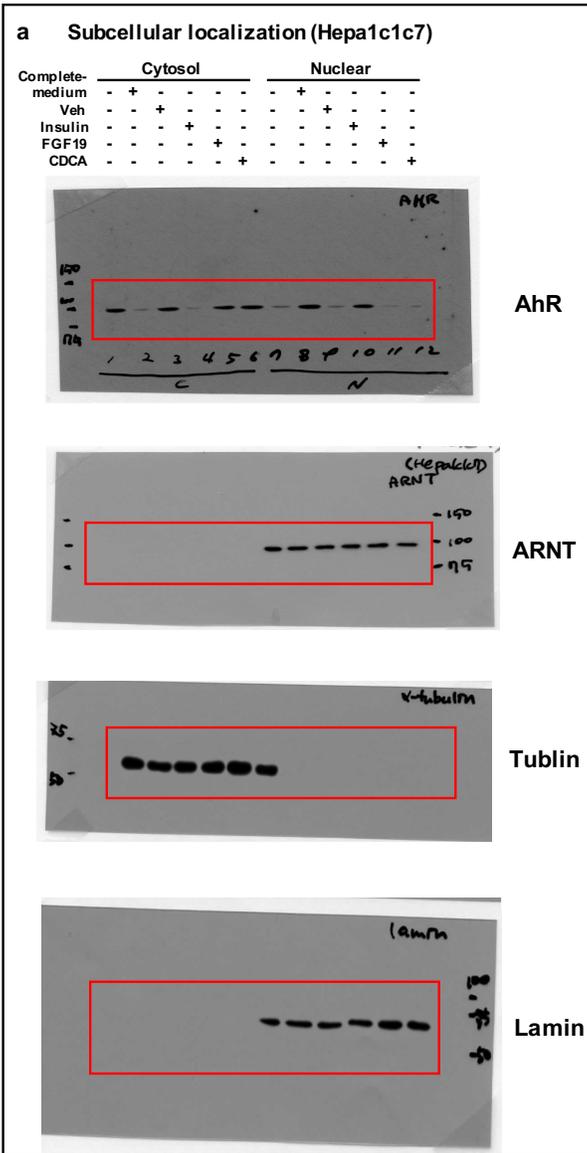
Supplementary Figure 10. Hepa1c1c7 cells were transfected with empty vector or pCMX-CA-AhR expressing human CA-AhR. Human HepG2 cells were also grown in normal media. After 2 days, protein was isolated from the cells as well as from human liver tissue and AhR or actin was detected by immunoblotting. As expected human CA-AhR and mouse WT AhR have similar mobilities. Full size immunoblots are in Supplementary Figure 13b.



Supplementary Figure 11. Levels of individual PC or PE molecules in liver samples of 15 normal, 15 simple steatosis, and 15 severe NASH-fibrosis patients were determined by LC-MS. Means +/- SD are shown (n=15 human).

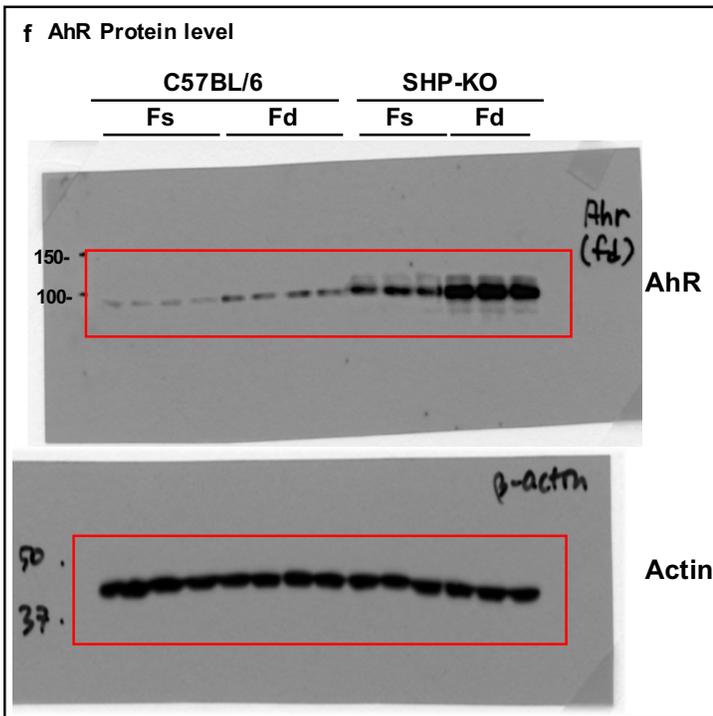
Supplementary Figure 12. Full size immunoblots of cropped blots in the main manuscript figures.

a Full size immunoblots of cropped blots for Fig. 4a and 4b

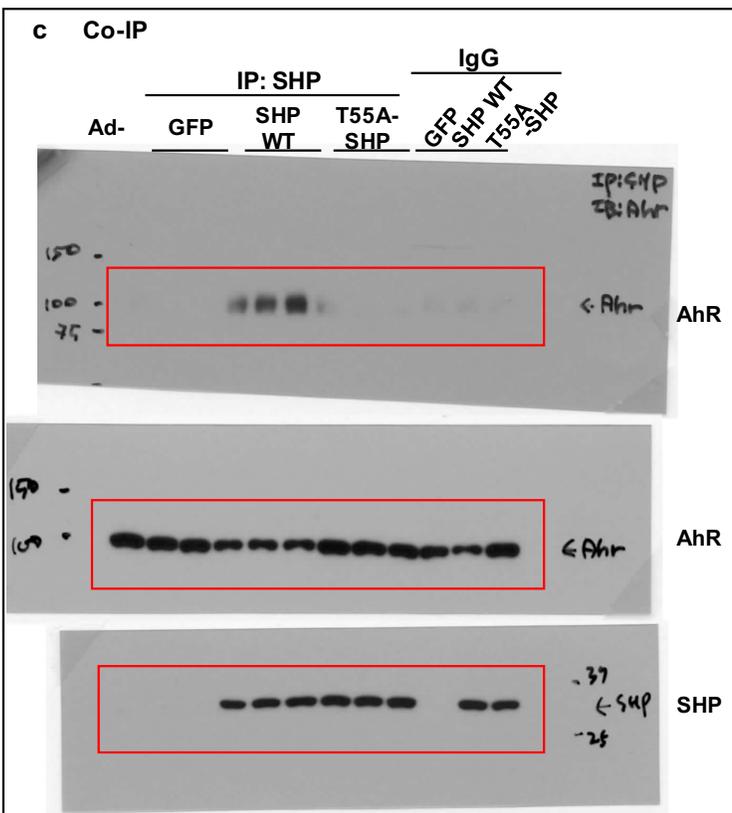


Supplementary Figure 12. Full size immunoblots of cropped blots in the main manuscript figures.

b Full size immunoblots of cropped blots for Fig. 5f

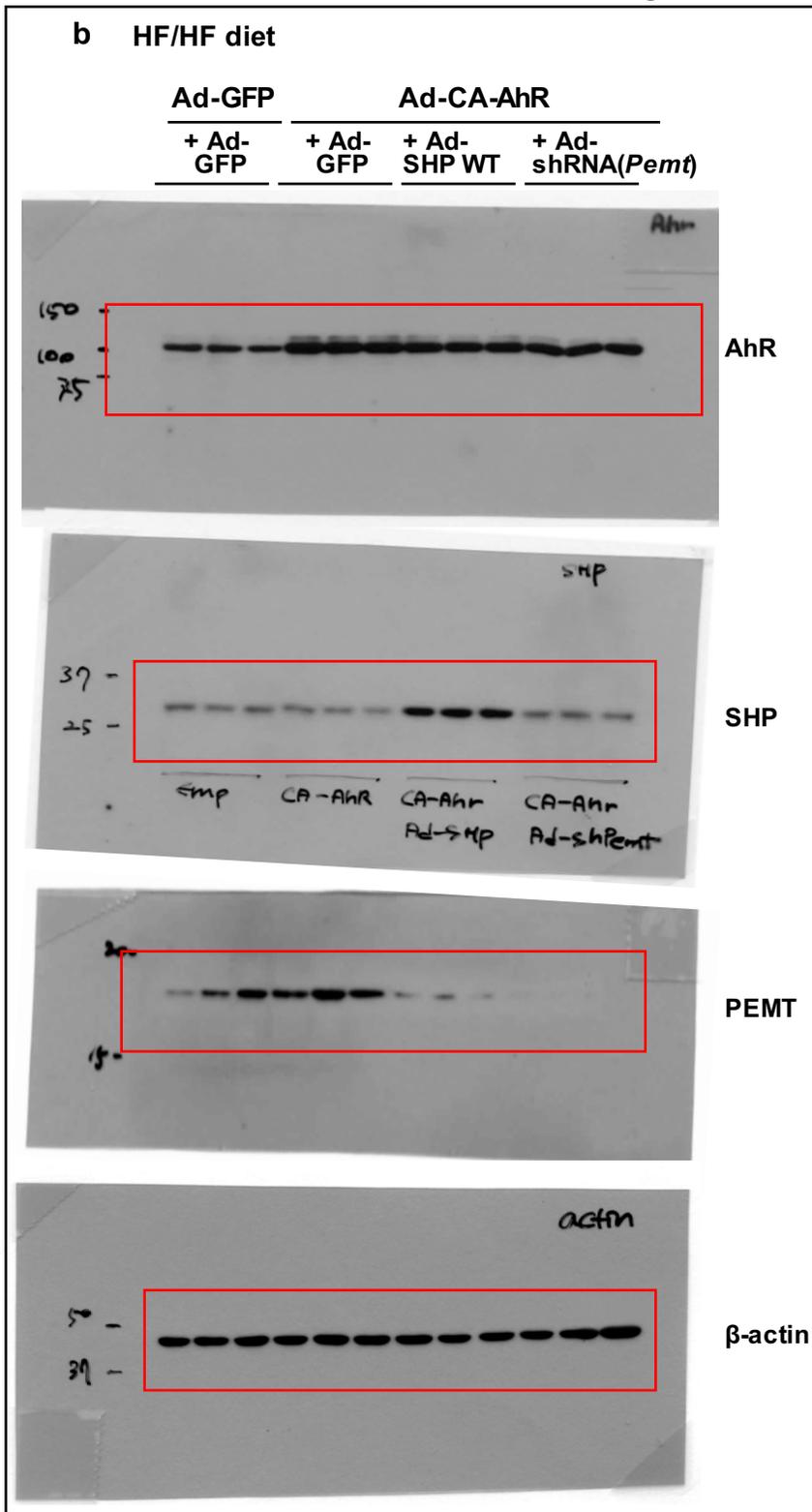


c Full size immunoblots of cropped blots for Fig. 6c



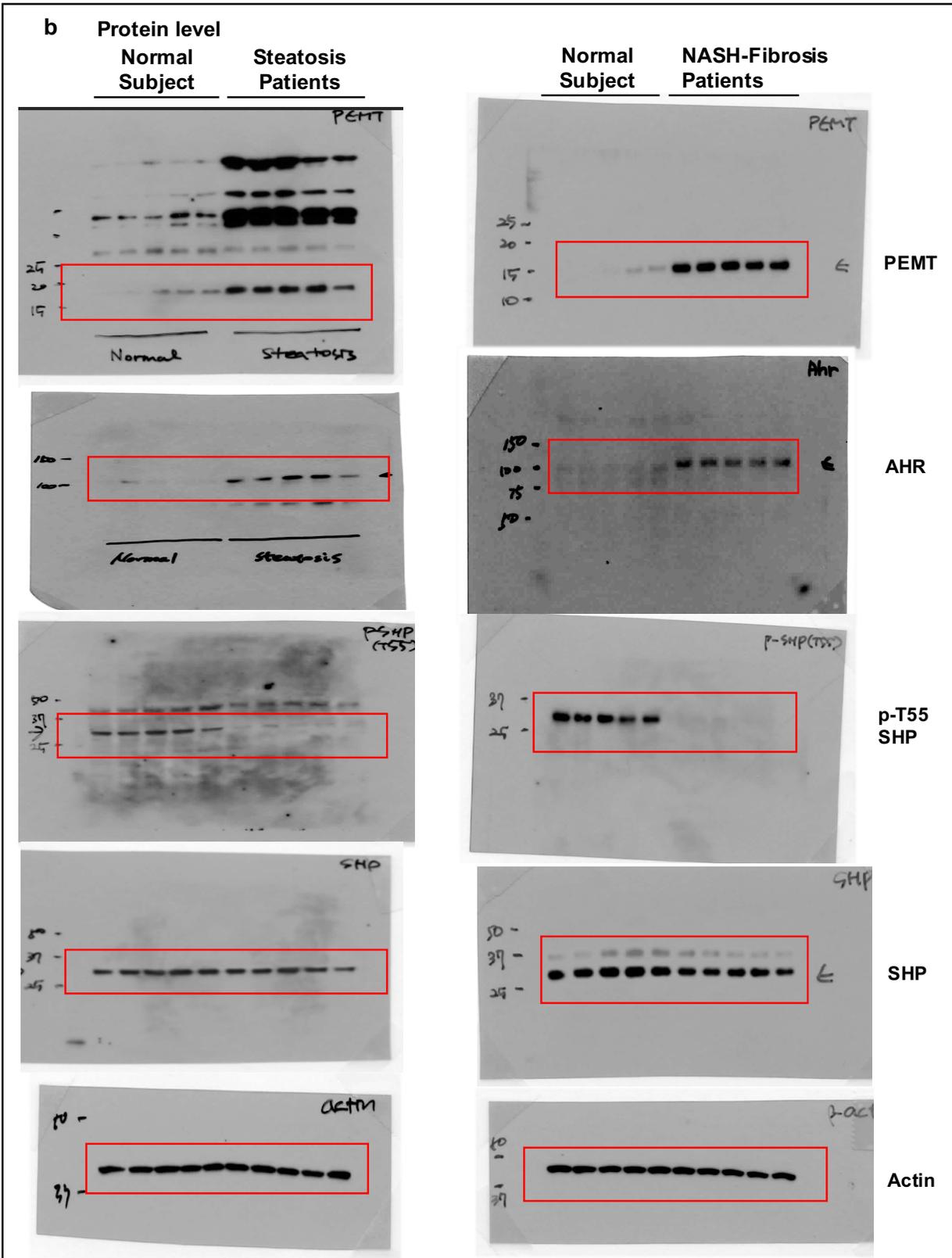
Supplementary Figure 12. Full size immunoblots of cropped blots in the main manuscript figures.

d Full size immunoblots of cropped blots for Fig. 7b



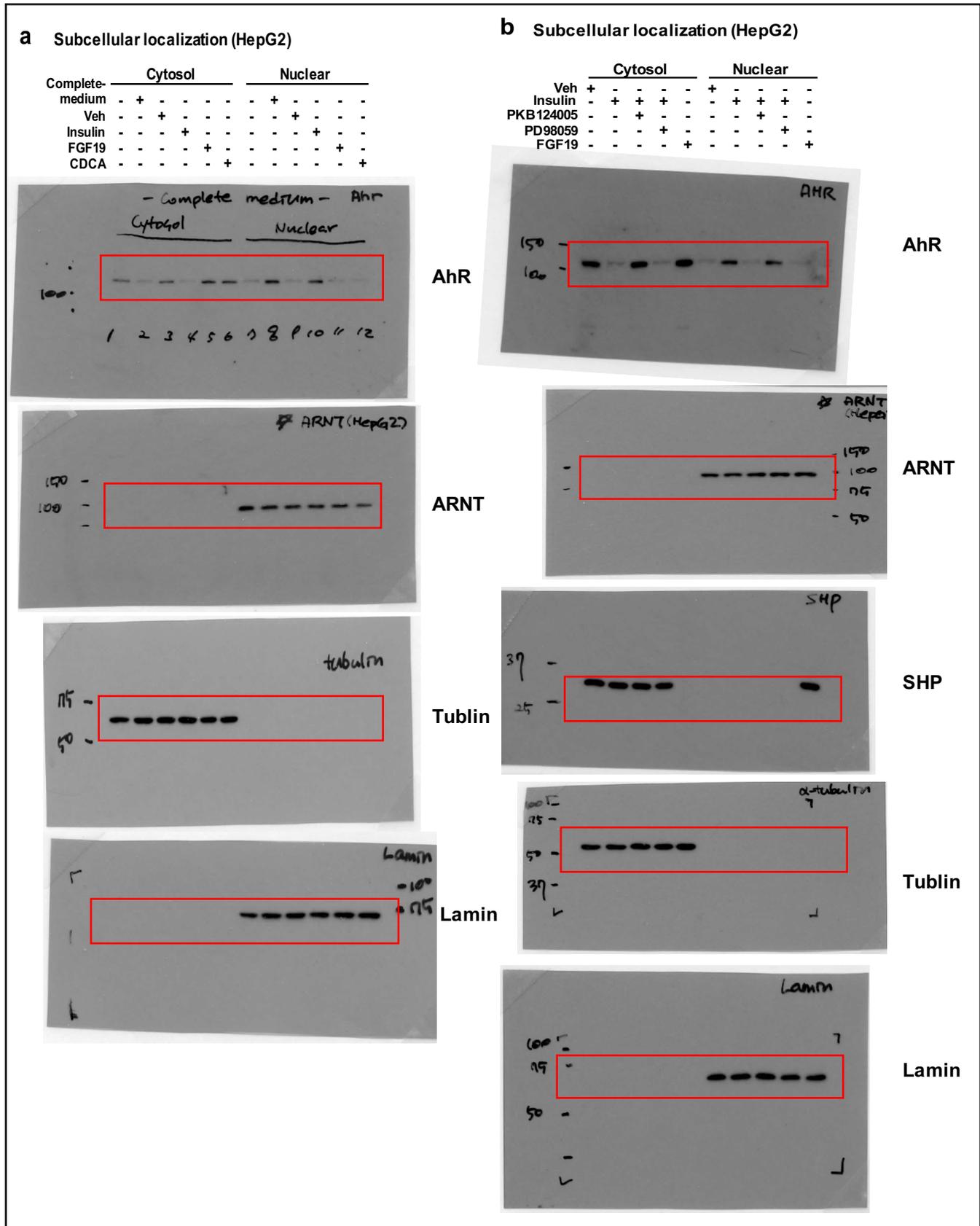
Supplementary Figure 12. Full size immunoblots of cropped blots in the main manuscript figures.

e Full size immunoblots of cropped blots for Fig. 8b



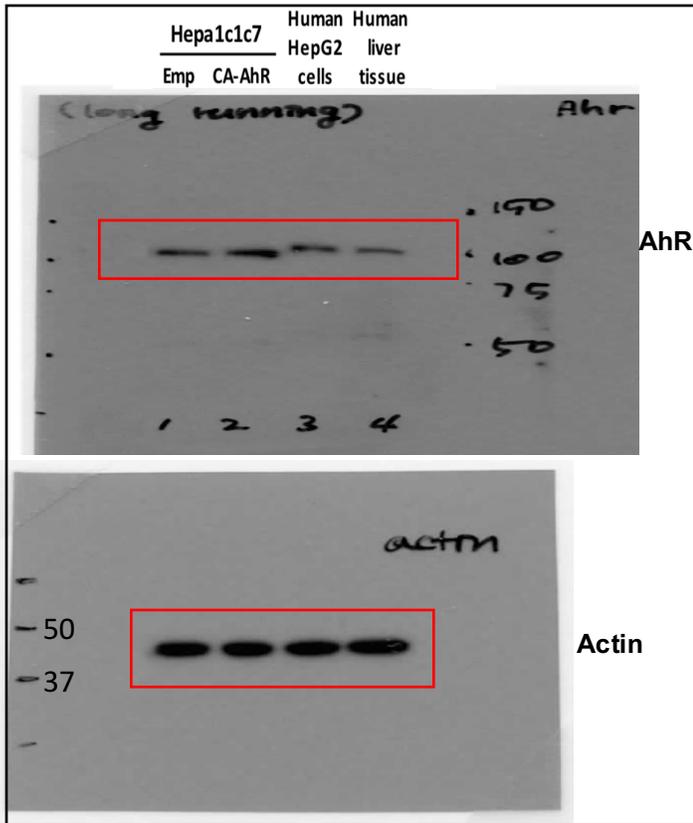
Supplementary Figure 13. Full size immunoblots of cropped blots in the Supplementary figures.

a Full size immunoblots of cropped blots for Supplementary Figure 3a and 3b



Supplementary Figure 13. Full size immunoblots of cropped blots in the Supplementary figures.

b Full size immunoblots of cropped blots for Supplementary Figure 10



Supplementary Tables

Supplementary Table 1. Sequences of the primers used in ChIP assays

Species	Type	Gene	Sequence
mouse	ChIP	AhR	AGTCCGTCCACCAGTTCG
mouse	ChIP	AhR	TCTTGATGTCTGGGTTACAAGG
mouse	ChIP	Ahcyl2	GGAGGAGGGACGAAAGGAC
mouse	ChIP	Ahcyl2	CAGAACCTGTAGTGCGCTTG
mouse	ChIP	Mthfr	CGCCATCTTCCTCCTTTG
mouse	ChIP	Mthfr	CACATCTACGAGACGAGACGAC
mouse	ChIP	Ahcyl2	GGAGGAGGGACGAAAGGAC
mouse	ChIP	Ahcyl2	CAGAACCTGTAGTGCGCTTG
mouse	ChIP	Atic	CTGTCCGTCCCTTGACTCC
mouse	ChIP	Atic	TTCTCATTACTCGCGGCTTC
mouse	ChIP	Mtfmt	GTGGCTGATGGGAAGGAG
mouse	ChIP	Mtfmt	GGAGATGGAGGGTCTGCTG
mouse	ChIP	Cyp1a1	CGGTTGTGAGTTGGGTAGC
mouse	ChIP	Cyp1a1	TAAGCCTGCTCCATCCTCTG
mouse	ChIP	Gnmt	TCTCCCATGCCCATACTACC
mouse	ChIP	Gnmt	CCGTACCGCAGAGTACAAGG
mouse	ChIP	Pemt	GGAGCTGTACCTGCCTGAAG
mouse	ChIP	Pemt	ATGCCCTAGTCCCTCTCTCC
mouse	ChIP	Aldh1a1	TTTCTTCTCCAGTTGATTTCT
mouse	ChIP	Aldh1a1	CGCTTATATCTATCCTTCTATTCT
mouse	ChIP	Dhfr	GCAAGTGGTACACAGCTCAGG
mouse	ChIP	Dhfr	CCAGGGTAGGTCTCCGTTCC

Supplementary Table 2. Sequences of the primers used in q-RTPCR assays

Species	Type	Gene	Sequence
Mouse	mRNA	36B4 (control)	TGCTGAACATGCTCAAC
Mouse	mRNA	36B4 (control)	GTCGAACACCTGCTGGATGAC
Mouse	mRNA	AhR	TCCACAACCTGGCTTTGTTTG
Mouse	mRNA	AhR	CCAGAATAAGCTGCCCTTTG
Mouse	mRNA	Mtfmt	CAGACTCTCAGACTTCCA
Mouse	mRNA	Mtfmt	TGTCATCTTCTTGCTTGTA
Mouse	mRNA	Aldh1a1	TTTCTTCTCCAGTTGATTTCT
Mouse	mRNA	Aldh1a1	CGCTTATATCTATCCTTCTATTCT
Mouse	mRNA	Gnmt	GCTTTCAGGAGATGGCTTTG
Mouse	mRNA	Gnmt	GTGGGCTTTGTTGTTGACTG
Mouse	mRNA	Pemt	AGCAGAGAAGCTCGGAAGCTG
Mouse	mRNA	Pemt	CCAGGAAGTAGGTGGTGTGG
Mouse	mRNA	Ahcyl2	GTCCCACGGTCTTCTAGTCG
Mouse	mRNA	Ahcyl2	CTGACTCTCGCACCAGCTC
Mouse	mRNA	Atic	CTGTCCGTCCCTTGACTCC
Mouse	mRNA	Atic	TTCTCATTACTCGCGGCTTC
Mouse	mRNA	Mthfr	GTGGTCCTCTGTGCCTCTTC
Mouse	mRNA	Mthfr	AGCCAGCCTCTGCTTAGATG
Mouse	mRNA	Cyp1a1	CAGCATCCTCTTGCTACTTGG
Mouse	mRNA	Cyp1a1	TGAGGCTGTCTGTGATGTCC
Mouse	mRNA	Dhfr	GCTGGGTGCAGTCTTAGGAG
Mouse	mRNA	Dhfr	AGGGAGCACTGAAGAAGTGG
Mouse	pre-mRNA	Pemt	AAATACGAGCCCGACAACCTG
Mouse	pre-mRNA	Pemt	ACCACTACCACCACCAATCG
Mouse	pre-mRNA	AhR	TTTCGTCGGTAGAGCAGTCC
Mouse	pre-mRNA	AhR	CTGTGTCGCTTAGAAGGATTTG
Mouse	pre-mRNA	Cyp1a1	TTCTGTCTCCGTTACCTG
Mouse	pre-mRNA	Cyp1a1	CCTAACTGCTTCCCATCACC
Human	mRNA	hPEMT	GCTCTCCAGCTTCTTTGCAC
Human	mRNA	hPEMT	AGGTAGTTGGCTGTGCTTCC
Human	mRNA	hGNMT	AGCCAACTGGATGACTCTGG
Human	mRNA	hGNMT	GTCTGGCAAGTGAGCGAAAC
Human	mRNA	hAHR	ACTCCACTTCAGCCACCATC
Human	mRNA	hAHR	CTTCCTTTGGCATCACAACC
Human	mRNA	hSHP	CAGAGATCAGGTGGGCAGAG
Human	mRNA	hSHP	TGTGGCTGAGTGAAGAGCTG

Supplementary Table 3. Sequences in the indicated genes of binding motifs that were identified by Jaspar and summarized in Fig. 3.

Gene	Motifs	predicted site sequence	Gene	Motifs	predicted site sequence	Gene	Motifs	predicted site sequence	
Ahr	Ahr::Arnt	CGCGTG	Ahr	Mat2a	Ahr::Arnt	CTCGTG	Mthfr	Ahr::Arnt	CGGTGT
Ahr	Ahr::Arnt	CGCGTG	Ahr	Mat2a	Pparg::Rxra	GAAGGGCGGAGGGCA	Mthfr	Ahr::Arnt	TCCGTG
Ahr	Nr1h3::Rxra	TGACGCTGGTGTCCACAG	Ahr	Mat2a	Ahr::Arnt	TGGGTG	Mthfr	YY1	GAAGATGGCGGG
Ahr	Ahr::Arnt	TGTTGT	Ahr	Mat2a	Nr5a2	TAGGGGAAGGTACC	Mthfr	Ahr::Arnt	TGGGTG
Ahr	Ahr::Arnt	TGTTGT	Ahr	Mat2a	Ahr::Arnt	CTCGTG	Mthfr	SREBF1	GTACGTGAG
Ahr	Ahr::Arnt	CGTGTG	Ahr	Mat2a	SREBF1	GTCTCCTCAG	Mthfr	SREBF1	CTCAGGTGAC
Ahr	Ahr::Arnt	AGCGTG	Ahr	Mat2a	SREBF2	CTGAGGAGAC	Mthfr	SREBF2	CTCAGGTGAC
Ahr	Ahr::Arnt	TGCGCG	Ahr	Mat1a	Ahr::Arnt	TGCGTG	Mthfr	CREB1	TCACGTGA
Ahr	Ahr::Arnt	CACGTG	Ahr	Mat1a	YY1	CGAATGGCCGT	Mthfr	CREB1	TCACGTGA
Ahr	Ahr::Arnt	CACGTG	Ahr	Mat1a	Nr1h3::Rxra	TGTCCATACTCACTCTT	Mthfr	Ahr::Arnt	CACGTG
Ahr	CREB1	TGACGCGAG	Ahr	Mat1a	SREBF1	CTCACTCTT	Mthfr	Ahr::Arnt	CACGTG
Ahr	Ahr::Arnt	TGCGTG	Ahr	Mat1a	Nr1h3::Rxra	TCTCCAGAGTGCCCTCT	Mthfr	Ahr::Arnt	CACGTG
Ahr	SREBF1	ACCACCCAC	Ahr	Mat1a	Pparg::Rxra	TGAGGGTGAAGGCA	Mthfr	Ahr::Arnt	CACGTG
Ahr	SREBF2	GTGGGTGGT	Ahr	Mat1a	Nr5a2	CAGGGCAAAGCCAGC	Mthfr	Ahr::Arnt	CGGGTG
Ahr	FOXA1	GTGGTGTGCGCCAG	Ahr	Mat1a	FOXA1	AAGATGTTTGAGAT	Mthfr	SREBF1	CTGCCCCAC
Ahr	Foxo1	ACCTGTTTTCC	Ahr	Mat1a	SREBF1	GTCACTGCAT	Mthfr	SREBF2	GTGGGGCAG
Ahr	SREBF1	CTCACACCCC	Ahr	Mat1a	SREBF2	ATGACATGAC	Mthfr	SREBF1	CTGCGCTCAC
Ahr	CREB1	TGAGGCCA	Ahr	Mat1a	CREB1	TGACATGA	Mthfr	CREB1	TGACGCGA
Ahr	FOXA1	AAGGAATTGCTAG	Ahr	Mat1a	Ahr::Arnt	TGCGTG	Mthfr	SREBF1	GTCACTGAC
Ahr	CREB1	TGATGTCT	Ahr	Mat1a	SREBF1	ACCAGGCCAT	Mthfr	SREBF2	GTCACTGAC
Pemt	Model name	predicted site sequence	Pemt	Mat1a	SREBF2	ATGGCCTGGT	Mthfr	CREB1	TGACCGCA
Pemt	Ahr::Arnt	TGCGTG	Pemt	Mat1a	YY1	TAGAATGGAGGA	Mthfr	Ahr::Arnt	TGCGTG
Pemt	Foxo1	TCGTATTTCT	Pemt	Mat1a	FOXA1	TAGATATGACCCAG	Mthfr	YY1	CAACATGGCCCG
Pemt	SREBF1	ATCACCGCGAG	Pemt	Mat1a	FOXA1	CATCTGGGTACATAT	Mthfr	Ahr::Arnt	CGCGTG
Pemt	SREBF2	CTGCGTGTAT	Pemt	Mat1a	Pparg::Rxra	GAAGCCAGAGGTCT	Mthfr	FOXA1	GTCTGTTCCCTTA
Pemt	Ahr::Arnt	CGCGTG	Pemt	Mat1a	YY1	AAATATGGTCAA	Mthfr	Foxo1	TCCTGTTTCCC
Pemt	Ahr::Arnt	CACGTG	Pemt	Mat1a	SREBF1	CTCACACGAT	Mthfr	CREB1	TGACGCAA
Pemt	Ahr::Arnt	CACGTG	Pemt	Mat1a	SREBF2	ATCGTGTGAG	Mthfr	Ahr::Arnt	TGCGTG
Pemt	Ahr::Arnt	CGCATG	Pemt	Mat1a	Ahr::Arnt	CGTGTG	Mthfr	Ahr::Arnt	TGCGTG
Pemt	FOXA1	GGCCTCTTGCCATT	Pemt	Mat1a	FOXA1	GAGCTGTGTCTCT	Mthfr	SREBF1	AACACCCAC
Pemt	Ahr::Arnt	CTCGTG	Pemt	Mat1a	Ahr::Arnt	TGTTGTG	Mthfr	SREBF2	GTGGTGTGT
Dnmt3a	Model name	predicted site sequence	Dnmt3a	Mat1a	FOXA1	AAGGTGTTGTCTTA	Mthfr	Ahr::Arnt	CGCGTG
Dnmt3a	SREBF1	ACCACCCGAG	Dnmt3a	Mat1a	Foxo1	AGGTGTTGCT	Mthfr	Ahr::Arnt	CACGTG
Dnmt3a	Ahr::Arnt	CGGCTG	Dnmt3a	Mat1a	FOXA1	TTACTGTGGATAATA	Mthfr	Ahr::Arnt	CACGTG
Dnmt3a	Pparg::Rxra	GAGGGGCACAGGGCG	Dnmt3a	Mat1a	FOXA1	CATTCTTGCTCTG	Mthfr	SREBF1	ATCACCTCGG
Dnmt3a	Ahr::Arnt	CCCGTG	Dnmt3a	Mat1a	YY1	CAAGATGTTGAC	Mthfr	SREBF2	CCGAGGTGAT
Dnmt3a	Ahr::Arnt	TGCGTG	Dnmt3a	Mat1a	Foxo1	AGATGTTGACC	Mthfr	CREB1	GGAGGCCA
Ahcy12	Model name	predicted site sequence	Ahcy12	Mat1a	CREB1	TGAGGCTA	Mthfr	Ahr::Arnt	AGCGTG
Ahcy12	SREBF1	ATGACGCGAC	Ahcy12	Mat1a	FOXA1	TGGCTACTATTTAA	Mthfr	Ahr::Arnt	TGCGTG
Ahcy12	SREBF1	GTGCGTGCAT	Ahcy12	Mat1a	Nr1h3::Rxra	TGGCTCTTGTGAGCCCTG	Mthfr	Ahr::Arnt	CGGGTG
Ahcy12	SREBF2	ATGACGCGAC	Ahcy12	Mat1a	FOXA1	TCATTTTGATTTTG	Mthfr	Ahr::Arnt	TGCGTG
Ahcy12	CREB1	TGACGCGA	Ahcy12	Mat1a	YY1	CAAAATGGAGAC	Mthfr	Ahr::Arnt	GGCGTG
Ahcy12	FOXA1	TCCGTTTTTATACTT	Ahcy12	Mat1a	Ahr::Arnt	TGTTGTG	Mthfr	Ahr::Arnt	GGCGTG
Ahcy12	Nr5a2	AACTCCAGGACAGC	Ahcy12	Mat1a	Ahr::Arnt	TGCTTG	Mthfr	Nr1h3::Rxra	TGCCCTGGGTGCCACCCG
Ahcy12	Pparg::Rxra	GTGGGGATAGGCCG	Ahcy12	Mat1a	Foxo1	ACATGTTTCTA	Mthfr	YY1	CAACAGGGCCCG
Ahcy12	Ahr::Arnt	TGGGTG	Ahcy12	Mat1a	SREBF1	CTCACAGCAT	Atic	Ahr::Arnt	GGCGTG
Ahcy12	Nr1h3::Rxra	TGCACTGCCTGCCTGCGC	Ahcy12	Mat1a	FOXA1	TGCATCTGCTTGG	Atic	Nr1h3::Rxra	CGACCCAGGTGACCCCGA
Ahcy12	YY1	CAAGTGGTTG	Ahcy12	Mat1a	Pparg::Rxra	CTGGGGGAAAGGGGA	Atic	Ahr::Arnt	CACGTG
Ahcy12	FOXA1	AAGTGTGTTGCTGAG	Ahcy12	Mat1a	Ahr::Arnt	AGCGTG	Atic	Ahr::Arnt	CACGTG
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Ahcy12	YY1	TACATGGCGCC	Ahcy12	Dhfr	Ahr::Arnt	TGCGGG	Aldh11l	YY1	CAAGATAGCACC
Ahcy12	Ahr::Arnt	CGGGTG	Ahcy12	Dhfr	Nr5a2	GCCCTCAAGGCCGGT	Aldh11l	CREB1	TGAAGCCA
Gnmt	Ahr::Arnt	TGGGTG	Gnmt	Dhfr	FOXA1	TATTGTGTAGCTAA	Aldh11l	Nr1h3::Rxra	TGTACCCTGTTGACCTCAG
Gnmt	FOXA1	CGAATATCTGCATTA	Gnmt	Dhfr	Ahr::Arnt	TGCGCG	Aldh11l	FOXA1	ACCCTGTTGACCTCA
Gnmt	Pparg::Rxra	TTAGGGTAGGGCCCA	Gnmt	Dhfr	Ahr::Arnt	TGCGCG	Aldh11l	Foxo1	CCCTGTTGACC
Gnmt	SREBF1	CTCAGGCAAT	Gnmt	Dhfr	Foxo1	AGCTGTGTACC	Aldh11l	CREB1	TGAGGTCA
Gnmt	Ahr::Arnt	TGCGTG	Gnmt	Dhfr	CREB1	TGCGTCA	Aldh11l	CREB1	TGACCTCA
Gnmt	Nr1h3::Rxra	GGGCTTGAAGTCAACCAGG	Gnmt	Dhfr	CREB1	TGACGGCA	Aldh11l	FOXA1	TGTCTGGTACTTAG
Gnmt	CREB1	TGACTTCA	Gnmt	Dhfr	Ahr::Arnt	AGCGTG	Aldh11l	SREBF1	GTCCAGCAGC
Gnmt	CREB1	TGAAGTCA	Gnmt	Dhfr	YY1	CATGATGGCAGC	Aldh11l	Nr5a2	GGGGTCCAGGCCAAG
Gnmt	Ahr::Arnt	TGGGTG	Gnmt				Aldh11l	Foxo1	TGCTGGTGACA
Gnmt	Ahr::Arnt	TGCGAG	Gnmt						
Gnmt	Ahr::Arnt	TCCGTG	Gnmt						
Gnmt	CREB1	AGACGCCA	Gnmt						
Gnmt	YY1	CAACAGGGCCCG	Gnmt						
Gnmt	CREB1	TGAGGCCA	Gnmt						
Gnmt	Nr1h3::Rxra	TGGCTCAGGTCTCCAC	Gnmt						
Gnmt	SREBF1	GTCTCCAC	Gnmt						
Gnmt	SREBF2	GTGGGGAGAC	Gnmt						
Gnmt	Pparg::Rxra	GCAGGAGAGAGTGG	Gnmt						
Gnmt	SREBF1	ACCACGTCT	Gnmt						
Gnmt	SREBF2	ATGACGTGGT	Gnmt						
Gnmt	CREB1	TGACGTGG	Gnmt						
Gnmt	CREB1	CCACGTCA	Gnmt						
Gnmt	CREB1	TGAAGCCA	Gnmt						