Gene Symbol	Gene Title	Entrez Gene	Leydig 3 week log2(KO / WT)	Leydig adult log2(KO / WT)
0610007P14Rik	RIKEN cDNA 0610007P14 gene	58520	-0.266	0.367
Abcb1a	ATP-binding cassette, sub-family B (MI	18671	-0.506	-0.399
Acbd3	acyl-Coenzyme A binding domain cont	170760	0.120	0.246
Adh1	alcohol dehydrogenase 1 (class I)	11522	-0.428	-0.831
Calcoco1	calcium binding and coiled coil domain	67488	-0.675	-0.296
Carm1	coactivator-associated arginine methyl	59035	-0.161	0.156
Ccdc80	coiled-coil domain containing 80	67896	0.899	0.446
Cebpb	CCAAT/enhancer binding protein (C/EI	12608	0.470	1.349
Cited1	Cbp/p300-interacting transactivator w	12705	-0.314	-0.513
Cubn	cubilin (intrinsic factor-cobalamin rece	65969	0.023	0.520
Cyb5	cytochrome b-5	109672	-0.663	-0.413
Cyb5b	cytochrome b5 type B	66427	-0.291	-0.196
Cyb5d2	cytochrome b5 domain containing 2	192986	-0.703	-0.816
Cyb5r1	cytochrome b5 reductase 1	72017	-0.310	-0.377
Cyb5r2	cytochrome b5 reductase 2	320635	0.452	-0.036
Cyb5r3	cytochrome b5 reductase 3	109754	0.143	0.073
Cyb5r4	cytochrome b5 reductase 4	266690	0.313	0.064
Cyp11a1	cytochrome P450, family 11, subfamily	13070	0.023	-0.031
Cyp17a1	cytochrome P450, family 17, subfamily	13074	0.012	-0.241
Cyp24a1	cytochrome P450, family 24, subfamily	13081	0.277	-0.594
Cyp39a1	cytochrome P450, family 39, subfamily	56050	0.053	3.064
Cyp3a13	cytochrome P450, family 3, subfamily a	13113	0.905	0.804
Cyp46a1	cytochrome P450, family 46, subfamily	13116	-0.548	0.029
Cyp51	cytochrome P450, family 51	13121	0.416	0.112
Dhcr24	24-dehydrocholesterol reductase	74754	0.697	0.132
Dhcr7	7-dehydrocholesterol reductase	13360	-0.331	-0.955
Dyrk1a	dual-specificity tyrosine-(Y)-phosphory	13548	-1.126	-0.736
Ebp	phenylalkylamine Ca2+ antagonist (em	13595	-0.151	-0.209
Emp2	epithelial membrane protein 2	13731	0.478	0.399
Esrra	estrogen related receptor, alpha	26379	-0.114	-0.221
Esrrb	estrogen related receptor, beta	26380	-1.118	0.610
Fa2h	fatty acid 2-hydroxylase	338521	0.239	0.223
Fads1	fatty acid desaturase 1	76267	-0.036	-0.602
Fads2	fatty acid desaturase 2	56473	-0.094	-0.468
Fdft1	farnesyl diphosphate farnesyl transfera	14137	0.243	0.007
Fdps	farnesyl diphosphate synthetase	110196	0.498	-0.042
Fdxr	ferredoxin reductase	14149	0.180	-0.363
Fkbp4	FK506 binding protein 4	14228	0.001	0.177
Gsk3b	glycogen synthase kinase 3 beta	56637	1.195	0.798
H2-Ke6	H2-K region expressed gene 6	14979	0.255	-0.162
Hdlbp	high density lipoprotein (HDL) binding	110611	-0.383	-0.257
Hmgcr	3-hydroxy-3-methylglutaryl-Coenzyme	15357	0.223	-0.278
Hmgcs2	3-hydroxy-3-methylglutaryl-Coenzyme	15360	0.208	-0.409
Hsd17b11	hydroxysteroid (17-beta) dehydrogena	114664	-0.348	-0.300
Hsd17b12	hydroxysteroid (17-beta) dehydrogena	56348	-0.177	-0.519
Hsd17b2	hydroxysteroid (17-beta) dehydrogena	15486	0.373	-0.171
Hsd17b3	hydroxysteroid (17-beta) dehydrogena	15487	-0.052	-0.554
Hsd17b7	hydroxysteroid (17-beta) dehydrogena	15490	0.337	-0.655
Hsd3b1	hydroxy-delta-5-steroid dehydrogenas	15492	-0.493	-0.914
Hsd3b7	hydroxy-delta-5-steroid dehydrogenas	101502	0.028	-0.083
Idi1	isopentenyl-diphosphate delta isomera	319554	-0.594	-0.463
Igf1	insulin-like growth factor 1	16000	-0.082	-0.412
Insig1	insulin induced gene 1	231070	-0.493	-0.480
Insig2	insulin induced gene 2	72999	-0.258	-0.365
Kl	klotho	16591	-0.693	0.898
Ldlr	low density lipoprotein receptor	16835	-0.262	-0.496
Lhb	luteinizing hormone beta	16866	-0.025	0.337
Lhcgr	luteinizing hormone/choriogonadotrop	16867	-0.915	-1.107
Lipa	lysosomal acid lipase A	16889	0.782	-0.654
Lipe	lipase, hormone sensitive	16890	0.672	0.453
Lss	lanosterol synthase	16987	-0.315	0.074
Mbtps1	membrane-bound transcription factor	56453	0.025	-0.253
Mbtps2	membrane-bound transcription factor	270669	-0.304	-0.128
Mvd	mevalonate (diphospho) decarboxylase	192156	0.320	0.373
Mvk	mevalonate kinase	17855	0.097	0.159
Myd88	myeloid differentiation primary respor	17874	-0.473	-0.414
Myoc	myocilin	17926	-0.562	0.105
Ncoa1	nuclear receptor coactivator 1	17977	-0.283	-0.496
Ncoa2	nuclear receptor coactivator 2	17978	-0.715	-0.649
Ncoa3	nuclear receptor coactivator 3	17979	-0.346	0.038
Nenf	neuron derived neurotrophic factor	66208	-0.279	0.666
Npc1l1	NPC1-like 1	237636	0.475	0.858
Nphs2	nephrosis 2 homolog, podocin (human	170484	-0.072	-0.570
Nr1d2	nuclear receptor subfamily 1, group D,	353187	-1.097	-0.937
Nr1h2	nuclear receptor subfamily 1, group H,	22260	-0.149	0.397
Nr1h3	nuclear receptor subfamily 1, group H,	22259	-0.022	0.392
Nr2f2	nuclear receptor subfamily 2, group F,	11819	-0.538	0.513
Nr3c1	nuclear receptor subfamily 3, group C,	14815	-0.109	-0.376
Nr4a1	nuclear receptor subfamily 4, group A,	15370	0.435	0.224
Nr4a2	Nuclear receptor subfamily 4, group A,	18227	0.877	-0.654
Nsdhl	NAD(P) dependent steroid dehydroger	18194	-0.259	-0.294
Osbp	oxysterol binding protein	76303	-0.660	-0.013
Osbp2	oxysterol binding protein 2	74309	0.744	0.562
Osbpl11	oxysterol binding protein-like 11	106326	-0.523	-0.539
Osbpl1a	oxysterol binding protein-like 1A	64291	-0.065	0.020
Osbpl2	oxysterol binding protein-like 2	228983	0.388	-0.127
Paqr5	progestin and adipoQ receptor family	74090	0.868	0.682
Paqr7	Progestin and adipoQ receptor family	71904	0.522	1.041
Paqr8	progestin and adipoQ receptor family	74229	0.051	-0.215
Pgrmc1	progesterone receptor membrane com	53328	0.022	-0.261
Pgrmc2	progesterone receptor membrane com	70804	-0.397	-0.049
Pmvk	phosphomevalonate kinase	68603	0.894	0.224
Prkar1a	protein kinase, cAMP dependent regul	19084	0.247	-0.009
Rhoa	ras homolog gene family, member A	11848	-0.083	0.276
Rora	RAR-related orphan receptor alpha	19883	1.176	0.880
Runx2	runt related transcription factor 2	12393	0.693	0.456
Rxra	retinoid X receptor alpha	20181	0.578	0.509
Rxrb	retinoid X receptor beta	20182	-0.876	0.420
Sc4mol	sterol-C4-methyl oxidase-like	66234	-0.607	-0.961
Sc5d	sterol-C5-desaturase (fungal ERG3, del	235293	-0.434	-0.599
Scap	SREBF chaperone	235623	-0.686	-0.435
Scarb1	scavenger receptor class B, member 1	20778	0.261	0.147
Sf1	splicing factor 1	22668	-0.132	-0.233
Slc37a4	solute carrier family 37 (glucose-6-pho	14385	0.867	0.388
Smad2	MAD homolog 2 (Drosophila)	17126	-0.332	-0.053
Smad3	MAD homolog 3 (Drosophila)	17127	-0.361	-1.054
Smarca2	SWI/SNF related, matrix associated, ac	67155	-0.462	-0.010
Smarca4	SWI/SNF related, matrix associated, ac	20586	-0.675	-0.190
Snai1	snail homolog 1 (Drosophila)	20613	-0.040	-0.182
Soat1	sterol O-acyltransferase 1	20652	-0.199	-0.724
Sorl1	sortilin-related receptor, LDLR class A r	20660	-0.067	-0.284
Sqle	squalene epoxidase	20775	0.071	0.014
Sra1	steroid receptor RNA activator 1	24068	-0.053	-0.123
Srd5a1	steroid 5 alpha-reductase 1	78925	-0.476	0.384
Srebf1	sterol regulatory element binding tran	20787	-0.724	-0.443
Srebf2	sterol regulatory element binding facto	20788	0.273	0.177
Star	steroidogenic acute regulatory protein	20845	-0.308	-0.745
Stard5	StAR-related lipid transfer (START) don	170460	0.754	-0.601
Stard6	StAR-related lipid transfer (START) don	170461	0.330	0.246
Stat5a	signal transducer and activator of tran	20850	-0.397	-0.730
Sult1a1	sulfotransferase family 1A, phenol-pre	20887	-0.701	1.075
Sult1e1	sulfotransferase family 1E, member 1	20860	-0.645	-1.397
Sult4a1	sulfotransferase family 4A, member 1	29859	0.940	0.955
Suox	sulfite oxidase	211389	-0.303	0.160
Tbl1x	transducin (beta)-like 1 X-linked	21372	0.802	1.617
Thrb	thyroid hormone receptor beta	21834	-1.733	0.787
Tm7sf2	transmembrane 7 superfamily membe	73166	-0.004	-0.141
Wwox	WW domain-containing oxidoreductas	80707	-0.499	-0.529

Supplemental Table 1 - Steroid and cholesterol biosynthesis genes represented in Figure 3B.

Gene Symbol	Gene Title	3 wk WT	adult WT	3 wk KO	adult KO
GLG1	golgi apparatus protein 1	0.114008	1.30649	-1.078474	-0.342023
BMP6	bone morphogenetic protein 6	-1.046307	1.329982	-0.361103	0.077428
CLCN3	chloride channel 3	-0.442321	1.265443	-1.068919	0.245797
NRP1	neuropilin 1	-0.654155	1.342431	-0.860422	0.172146
PPP3CB	protein phosphatase 3, catalytic subunit, beta isoform	-0.595563	1.33366	-0.914146	0.176049
CTNNB1	catenin (cadherin associated protein), beta 1	-0.752331	1.253985	-0.85733	0.355676
YWHAB	tyrosine 3-monooxygenase/tryptophan 5-monooxygenase activation protein, beta polypeptide	-0.775892	1.166821	-0.888324	0.497395
GNA13	guanine nucleotide binding protein, alpha 13	1.075171	0.460277	-0.291619	-1.243829
HDGF	Hepatoma-derived growth factor	0.978877	0.614725	-0.352881	-1.240721
ADCY9	adenylate cyclase 9	0.820709	0.815178	-0.41554	-1.220347
MYLK	myosin, light polypeptide kinase	0.675094	0.967448	-0.461188	-1.181354
PPP1R8	protein phosphatase 1, regulatory (inhibitor) subunit 8	0.74519	0.905854	-0.464174	-1.186871
KCTD12	potassium channel tetramerisation domain containing 12	1.000527	0.684571	-0.607463	-1.077635
MAP2K5		0.872807	0.833638	-0.644323	-1.062122
AKAP11		0.331405	1.268488	-0.825267	-0.774625
AKAP9	A kinase (PRKA) anchor protein (yotiao) 9	0.405346	1.226483	-0.815262	-0.816567
CREBBP		0.592881	1.078594	-1.045752	-0.625723
YWHAZ	tyrosine 3-monooxygenase/tryptophan 5-monooxygenase activation protein, zeta polypeptide	0.537288	1.130454	-0.980013	-0.687728
CLCN6		0.672539	1.037928	-0.793804	-0.916664
ITPR1	inositol 1,4,5-triphosphate receptor 1	0.762897	0.963002	-0.837937	-0.887963
PYGB	brain glycogen phosphorylase	0.93245	0.79561	-0.911184	-0.816876
SMAD4	MAD homolog 4 (Drosophila)	0.886398	0.840993	-0.950558	-0.776832
CHUK	conserved helix-loop-helix ubiquitous kinase	1.18771	0.466799	-0.864296	-0.790213
YWHAG	tyrosine 3-monooxygenase/tryptophan 5-monooxygenase activation protein, gamma polypeptide	1.079405	0.592444	-1.043716	-0.628133
H1F0	H1 histone family, member 0	1.12136	0.194218	-0.009924	-1.305654
CLCN2	chloride channel 2	1.22239	0.381336	-0.609018	-0.994708
CREB1		1.199677	0.415056	-0.601428	-1.013305
KCTD3		1.230501	0.339904	-0.523242	-1.047163
PIK3R4	phosphatidylinositol 3 kinase, regulatory subunit, polypeptide 4, p150	1.14204	0.528808	-0.73482	-0.936027
PPP1R12A		1.144663	0.512395	-0.663789	-0.993268
GRB2	growth factor receptor bound protein 2	1.31958	0.050069	-0.28593	-1.083719
ATF1	activating transcription factor 1	1.262101	0.189935	-0.328008	-1.124027
PRKAR1A	protein kinase, cAMP dependent regulatory, type I, alpha	1.288619	0.122023	-0.299355	-1.111287
PLCG1		1.322969	0.10884	-0.389663	-1.042146
PRKD3	protein kinase D3	1.355961	0.029377	-0.375711	-1.009627
ADD3	adducin 3 (gamma)	1.319746	0.156408	-0.469477	-1.006677
POLR2B	polymerase (RNA) II (DNA directed) polypeptide B	1.343698	0.125439	-0.511455	-0.957682
PDE3B		1.306648	0.222507	-0.572221	-0.956934

Supplemental Table 2 – cAMP-, PKA-, and CREB-regulated genes in Leydig cells represented in Figure 3H.

	3wk WT vs KO	adult WT vs KO
Nr5a1	-1.41	1
Gata4	-1.15	1.15
Gata6	-1.15	-1.11
Crem	-1.11	1.07
Yy1	1.15	1.07
Creb1	1	1.07
Creb3	1	-1.07
Ap1s1	1.07	1.07
Ap1b1	1.07	-1.15

testes

	3wk WT vs KO	adult WT vs KO
Nr5a1	-1.09	1.14
Gata4	1.19	1.29
Gata6	1	-1.37
Crem	-1.17	-1.19
Yy1	1.66	1.49
Creb1	-1.03	1
Creb3	1	1.16
Ap1s1	1.16	1.05
Ap1b1	1.24	1.13
Ap1g1	-1.33	-1.01

Leydig cells

Supplemental Table 3 – Transcription factors targeting meiotic process genes are mostly unchanged in testes and Leydig cells of *Mrp4* KO mice. Selected transcription factors that target various meiotic processes have similar expression patterns in both testes and Leydig cells. Data are expressed as fold difference in $Mrp4^{+/+}$ vs. $Mrp4^{-/-}$ mice, calculated as the $\log_2$ difference in the geometric mean of the signals. Positive values were raised to the power 2. If the log difference was negative, values were the negative reciprocal of the exponential value.

	Forward Primer	Reverse Primer
Lhr	GCGCGCCGGATGGT	AAAGCTTGTGATGGGATTACTTTGA
Star	CGGGTGGATGGGTCAAGTT	GGACAGCTCCTGGTCACTATAGAGT
Pbr	CTGGACACTGGCTCCCATCT	CCAGCTCTTTCCAGACTATGTAGGA
Cyp11a1	GGCCGGCGGATTGC	CATCACGGAGATTTTGAACTTCAA
Hsd3b1	CCCAGGCAGACCATCCTAGA	GAACACAGGCCTCCAATAGGTT
Cyp17a1	CCAGAGAAGTGCTCGTGAAGAA	CCTTTTCCTTGGTCCGACAA
Cyp2b9	TGCTCAAGTACCCCCATGTCA	AGAGAAAGTCCAAAAGGAGA
Cyp2b10	TCTTCCAACGTTCCCCATTG	TCTTCCAACGTTCCCCATTG
Por	TCTTCCAACGTTCCCCATTG	TGCTCCCTCCATGTGATGAA
Cyp7a1	AATGCACTTGGATCCTGAAATCTAC	TTCATCAAGGTACCGGTCGTATT
Cyp7b1	CGGCCCTGTTCCTCCTTAC	GATAAGGAAGCCAACCTTTTATCAAG
Cyp3a11	CCAAACCTCTGCCATTTTTAGG	GCACTCCATGTCGAATTTCCA
Cyp3a13	GCTGATGATAAACTCCCAGAATTACAA	CCAAAGAATCTCATAAAGC
Cyp1a2	ATCCTTTGTCCCCTTCACCAT	GGGAATGTGGAAGCCATTCA
Gapdh	GTCCCGTAGACAAAATGGTGAAG	TCGGTGTGAACGGATT
AR	TGTCGTCTCCGGAAATGTTATG	GTTTTAGATTTCCAAGTTTCTTCAGCTT
Actin	AGCCATGTACGTAGCCATCC	CTCTCAGCTGTGGTGGTGAA
Slco6b1	TCGGAGGAAGAGGTAAATGAC	TGTAAAAGGCAAGAGGTTCC
Slco6c1	AGTTCATGCGGCTTCTATTTA	GTTTTCCACCACCCACTCTGC
Rsp16	TCGGACGCAAGAAAACAGC	GACCCGAATATCCACACCAG

Supplemental Table 4 – Real-time PCR primer list.