*Supplementary File 1a*

|  |  |  |  |
| --- | --- | --- | --- |
| Cluster | Gene | Log2(Fold-Change) | Adjusted p-value |
| 0 | *HOXA7* | 1.9496338890655 | 0 |
| 0 | *eGFP* | 1.79926919223305 | 0 |
| 0 | *HOXB8* | 1.70319522234973 | 0 |
| 0 | *CDX4* | 1.59300323388873 | 0 |
| 0 | *MSX1* | 1.36679666722387 | 2.46628686800213E-295 |
| 0 | *ATP2B1* | 0.9505805990838 | 1.42802105117689E-257 |
| 0 | *WNT5A* | 1.05362309733373 | 1.04864804124596E-243 |
| 0 | *FGF19* | 1.23946510195106 | 1.37033716161311E-237 |
| 0 | *ID1* | 1.12987314753611 | 5.25102458527783E-226 |
| 0 | *Pou5f3* | -1.38972912656039 | 2.36221422404344E-218 |
| 1 | *MIXL1* | 3.58795746206821 | 0 |
| 1 | *CER1* | 2.87849110404204 | 0 |
| 1 | *GSC* | 2.51944790052532 | 0 |
| 1 | *CHRD* | 2.20958320983799 | 0 |
| 1 | *LDHA* | 2.13917827613479 | 0 |
| 1 | *EOMES* | 2.11133471305459 | 0 |
| 1 | *HHEX* | 1.70798541915079 | 0 |
| 1 | *CFC1* | 1.6906566684956 | 0 |
| 1 | *STK26* | 1.65314571843814 | 0 |
| 1 | *GATA6* | 1.57995715798053 | 0 |
| 2 | *AGRP* | 2.05116123467884 | 0 |
| 2 | *MSGN1* | 2.01742248398195 | 0 |
| 2 | *CXCL14* | 1.50158277610382 | 1.32053929591911E-276 |
| 2 | *DLL1* | 1.16586506142267 | 1.7443439310959E-253 |
| 2 | *ALDH1A2* | 1.41866777284285 | 6.04971852125113E-242 |
| 2 | *MSX1* | -2.52904115471438 | 6.37662024762309E-237 |
| 2 | *KRAS* | 0.82770791949726 | 9.96915154395077E-217 |
| 2 | *RNH1* | 1.08605058601933 | 8.65638198126585E-206 |
| 2 | *RDH10* | 1.04307059206148 | 6.36102174754014E-191 |
| 2 | *SGPL1* | 0.817201414934171 | 2.82128783860915E-190 |
| 3 | *GBX2* | 1.53817472516901 | 0 |
| 3 | *GJA1* | 1.38835536010913 | 0 |
| 3 | *EDNRB* | 1.20009455194226 | 2.52478672682819E-289 |
| 3 | *CLDN1* | 1.20413809594401 | 1.17935128903501E-277 |
| 3 | *CDH11* | 1.25112401401076 | 6.25834013605549E-257 |
| 3 | *SOX3* | 1.54211085212976 | 3.17635246464633E-247 |
| 3 | *HINTW* | 1.92943556803832 | 3.02369221987231E-199 |
| 3 | *PDGFA* | 0.986728347014766 | 5.40924194099481E-195 |
| 3 | *CTTNBP2* | 0.866668411323754 | 4.78619642503906E-191 |
| 3 | *AP1S3* | 0.806097731269968 | 1.35496510194021E-175 |
| 4 | *WNT5A* | 1.19230310822398 | 1.46284545077589E-183 |
| 4 | *eGFP* | 1.47190878778027 | 5.42969070297272E-178 |
| 4 | *CDX4* | 1.28396931508265 | 4.7994468946369E-171 |
| 4 | *HOXB8* | 1.38798865712259 | 1.33901112440224E-170 |
| 4 | *MSX1* | 1.23406164719858 | 1.66593707144748E-166 |
| 4 | *FGF19* | 1.31913947173534 | 5.1881920449563E-165 |
| 4 | *KPNA2* | 1.1244865752887 | 1.08515343694279E-164 |
| 4 | *HOXA7* | 1.44451732868615 | 7.38455521897304E-156 |
| 4 | *TMSB4X* | -1.18765913768026 | 1.25741984738072E-148 |
| 4 | *TCF12* | 0.689377680633102 | 3.7014579463651E-145 |
| 5 | *MSGN1* | 2.06036738777217 | 2.75041310311928E-206 |
| 5 | *ALDH1A2* | 1.8077664815224 | 4.16103222583803E-205 |
| 5 | *AGRP* | 1.80310854909397 | 4.34016209682778E-174 |
| 5 | *RDH10* | 1.30971797527668 | 5.48815068084915E-165 |
| 5 | *CENPF* | 1.36649903527463 | 8.29532481213387E-162 |
| 5 | *DLL1* | 1.00958582280298 | 5.1844140060902E-137 |
| 5 | *RGS3* | 0.780991833343416 | 9.84168966965528E-130 |
| 5 | *RNH1* | 1.10060407980127 | 1.93676703344941E-128 |
| 5 | *MSX1* | -2.42204659813208 | 2.73078300315636E-127 |
| 5 | *HMGB2* | 0.56896092368797 | 1.92833812621915E-122 |
| 6 | *TNNT2* | 0.417121158385769 | 3.99299369410458E-190 |
| 6 | *PMP22* | 0.263415775764942 | 1.36122866810487E-146 |
| 6 | *RN7SL1* | 0.846911374647191 | 7.36609061716575E-144 |
| 6 | *RAMP3* | 0.290333547890103 | 3.09950133586924E-143 |
| 6 | *ARMC7* | 0.341010996351886 | 6.62616408602338E-143 |
| 6 | *RGS3* | -0.294855602676253 | 9.8465042510006E-133 |
| 6 | *ASCC3* | -0.300076531691926 | 2.1927912379702E-131 |
| 6 | *LHX1* | 0.298536165933243 | 8.26926129288258E-130 |
| 6 | *HS6ST2* | -0.307576179937828 | 3.04263269316031E-129 |
| 6 | *ZCCHC6* | -0.349285088332166 | 5.78347157870883E-129 |
| 7 | *FABP7* | 2.31681516022095 | 1.60283532836868E-187 |
| 7 | *DLX5* | 2.20899844325514 | 2.92801657280801E-183 |
| 7 | *MSX2* | 2.16202382247032 | 1.70293073811211E-181 |
| 7 | *TMSB4X* | -1.61409782658695 | 1.35357226080171E-164 |
| 7 | *LDHB* | 1.10121559919432 | 1.15773661022506E-148 |
| 7 | *HOXA7* | 1.97308338168153 | 7.02283658518382E-143 |
| 7 | *TFAP2A* | 1.9970154846481 | 4.28029629795172E-133 |
| 7 | *CLDN3* | 1.70572427249482 | 5.99432961917036E-129 |
| 7 | *COL1A2* | -2.39408795305034 | 2.11770458415652E-127 |
| 7 | *CDH2* | -2.17845396127837 | 2.69935264062083E-127 |
| 8 | *PPIA* | -0.646872763502564 | 6.35709080058737E-57 |
| 8 | *MRPL34* | -0.645923944211213 | 7.42362574098425E-56 |
| 8 | *MRPL41* | -0.553041183770016 | 3.52860856240581E-51 |
| 8 | *FABP5* | -0.370293164107938 | 3.25608419183137E-44 |
| 8 | *RAC1* | -0.47358803496502 | 2.0412957765153E-43 |
| 8 | *DGCR6* | -0.509463531405073 | 1.38099324730152E-40 |
| 8 | *MED6* | -0.375431679312548 | 3.16267361411543E-40 |
| 8 | *PSMA1* | -0.678703160750433 | 1.50007582355636E-39 |
| 8 | *DCTN2* | -0.415042168137644 | 3.43297847916506E-39 |
| 8 | *IMP4* | -0.350031992402085 | 1.22684411592149E-38 |
| 9 | *GSC* | 0.250722057211903 | 1.13221965643841E-41 |
| 9 | *CHRD* | 0.941430119116635 | 9.30065811856524E-38 |
| 9 | *EOMES* | 0.450490399351236 | 5.94507832012396E-30 |
| 9 | *STK26* | 0.476404665076204 | 5.49113305755186E-26 |
| 9 | *LDHA* | 0.391888595241813 | 2.04436593524018E-25 |
| 9 | *SOX17* | -0.955514622045934 | 1.36362331166111E-24 |
| 9 | *EXFABP* | 0.290329737818581 | 4.48248603254064E-23 |
| 9 | *SMS* | 0.614485826748932 | 2.06556013454308E-22 |
| 9 | *SFRP1* | 0.533561232121688 | 1.18075121793058E-19 |
| 9 | *IGFBP2* | 0.473427770760102 | 7.88385397672752E-19 |
| 10 | *SGK1* | 1.45640915817001 | 7.17863561437477E-92 |
| 10 | *ASTL* | 1.7810786026116 | 2.36792407275542E-91 |
| 10 | *CA2* | 1.67889652222983 | 1.23377942158736E-90 |
| 10 | *ERNI* | 1.0261144180689 | 1.77186631446483E-78 |
| 10 | *ANO3* | 1.24597707381906 | 3.44671185736367E-75 |
| 10 | *IGFBP2* | 1.21811855815857 | 6.51868675555751E-73 |
| 10 | *GNOT2* | 1.53647955217464 | 1.8757262825897E-72 |
| 10 | *ENS-3* | 1.07858965484008 | 8.21057589100296E-72 |
| 10 | *LDHA* | 1.57489934743726 | 2.89385437448538E-71 |
| 10 | *CDH2* | -2.44921443649737 | 5.85103897417772E-67 |
| 11 | *AvBD10* | 0.657018233264079 | 2.18047858731018E-213 |
| 11 | *LOC395991* | 4.4703934824971 | 3.54211066386537E-109 |
| 11 | *SOX17* | 4.30996078488594 | 1.81787512224253E-107 |
| 11 | *KRT7* | 3.13721369585305 | 7.06395698223179E-105 |
| 11 | *APOA1* | 4.62766475345107 | 1.78799713527858E-101 |
| 11 | *GATA5* | 1.86992678649693 | 1.35096599084095E-90 |
| 11 | *CXCR4* | 2.95181586119202 | 6.16718179324134E-90 |
| 11 | *TMSB4X* | 1.60408285895032 | 1.05032205194193E-88 |
| 11 | *CLDN3* | 2.2447134706466 | 6.57242344304436E-82 |
| 11 | *EZR* | 1.85143102060713 | 2.01483255728218E-78 |
| 12 | *MYH10* | -1.35919412913327 | 9.39564883180538E-39 |
| 12 | *LFNG* | -1.7372403956411 | 3.16256211639243E-38 |
| 12 | *PRTG* | -1.64626561038074 | 2.07081618464162E-36 |
| 12 | *CDH2* | -1.95491333679793 | 1.94056836881241E-35 |
| 12 | *ACVR2B* | -1.43355881903305 | 3.39718547938866E-35 |
| 12 | *GJA1* | -1.7623543058503 | 1.62977613299892E-34 |
| 12 | *COL1A2* | -1.93004311676896 | 1.0980575507006E-32 |
| 12 | *LBR* | -1.35089972372763 | 1.8627615931053E-32 |
| 12 | *HYOU1* | -1.20072948867266 | 1.87925377459531E-31 |
| 12 | *HSP90B1* | -1.50779986664999 | 2.93615244002362E-31 |
| 13 | *AGRP* | 0.71802128124676 | 9.22438153673927E-06 |
| 13 | *MSGN1* | 0.437497543184769 | 1.62259748570164E-05 |
| 13 | *MEOX1* | 0.294754624518752 | 0.000100170763316343 |
| 13 | *ZEB2* | 0.362640785204003 | 0.000278741824675477 |
| 13 | *SETD6* | 0.413337203221678 | 0.000615871467978752 |
| 13 | *eGFP* | 0.504494533251947 | 0.00209586528952035 |
| 13 | *TCF15* | 0.345905016395818 | 0.00659844205768626 |
| 13 | *ALDH1A2* | 0.256322744864254 | 0.00817806379401717 |
| 13 | *TSPAN18* | 0.362135032863625 | 0.0197754182627344 |
| 13 | *SMCO4* | 0.318228624638086 | 0.0215366480892156 |

*Supplementary File 1b*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **GO Term** | **Annotation ID** | **Genes found** | **Input size** | **Term genes** | **Adjusted p-value** | **Relative enrichment** | **genes** |
| *cell adhesion* | *GO:0007155* | *21* | *233* | *181* | *0.000368* | *3.593697* | *CDH11, ADAM9, PODXL, EMB, CLDN3, PTK7, PRTG, BSG, SPON1, NCAM1, NRXN1, NFASC, EPHA4, ITGB1, FN1, CDH2, RHOB, PCDH19, APP, AXL, ZYX* |
| *somitogenesis* | *GO:0001756* | *7* | *233* | *27* | *0.010297* | *8.030361* | *POFUT1, ROR2, PTN, LFNG, EPHA4, WNT3A, MSGN1* |
| *positive regulation of astrocyte differentiation* | *GO:0048711* | *3* | *233* | *4* | *0.044944* | *23.230687* | *BIN1, NOTCH1, SERPINE2* |
| *axon guidance* | *GO:0007411* | *10* | *233* | *76* | *0.044944* | *4.075559* | *B3GNT2, EMB, PRTG, BSG, OTX2, NFASC, EPHA4, NOTCH1, EPHA5, WNT3A* |
| *regulation of Notch signaling pathway* | *GO:0008593* | *4* | *233* | *10* | *0.046009* | *12.389699* | *POFUT1, LFNG, ADAM10, NOTCH1* |
| *regulation of axonogenesis* | *GO:0050770* | *4* | *233* | *11* | *0.058729* | *11.263363* | *SIPA1L1, EPHA4, CDH2, WNT3A* |
| *homophilic cell adhesion via plasma membrane adhesion molecules* | *GO:0007156* | *7* | *233* | *50* | *0.089415* | *4.336395* | *CDH11, PRTG, BSG, NCAM1, NFASC, CDH2, PCDH19* |
| *neuroligin clustering involved in postsynaptic membrane assembly* | *GO:0097118* | *2* | *233* | *2* | *0.089415* | *30.974249* | *NRXN1, CDH2* |
| *trigeminal ganglion structural organization* | *GO:0061563* | *2* | *233* | *2* | *0.089415* | *30.974249* | *SLIT1, CDH2* |
| *axis elongation involved in somitogenesis* | *GO:0090245* | *2* | *233* | *2* | *0.089415* | *30.974249* | *FN1, WNT3A* |

*Supplementary File 1c*

|  |  |  |  |
| --- | --- | --- | --- |
| **Gene** | **Log2FC HH4** | **Log2FC HH8** | **Adjusted p-value** |
| *HOXA7* | -4.56075396166316 | 4.56075396166316 | 7.74022587793996E-91 |
| *HOXB8* | -3.63126237573027 | 3.63126237573027 | 9.49944840703166E-91 |
| *MSX1* | -2.76035512958332 | 2.76035512958332 | 4.08265956222547E-78 |
| *CDX4* | -2.57421401161646 | 2.57421401161646 | 2.22292436776557E-75 |
| *FABP7* | -2.76363763027707 | 2.76363763027707 | 6.3404508832246E-69 |
| *FOXD3* | 1.51917404659086 | -1.51917404659086 | 7.04713825386027E-68 |
| *LDHB* | -1.27359191292784 | 1.27359191292784 | 2.63780145221445E-65 |
| *ID1* | -2.19062193003862 | 2.19062193003862 | 2.12348335957229E-64 |
| *WNT5A* | -1.75776508823501 | 1.75776508823501 | 1.55421818551336E-58 |
| *CHRD* | 2.70498887054941 | -2.70498887054941 | 6.50943821365007E-56 |
| *OAT* | -1.34951897680759 | 1.34951897680759 | 3.94106900443992E-51 |
| *LIN28A* | -1.37655334224822 | 1.37655334224822 | 8.14061416764603E-51 |
| *APCDD1* | -0.961433388217504 | 0.961433388217504 | 7.04547923207708E-49 |
| *ATP2B1* | -1.37968001741039 | 1.37968001741039 | 1.01763116962531E-47 |
| *MSX2* | -1.69993275312845 | 1.69993275312845 | 2.74151315923146E-46 |
| *HOXA4* | -1.33029719732012 | 1.33029719732012 | 3.3965748787443E-46 |
| *PRTG* | -1.319886716506 | 1.319886716506 | 2.5267805529959E-45 |
| *HOXA6* | -1.22752725777529 | 1.22752725777529 | 9.3010822596714E-42 |
| *eGFP* | -1.23150144669165 | 1.23150144669165 | 9.35961690536248E-42 |
| *YBX1* | -0.578258359335501 | 0.578258359335501 | 1.34213790988968E-41 |
| *FGF19* | -1.4207965986741 | 1.4207965986741 | 1.9127270213518E-40 |
| *EOMES* | 1.68506260682122 | -1.68506260682122 | 2.42215934533388E-39 |
| *AGRP* | 2.51538286230997 | -2.51538286230997 | 7.71380227137366E-39 |
| *TFDP2* | -1.10531603697908 | 1.10531603697908 | 3.88310406075555E-38 |
| *HOXA5* | -1.19605001732345 | 1.19605001732345 | 1.62788261219325E-37 |

*Supplementary File 1d*

|  |  |  |
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| **Gene** | **Forward primer (5’-3’)** | **Reverse primer (5’-3’)** |
| *ACTB* | CAGGTCATCACCATTGGCAAT | GCATACAGATCCTTACGGATATCCA |
| *Hoxa1* | CCTACAACCATGCCCTGTCT | CTTGGTGGTGAAGTTGGTCC |
| *Hoxa2* | AGGCAAGTGAAGGTCTGGTT | GGTCCTCCGAGCCCTTAAAT |
| *Hoxa3* | GCGCTTCCTGAATTCTTCCC | GCGCTTCCTGAATTCTTCCC |
| *Hoxa6* | CTTACACCCGCTACCAAACG | CGGGCTGGGTGGAATTTATG |
| *Hoxb1* | TCGATAGCCTCACGTCTTGG | TCTGGTGGTAAAGGGTAGCA |