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Osaka University

Doctoral thesis

**Regulation of anterior neural plate development  
studied using an epiblast stem cell model**

by

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## SUMMARY

The first major somatic tissue derived from the epiblast is the neural plate. To investigate the regulation of the neural plate development from the epiblast, I took advantage of an epiblast stem cell (EpiSC) line. The epiblastic state of EpiSCs was maintained under the culture condition with addition of activin (Nodal substitute). When this signal was removed, EpiSCs developed into the anterior neural plate cells equivalent to those of ~E7.5 mouse embryos in 1 day and to those of ~E8.25 embryos in 2 days. I confirmed this by immunocytochemistry and microarray analysis.

The anterior neural plate cells are further regionalized after E7.5. In E6.5~7 mouse embryos. Wnt antagonist Dkk1 is expressed in the visceral endoderm underlying the anterior-most part of the epiblast and continue to repress Wnt signal activity. This suggests that the Dkk1-dependent inhibition of Wnt signal primes the epiblast cells to develop into the anterior-most part of the neural plate (anterior forebrain precursor). In order to test this model using EpiSC culture, I inhibited endogenous Wnt signal activity by addition of Dkk1 or a chemical Wnt inhibitor. The inhibition of Wnt signal activated the *Hesx1* 5' enhancer and also the expression of *Hesx1* and *Six3*, which are characteristic of the anterior-most region of the neural plate, confirming the model.

Dkk1 is expressed in the anterior visceral endoderm in E6.5 to E7.5, and then expressed in the anterior mesendoderm. I lastly examined at which stage the effect of Dkk1 is more important on the anterior forebrain precursor development, and concluded that the Dkk1 action at the initial stage is more important.

From this study, I drew following main conclusions. (1) EpiSCs cultured under an activin-free condition mimic the anterior neural plate development in mouse embryos. (2) Inhibition of Wnt signal in EpiSCs under the activin-free culture condition activates the *Hesx1* expression and promotes the development of anterior forebrain precursor. (3) This effect involves the activation of the *Hesx1* 5' enhancer.

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## GENERAL INTRODUCTION

One tiny fertilized egg develops through a series of cell differentiation processes into a complex animal body consisting of various organs such as the brain, heart, limbs etc. Each organ consists of a combination of differentiated somatic cells that bear specialized functions to maintain the organismal life.

In the case of mammals, the egg is fertilized in the oviduct. The fertilized egg repeats several cell divisions and forms the morula consisting of 16-64 cells and migrates in the uterus. The internal cells of the morula develop into the inner cell mass (ICM), while the outer cells into the trophectoderm of the blastocyst after 3.5 days of fertilization. The trophectoderm gives rise to the placenta. The inner cell mass is the precursor of all non-placental tissues, namely extraembryonic membranous tissues, such as yolk sac, ectoplacental cone and associated extraembryonic tissues and somatic tissues of the embryo body. Five days after fertilization, the blastocyst is implanted on the uterine wall. After implantation, the embryo takes an egg cylinder form, and inside the egg cylinder, the epiblast develops as the precursor of somatic cells.

Fig. 1

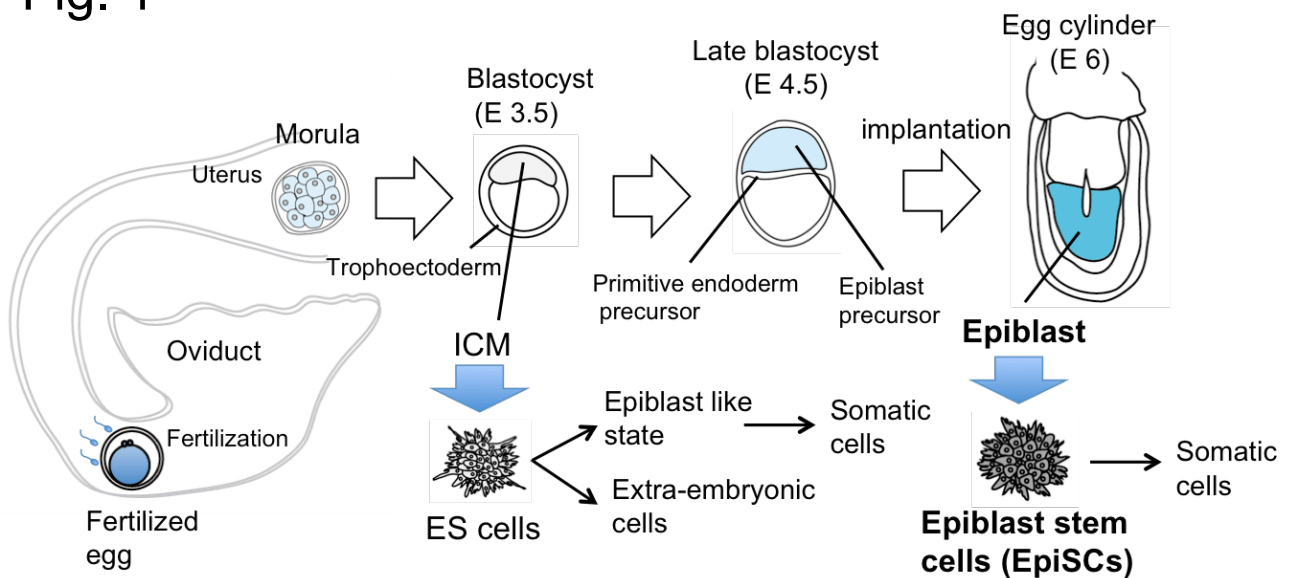
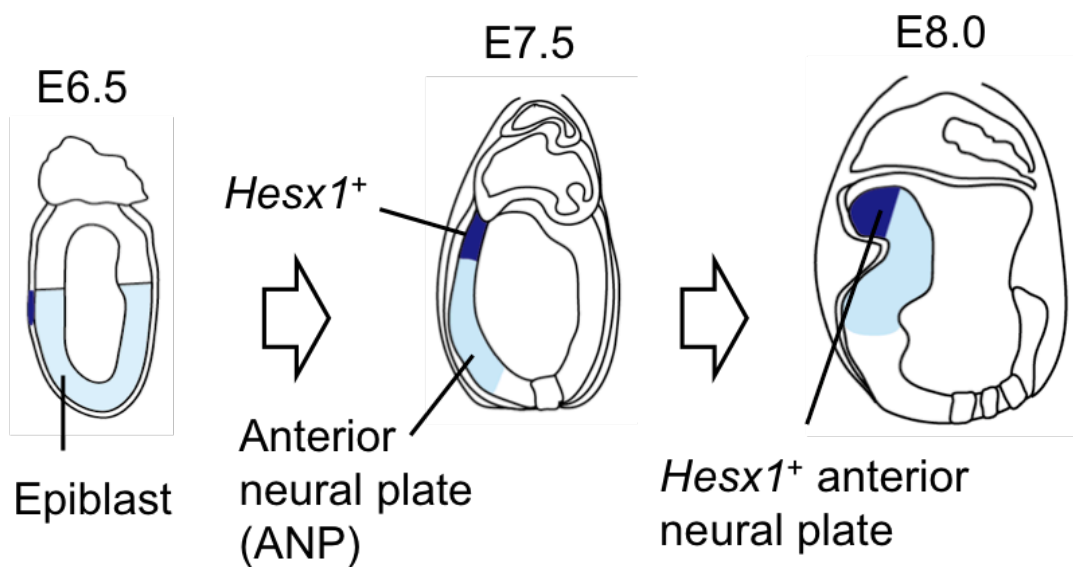


Figure 1. The development of early stage mouse embryo from fertilization to egg cylinder

The first major somatic tissue derived from the epiblast is the anterior neural plate, the precursor of the brain. The posterior neural plate, the precursor of the spinal chord develops later. The cellular and transcriptional regulation involved in the anterior neural plate development is significantly different from those of the posterior neural plate development, as will be detailed in Part 1, although in previous studies, the developmental regulation to give rise to anterior and posterior neural plates has been regarded to be similar. The anterior neural plate is further regionalized after E7.5. Anterior-most region of the anterior neural plate develops into anterior forebrain precursor marked by *Hesx1* expression (Fig. 2). Development of the anterior forebrain precursor depends on the action of *Hesx1* and other transcription factors, as will be discussed in Part 2.

**Fig. 2**



**Figure 2. The development of mouse embryo from E 6.5 to E 8.0**

In order to study the development of the anterior neural plate as the first developing somatic tissue, I utilized EpiSCs in culture as a model of embryonic epiblast. EpiSCs are established from the epiblast of E5.5~6.5 mouse embryos (Tesar et al., 2007, Brons et al., 2007) and have the ability to self-renew and differentiate into all somatic cells, but not into extraembryonic tissues (Fig. 1). EpiSCs culture system has following advantages in experimental analysis compared to using embryo itself. (1) Tissue-intrinsic regulation can be studied without involvement of intervening tissues. (2) Gene transfer into EpiSCs is efficient under the condition we established. (3) A mass of cells ( $>10^6$ ) can be used for molecular analyses, compared to a small number ( $<1000$ ) in the egg cylinder epiblast. For these advantages, I used EpiSC model to study the regulatory mechanism to produce the anterior neural plate. It should also be emphasized that EpiSC is better suited for the study of somatic cell development than ES cells. It is because ES cells also produce non-somatic cells in addition to somatic cells and go through an epiblast-like state before development into somatic cells (Fig. 1).

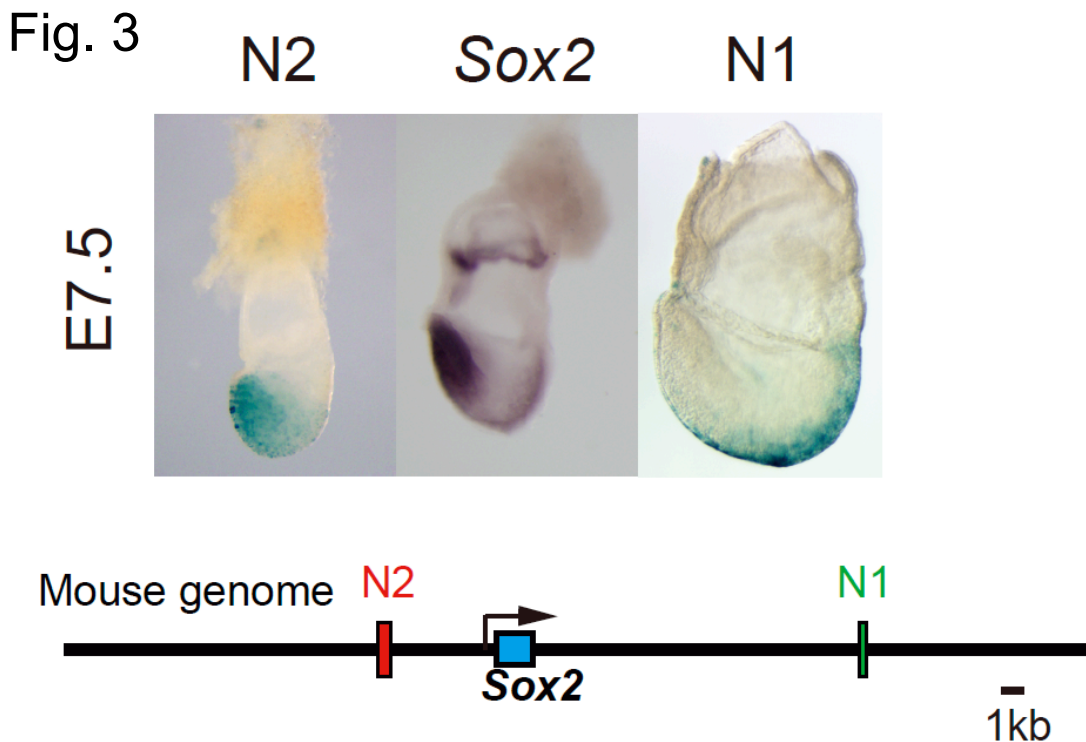
## **PART 1**

**The anterior neural plate cells derived from EpiSCs  
under the activin-free culture condition**



## INTRODUCTION

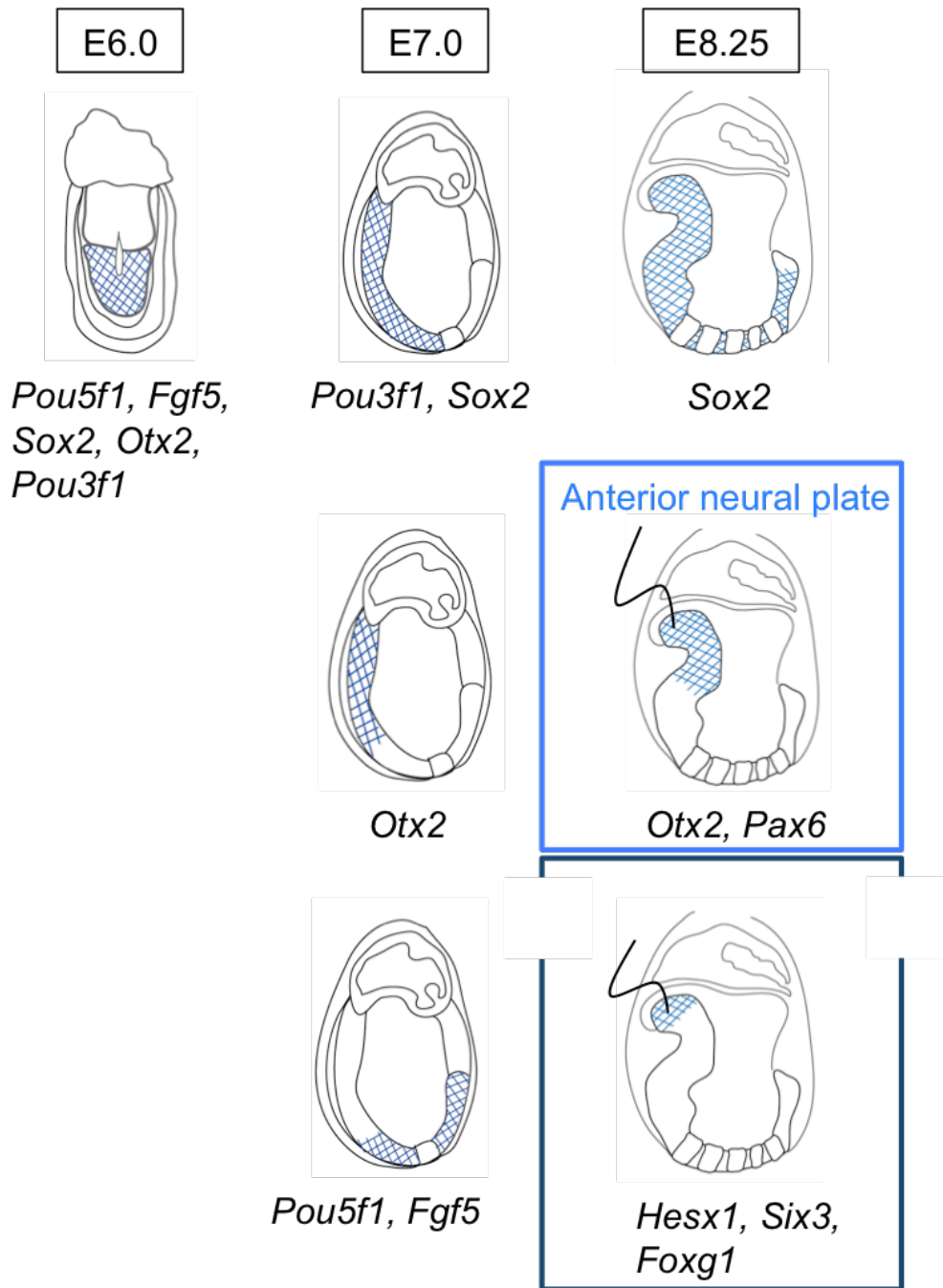
The mechanism of development of neural plate is significantly different between the anterior and posterior parts of an embryo. Regulation of the *Sox2* gene, essential for the neural plate development, provides an important clue to this difference. *Sox2* expression in the anterior neural plate is regulated by the N2 enhancer located 4 kb upstream of the *Sox2* gene in the mouse genome (Fig. 3). The anterior neural plate is derived directly from the epiblast with the changes in the expression of transcription factors as shown in Fig.4 (Iwafuchi-Doi 2011, 2012). The anterior neural plate expresses a group of transcription factor genes such as *Otx2* and *Pax6*. In this study I investigated the regulation involved in the development of the anterior neural plate.



**Figure 3. The expression of *Sox2* is regulated by N2 and N1 enhancers at early stages of neural plate development.**

The activity of N2 enhancer is shown to the left, N1 enhancer to the right, and the expression of *Sox2* in the middle. The activity of enhancers is indicated by the expression of the enhancer-driven LacZ gene. The expression of *Sox2* is visualized by in situ hybridization. The location of N2 and N1 enhancers in mouse genome is shown below. This Figure is modified from Takemoto, 2013, Figure 1.

Fig. 4



**Figure 4. The gene expression patterns during the anterior neural plate development**

The hatched areas indicate specific regions with gene expression of each characteristic transcription factor genes.

In contrast to the case of anterior neural plate development, *Sox2* expression in the posterior neural plate is regulated by the N1 enhancer located 15 kb downstream of the gene in mouse genome (Fig. 3). It was shown that posterior neural plate does not develop directly from the epiblast, but through an intermediate called axial stem cells, which are the common precursor of neural and mesodermal cells. The developmental fate of axial stem cells is regulated by the balance of *Sox2* expression for neural development and *Tbx6* expression for mesodermal development (Takemoto et al., 2011).

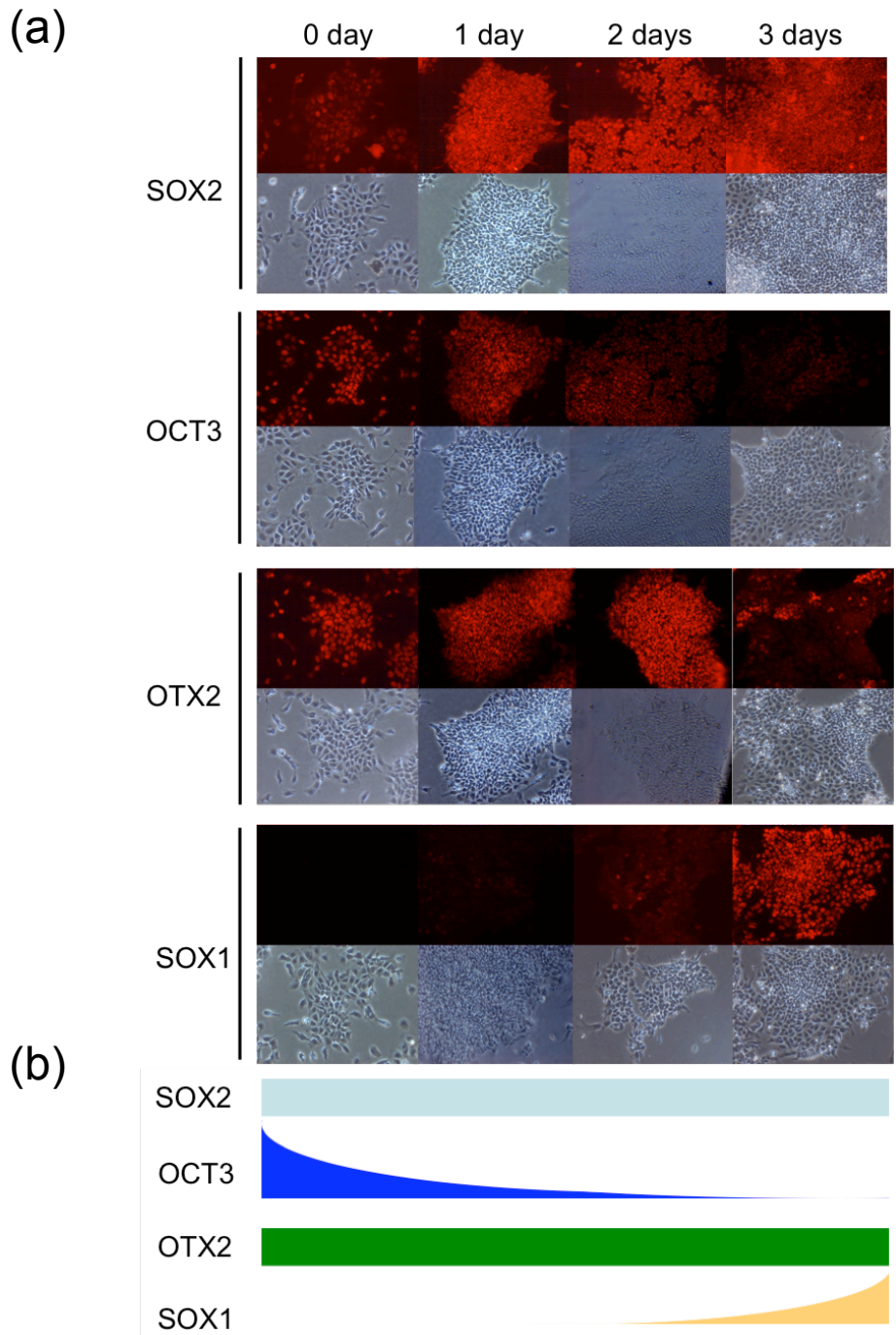
In order to clarify the regulation of anterior neural plate development, I took advantage of EpiSC culture system. EpiSC lines were established from the epiblast in mouse embryos. The epiblastic state of EpiSCs is maintained under the culture condition with the addition of activin (Nodal substitute) to the medium. The Nodal signaling is known to maintain the epiblast state in embryo. The repression of the nodal signaling by nodal antagonists such as *Lefty1* and *Cer12* is essential for the anterior neural plate development. These Nodal antagonists are expressed in the visceral endoderm underlying the anterior part of the epiblast, which is the region of future anterior neural plate. Moreover, *Nodal*-null embryos fail to maintain the epiblastic state beyond E5.5 and precociously develop neural tissues (Camus et al., 2006). These previous studies encouraged me to study the development of EpiSCs under the condition of activin removal, which is expected to promote the neural plate development. We found that the anterior neural plate cells develop under this condition. This enabled us to study the regulation of anterior neural plate development in embryos using the EpiSC model.

## RESULTS

### 1-1 Removal of activin initiates the anterior neural plate development of the EpiSCs.

The epiblastic state of EpiSCs is maintained under the culture condition with activin (Nodal replacement) in a serum free medium. Activation of Nodal signaling maintains the epiblastic state of EpiSCs. The absence of Nodal signaling in mouse embryo induces the precocious neural development as described in the introduction. The condition of removal of activin in EpiSCs may promote their neural plate development. In order to test this, I cultured EpiSCs without activin and examined the expression pattern of transcription factors after 1-3 days by immunocytochemistry (Fig. 4). The expression of Oct3/4, characteristic of the epiblastic state, was decreased after removal of activin. After 3 days of the removal of activin, the majority of cell stopped expression of Oct3/4, suggesting that the cells are no longer in the epiblastic state. The expression of Sox2 associated with the epiblast and neural plate was upregulated after 1 day of the removal of activin. Otx2, expressed in the epiblast and anterior neural plate in embryos, continued to be expressed throughout 2 days of culture after the removal of activin. Moreover, the expression of Sox1 known as a late neural plate development marker was upregulated only after 2 days. These observations suggested that EpiSCs developed into anterior domain of neural plate after 2 days. Taken together, the time course of the change in the expression of transcription factors indicated that embryonic neural development is grossly mimicked by EpiSCs development under the condition of removal of activin/nodal signaling.

Fig. 5



**Figure 5. The expression pattern of transcription factors during anterior neural plate development under the culture condition**

Red fluorescence shows the expression of transcription factors. 0 day is the epiblastic state under the culture condition with activin. The expression patterns of cells derived from EpiSCs 1 day to 3 days after removal of activin are shown in (a). Time course of changing expression pattern is illustrated as color bar in (b).

## 1-2 Microarray analysis of the changes in gene expression during development of the anterior neural plate cells from EpiSCs.

In order to analyze the changes in the gene expression during anterior neural plate development from EpiSCs, microarray analysis was done using EpiSCs, 0, 1 and 2 days after the removal of activin.

Microarray analysis showed that the expression levels of the genes characteristic to the EpiSCs, such as *Fgf5*, *Mycn* and *Nodal* were significantly decreased 1 day after the removal of activin (Fig. 6A). This down-regulation suggests that most of EpiSCs no longer maintain the epiblastic state without activin/Nodal signaling. By contrast, the genes associated with the neural plate development such as *Zeb2* and *Irx3* were moderately activated after 1 day and strongly activated after 2 days (Fig. 6B). Activation of these genes suggested that EpiSCs were directed to the development of neural plate already after 1 day. The genes activated in the late neural plate, such as *Sox1*, *Sox21* and *Pou3f2*, were not activated during 1 day but activated strongly after 2 days (Fig. 6C). This suggested that the cell-state derived from EpiSCs 1 day after the removal of activin corresponded to the neural plate in ~E7.5 mouse embryos.

The genes specific to the mature anterior neural plate, such as *Hesx1*, *Six3*, *Pax6*, were strongly expressed after 2 days (Fig. 6D). These results suggested that the cell state derived from EpiSCs 2 days after the removal of activin largely recapitulated the anterior neural plate in ~E8.25 mouse embryos. By contrast, the expression of genes associated with endodermal and mesodermal development, such as *Sox17* and *T*, was strongly repressed after 1 day and was continued to be repressed (Fig. 6E). Other transcription factor genes associated with the epiblast and/or anterior neural plate development were regulated variably, as grouped in Fig. 6F to H.

Taken together, the data of microarray analysis suggested that the cell-state 1 day after the removal of activin represented the anterior neural plate in ~E7.5 mouse embryo and that after 2 days represented the anterior neural plate-state in ~E8.25 mouse embryo. The details of fold changes in gene expression level are shown in Table 1. In this study, I concluded that the development of anterior neural plate cells derived from EpiSCs under the culture condition without activin/Nodal signaling mimics the development of anterior neural plate in embryo. Therefore this epiblast stem cells model enables us to analyze the development of anterior neural plate, without using the mouse embryo itself.

Fig. 6

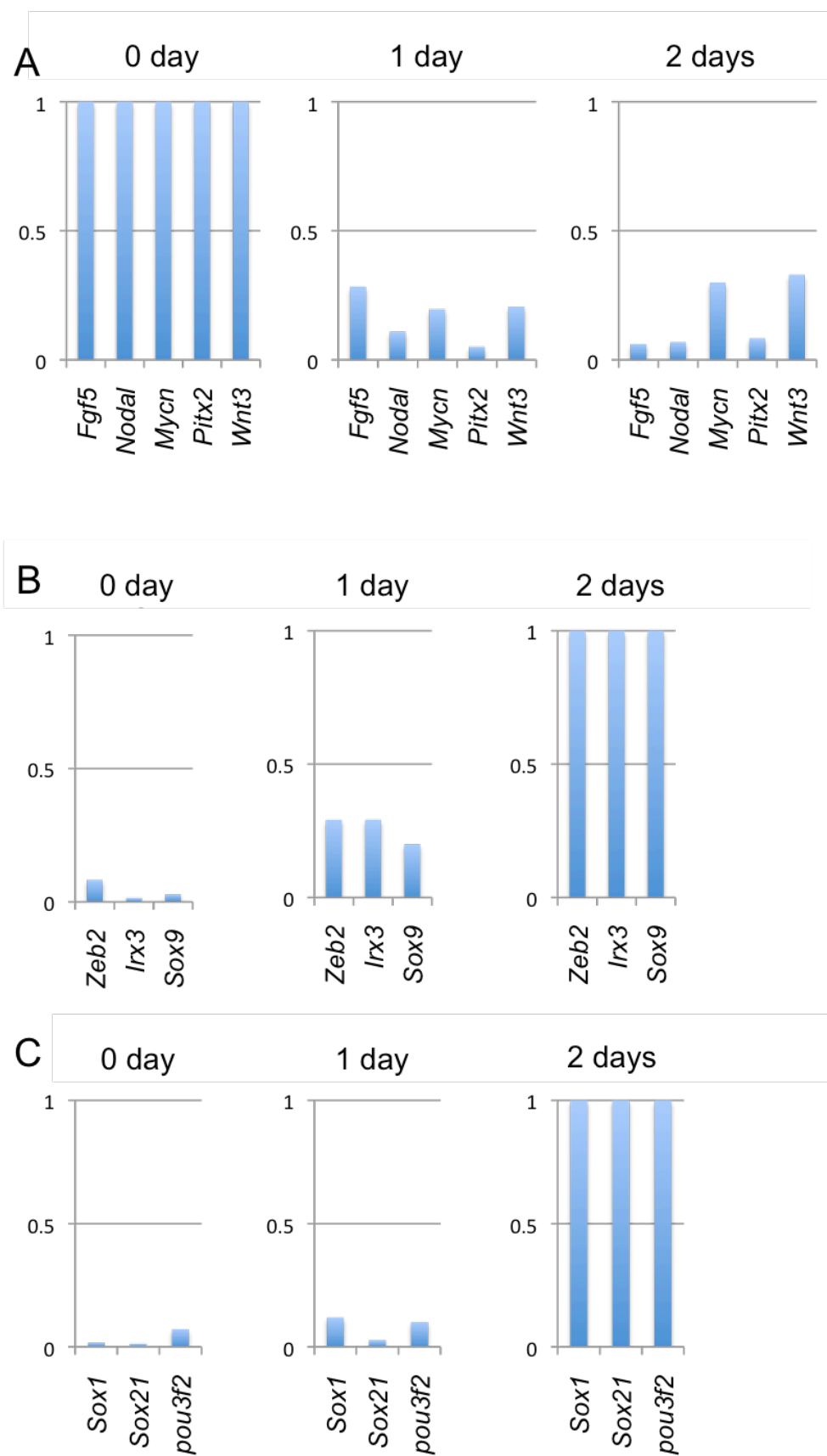


Fig. 6

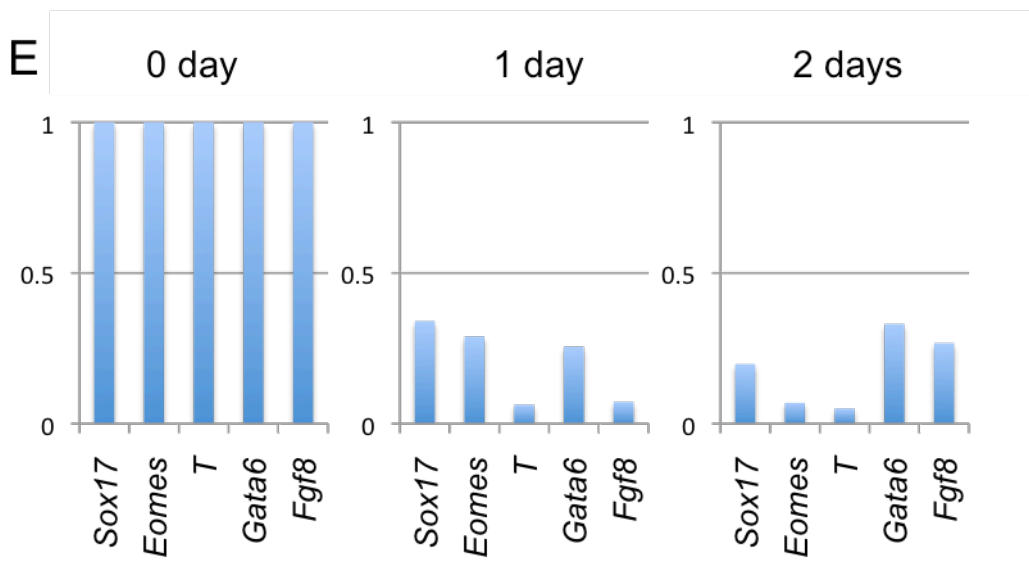
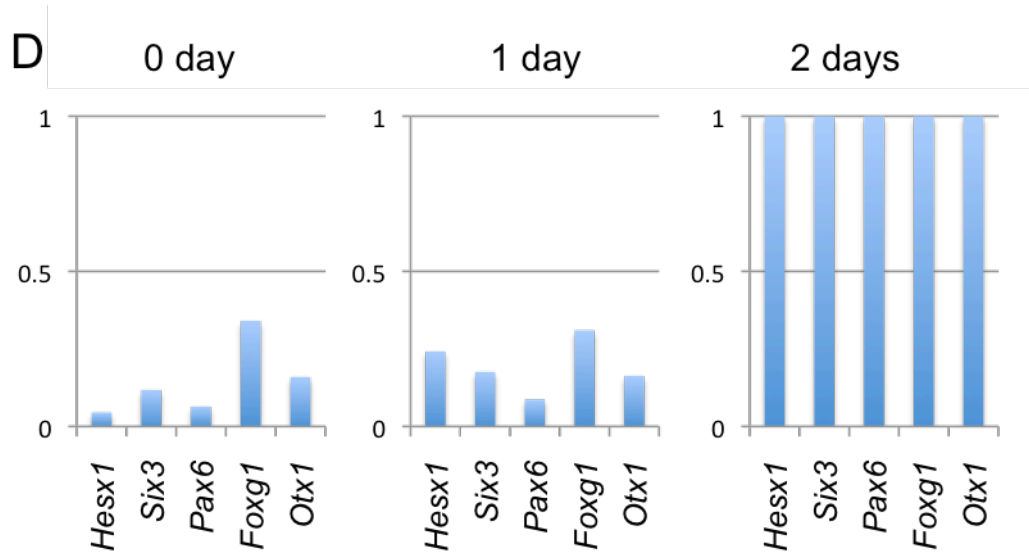
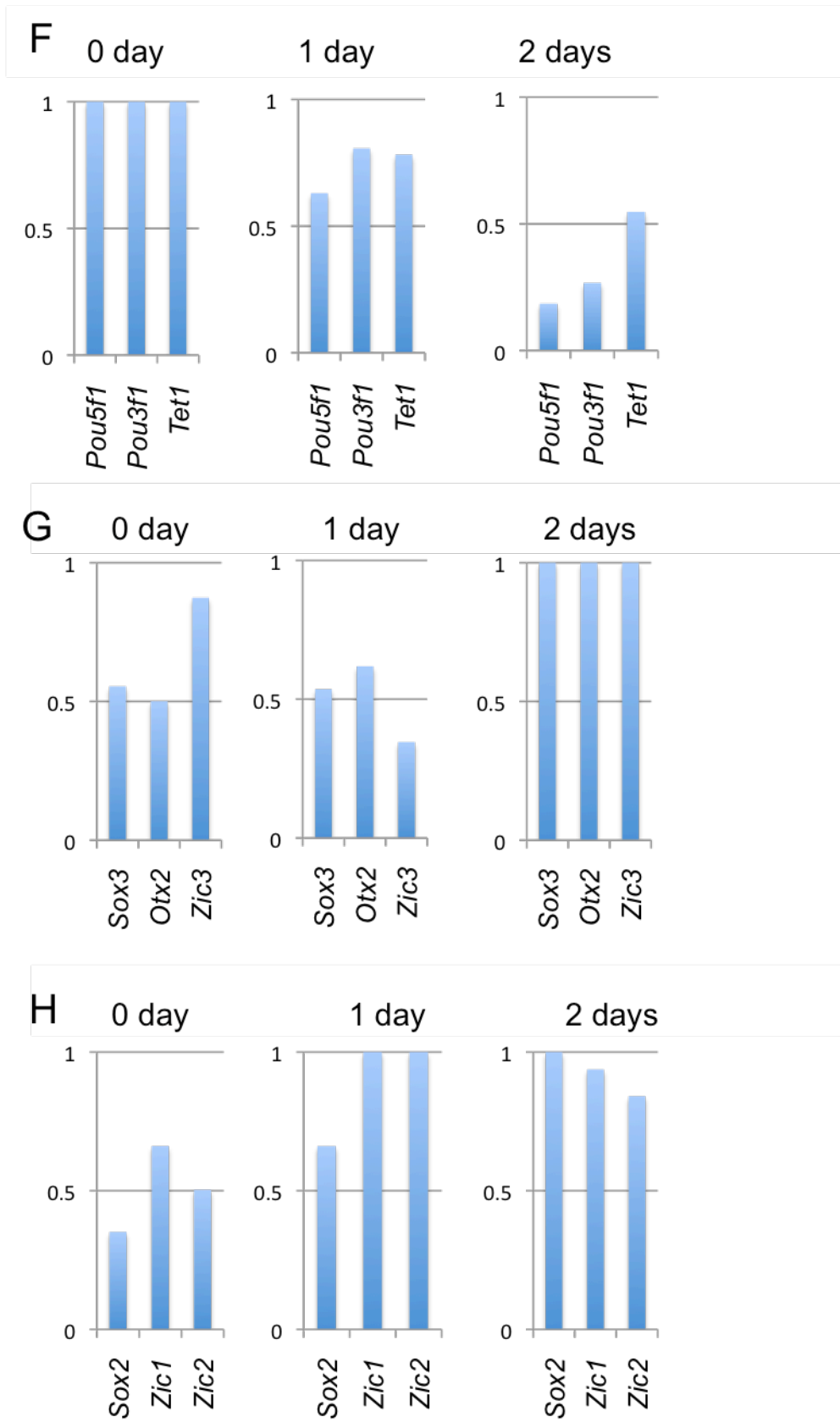




Fig. 6



**Figure 6. Microarray analysis of the changes in gene expression (mainly transcription factor genes) during the anterior neural plate development from the EpiSCs**

The gene expression level is shown as transcription level relative to each maximum level on 0 day, 1 day and 2 days after removal of activin. The genes characteristic to the epiblast state are shown in A, those characteristic to the neural plate in B and C, those characteristic to the anterior neural plate in D, those characteristic to endodermal and mesodermal in E, and those characteristic to both epiblast and neural plate in F-H.

## DISCUSSION

In this part, I analyzed the EpiSC development under the activin-free culture condition. The time course of changes in the expression of transcription factors indicated that EpiSCs develop into anterior neural plate cells after the removal of activin. Microarray analysis indicated that the cell state after 1 day after removal of activin represents the anterior neural plate of ~E7.5 embryo and that after 2 days represents that of ~E8.25.

This EpiSC culture is thus useful to study the regulation of anterior neural plate development. For example, the combination of overexpression and knockdown of transcription factors by transfecting relevant expression vectors was an effective tool to analyze the contribution of transcription factors in the anterior neural plate development. Using this approach, it was found that both the repressive and activating mechanisms function together by transcription factors to generate ANP from the epiblast (Iwafuchi Matsuda et al., 2012).

Another use of culture to analyze the transcriptional regulatory network is the ChIP-seq (chromatin immunoprecipitation-sequencing) analysis. ChIP-seq analysis is possible because abundant cells can be collected using EpiSCs in culture, which is not possible using embryonic tissues of E7.5 to E8.5. We have already determined the optimal condition of ChIP and performed the ChIP-seq analysis by utilizing biotinylated transcription factors in EpiSCs (bio-ChIP-seq). Example of Pou5f1 and Sox2 binding genomic sites are listed in Table 1. An interesting example is an overlap of Pou5f1 and Sox2 sites, which was found upstream of the *Sox3* gene (Fig. 7), suggesting co-regulation of *Sox3* by Pou5f1 and Sox2 in the epiblast. This experimental method enables us to carry out a genome-wide analysis of interaction of transcription factors with chromosomal sites in the epiblast and anterior neural plate. This analysis will provide important data to understand the changes in the transcriptional regulatory network during anterior neural plate development starting from the epiblast.

After E7.5 of mouse embryo development, anterior neural plate is further regionalized into the anterior-most region expressing *Hesx1* and remaining region. In this EpiSC culture model mimicking the anterior neural plate development, the cell state 2 days after the removal of activin recapitulates the anterior neural plate of developmental stage around E8.25. This makes it possible to analyze the regionalization step of the anterior neural plate. Analysis of the development of the *Hesx1*-expressing sub-division of anterior neural plate by use of EpiSCs culture will be presented in Part 2

of this thesis.

Table 2.

Pou5f1 ChIP sites, top 10 in fold enrichment

chr	start	end	length	abs_summit	pileup	LOG10(pvalue) of peak summit	fold_enrichment	LOG10(qvalue) of peak summit	name	Near-by genes
chr1	179069050	179069713	664	179069380	173.2	267.2627	59.61034	260.46817	oct_peak_3612	Akt3
chr9	123433856	123434362	507	123434087	172.3	264.76868	59.02152	257.9902	oct_peak_50296	Limd1
chr14	48216576	48217192	617	48216871	159.7	240.10056	55.00401	233.49422	oct_peak_15090	Atg14
chr3	135037868	135038615	748	135038309	157.9	236.2625	54.38983	229.68568	oct_peak_33096	Nhedc1
chr2	17793576	17794189	614	17793920	156.1	234.34758	53.77565	227.81384	oct_peak_26353	Neb1
chr15	93547400	93548096	697	93547765	156.1	233.09962	53.12214	226.59679	oct_peak_18462	Prickle1
chr2	93987152	93987858	707	93987521	149.9	221.02129	51.62603	214.69525	oct_peak_28424	In Hsd17bl2
chr3	36660863	36661738	876	36661432	149	219.12892	51.31895	212.82726	oct_peak_31050	Trpc3
chr6	149037033	149037806	774	149037291	149	219.12892	51.31895	212.82726	oct_peak_43243	In Dnnd5b
chr15	38475162	38475725	564	38475480	154.3	226.37271	50.99823	219.97693	oct_peak_17309	Azin1

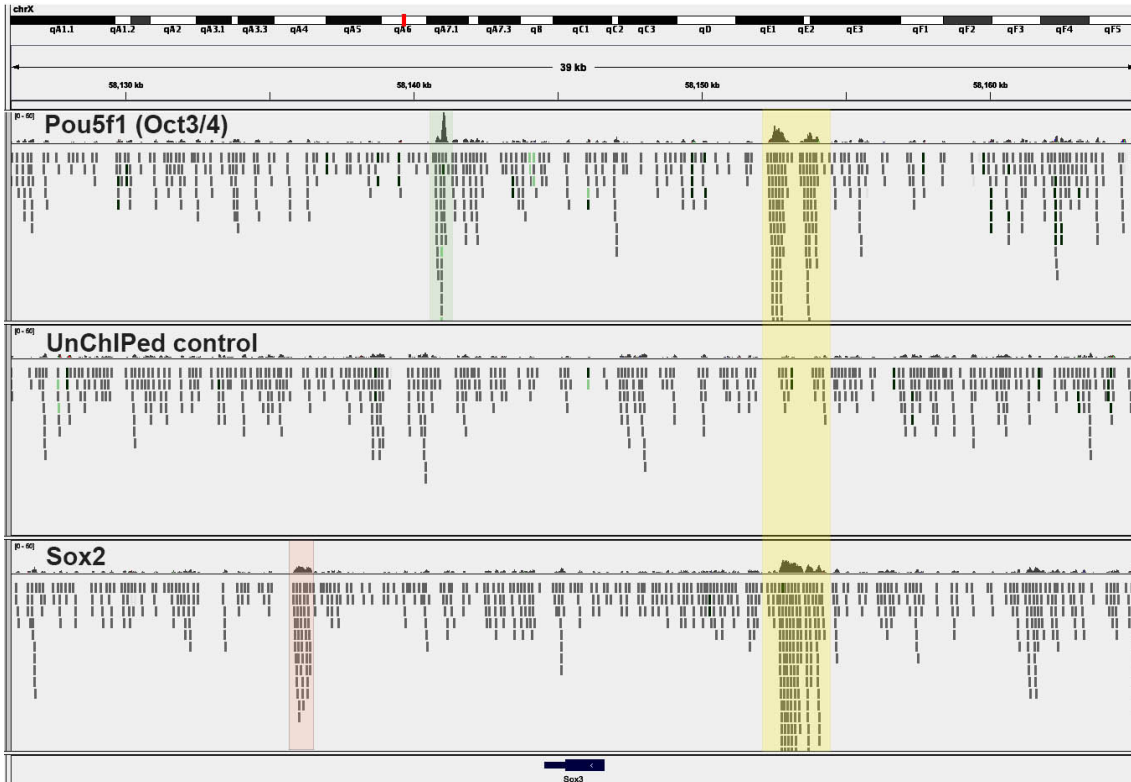
Sox2 ChIP sites, top 10 in fold enrichment

chr	start	end	length	abs_summit	pileup	LOG10(pvalue) of peak summit	fold_enrichment	LOG10(qvalue) of peak summit	name	Near-by gene
chr17	35639693	35640023	331	35639861	187	285.14606	59.3223	275.72415	sox2_peak_22956	Pou5f1
chr6	115962003	115962365	363	115962175	101	128.61462	32.1855	121.50236	sox2_peak_46456	PlxnD1, Tmcc1
chr8	9296640	9297767	1128	9297039	99	125.27409	31.55441	118.26549	sox2_peak_49299	In Fam155a
chr9	120058481	120058872	392	120058683	89	108.83782	28.39897	102.30016	sox2_peak_53759	Mobp
chr14	118815219	118815931	713	118815607	81	96.03217	25.87462	89.62773	sox2_peak_18101	Sox21
chr15	54686205	54686777	573	54686474	79	92.88216	25.24353	86.51411	sox2_peak_19618	In Enpp2
chr5	8488796	8489303	508	8489035	117	128.21327	24.70942	121.11359	sox2_peak_41345	Rundc3b
chr1	135389005	135389485	481	135389227	75	86.64738	23.98136	80.33472	sox2_peak_3124	Sox13, Snrpe
chr3	62742540	62743044	505	62742738	72	82.03062	23.03472	75.77604	sox2_peak_35305	Mme, Gpr149
chr3	8866014	8866692	679	8866357	69	77.467	22.08809	71.26626	sox2_peak_33870	In Mrps28

Table 2. Top 10 of fold enrichment of biotin-ChIPed genomic sites for Pou5f1 and Sox2

Above list shows Pou5f1 binding sites ordered according to the fold enrichment. Bottom list shows the Sox2 binding sites. Yellow color indicates that more frequent occurrence of transcription factor as target genes of Sox2 than of Pou5f1.

Fig. 7



**Figure 7. The interaction of Pou5f1 and Sox2 with the Sox3 genomic locus**

The interacting site of Pou5f1 visualized by IGV is shown on top, that of Sox2 on the bottom and Un-ChIPed control in the middle. Yellow color indicates the combined interaction site of Pou5f1 and Sox2 in EpiSCs. Green and red color indicate the sites of single interaction.

## **PART 2**

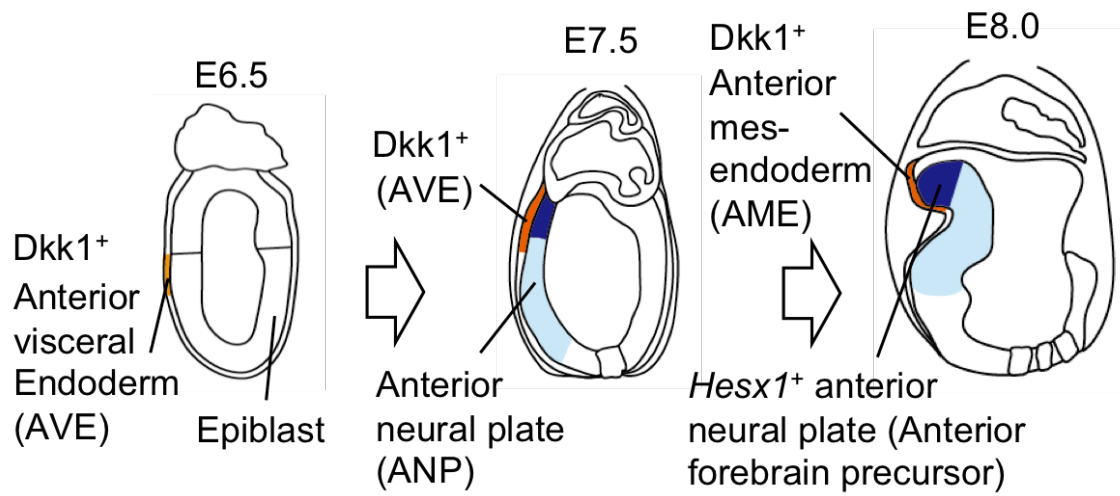
**Inhibition of Wnt signaling by Dkk1 promotes the development of  
anterior forebrain precursor,  
involving the activation of the *Hesx1* 5' enhancer**

## INTRODUCTION

After E7.5, the anterior neural plate is further regionalized into sub-domains that are under different transcriptional regulations. The development of the anterior-most domain of neural plate is marked by the *Hesx1* expression. *Hesx1*-null mouse embryos show the anterior truncation (lack of anterior forebrain) and embryonic lethality (Mukhopadhyay et al., 2001).

Wnt signal inhibitor Dkk1 is expressed in the tissues underlying the epiblast and the anterior neural plate, in the anterior visceral endoderm (AVE) up to E7.5 and then in the anterior mesendoderm (AME) (Fig. 8). *Dkk1*-null mouse embryos show forebrain truncation which is similar to *Hesx1*-null mouse embryos. It is possible that the inhibition of Wnt signaling by Dkk1 determines the anterior-most domain of the neural plate expressing *Hesx1*. To test this model, I inhibited Wnt signaling in EpiSCs under activin-free culture condition, by overexpressing Dkk1, by addition of recombinant Dkk1 or by addition of pharmacological Wnt antagonist XAV939. I then examined the effect of Wnt signal inhibition on the development of the anterior neural plate cells starting from EpiSCs. I also determined whether the effect involves regulation of the *Hesx1* 5' enhancer. Finally, I analyzed the stage dependence of the effect of Wnt signal inhibition.

Fig. 8



**Figure 8. The development of mouse embryo from E 6.5 to E 8.5**

Orange color indicates the anterior visceral endoderm and anterior mesendoderm expressing *Dkk1*. Light blue color indicates the anterior neural plate and dark blue color indicates the anterior forebrain precursor.

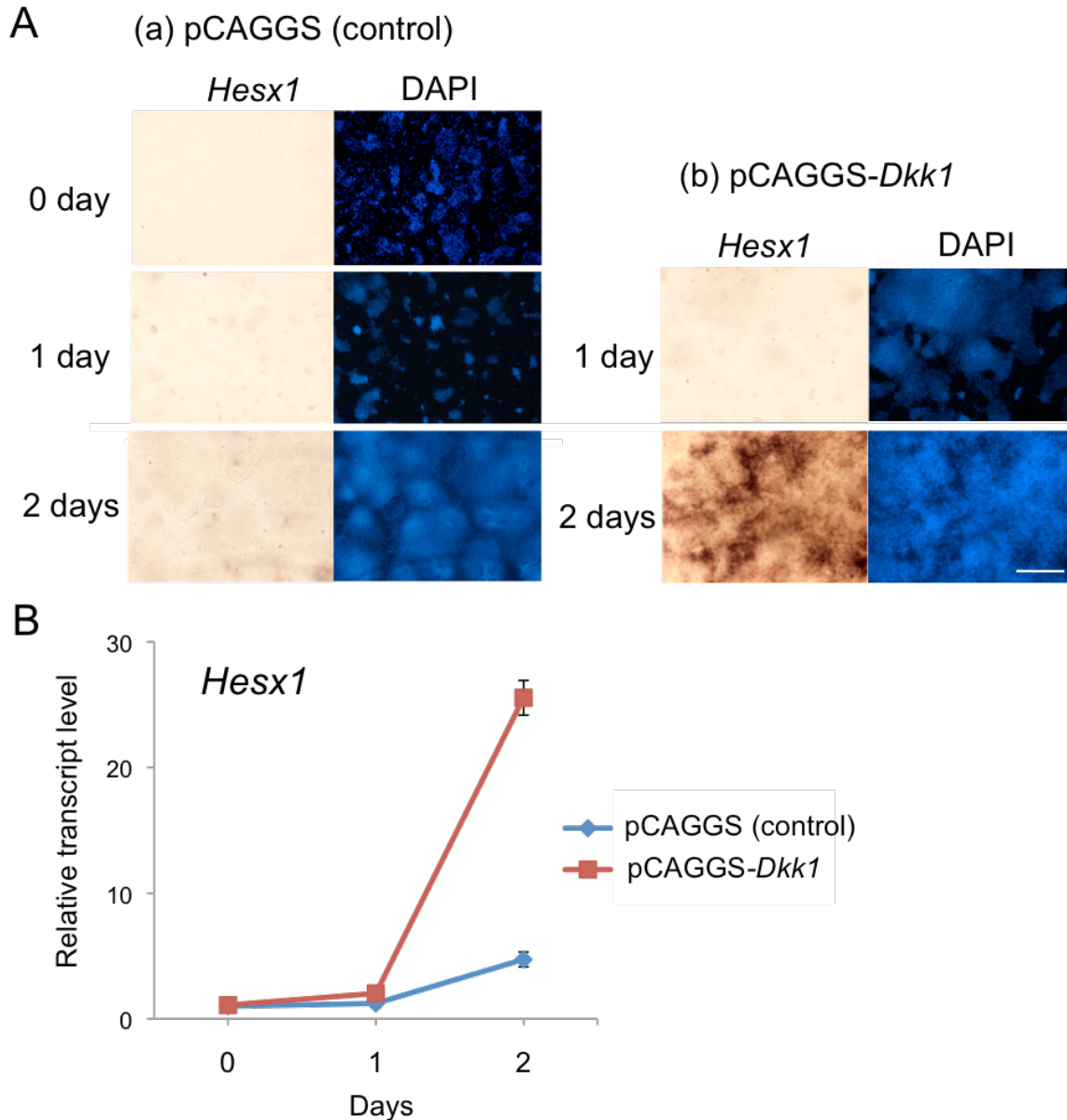


## 2-1 The effect of Dkk1 on the anterior neural plate development from the EpiSCs.

As reported in Part 1, the analysis of the expression pattern by immunocytochemistry and microarray analysis showed that EpiSCs develop into anterior neural plate cells after the removal of activin. However, the detection of *Hesx1*-expressing cells in the EpiSC-derived cells by in situ hybridization revealed that *Hesx1*-expressing cells were only a small fraction of the whole culture cells (Fig.9A-a). This observation indicated that under this condition EpiSCs develop into a broad range of anterior neural plate cells. An additional condition is required for the restricted development of the anterior forebrain precursor present in the anterior-most domain of the anterior neural plate in embryos.

In embryos of E6 to E8, Wnt3 is endogenously expressed in the epiblast, while Wnt antagonist Dkk1 is expressed in the visceral endoderm underlying the anterior-most part of the epiblast (Lewis et al., 2008). This suggests that the Dkk1-dependent inhibition of Wnt signal is involved in the development of anterior forebrain precursor in the anterior neural plate starting from the epiblast cells. In order to examine this model, I transfected the Dkk1 expression vector into EpiSCs and analyzed its effect under the activin-free condition. Vector-driven Dkk1 stimulated the development of anterior forebrain precursor, as indicated by in situ hybridization detection of *Hesx1* expression. The fraction of *Hesx1*-expressing cells was dramatically increased with transfection of pCAGGS-Dkk1 (Fig. 9A-b). Without exogenous Dkk1 expression, the expression level of *Hesx1* 2 days after removal of activin was only 5 fold higher than in EpiSCs cultured with activin, but this level was augmented further to ~25 fold with exogenous Dkk1 expression (Fig. 9B). This result suggested that by expression of Dkk1, the majority of the anterior neural plate cells that developed from EpiSCs in the absence of activin gained the character of anterior forebrain precursor.

Fig. 9

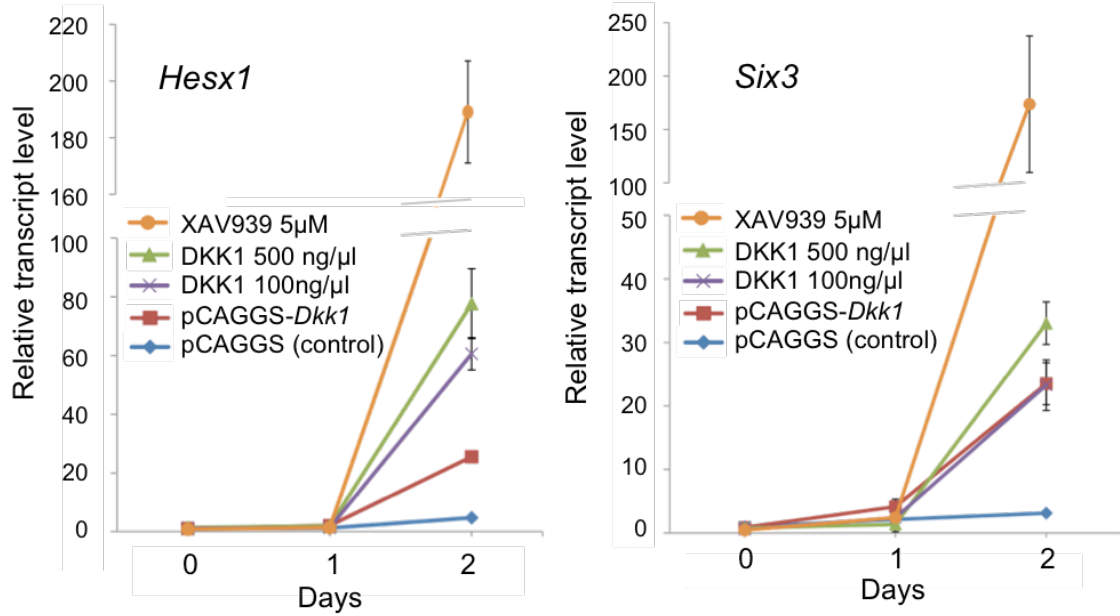


**Figure 9. Effect of *Dkk1* on the development of anterior neural plate cells derived from EpiSCs.** (a) *Hesx1* expression pattern was examined by in situ hybridization (left) and compared with 4', 6-diamino-2-phnylindole (DAPI)-stained nuclei (right). The increase of *Hesx1* expression was moderate under the condition of transfection of pCAGGS after 2 days removal of Activin. Under the condition of transfection of pCAGGS-*Dkk1*, *Hesx1* expression was dramatically increased after 2 days. (b) qRT-PCR analysis during anterior neural plate development with or without exogenous *Dkk1* expression. Data are average of duplicate cultures, with indication of standard errors.

## 2-2 Wnt signal inhibition promotes the development of the anterior forebrain precursor in the anterior neural plate

In order to examine if the effect of exogenous Dkk1 expression is via Wnt signal inhibition, I compared the effect of expression vector-derived Dkk1, recombinant Dkk1 and chemical Wnt signal inhibitor XAV939. The chemical inhibitor stabilizes axin by inhibition of the poly-ADP-ribosylating enzymes tankyrase1 (Shih-Min A. Huang et al., 2009), promotes proteasome-dependent  $\beta$ -catenin degradation and causes the repression of the Wnt signal. As shown in Fig. 10, pCAGGS vector-driven Dkk1 expression and addition of recombinant Dkk1 to culture medium activated the expression of *Hesx1* and *Six3* after 2 days. Activation of *Hesx1* expression was higher by addition of recombinant Dkk1 than vector-derived Dkk1. However the activation of *Six3* was comparable between the two procedures of Dkk1 addition. XAV939 also activated both *Hesx1* and *Six3* expression level after 2 days, to levels higher than with Dkk1 addition. Above observations indicated that inhibition of Wnt signal caused the activation of *Hesx1* and *Six3* involved in the development of the anterior forebrain precursor.

Fig. 10



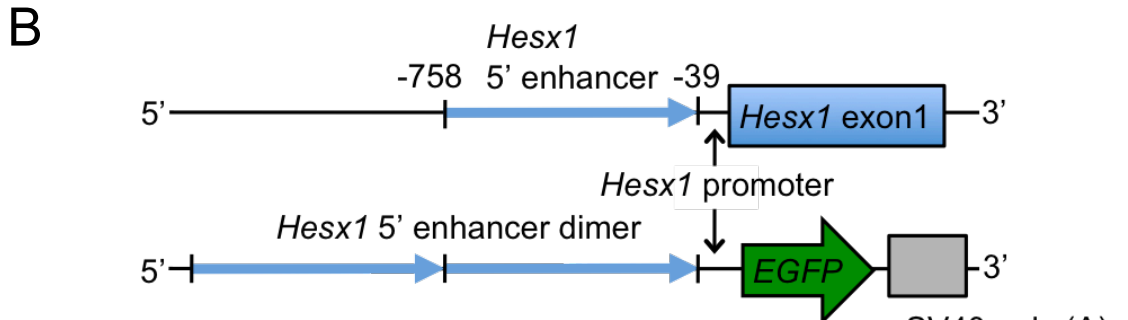
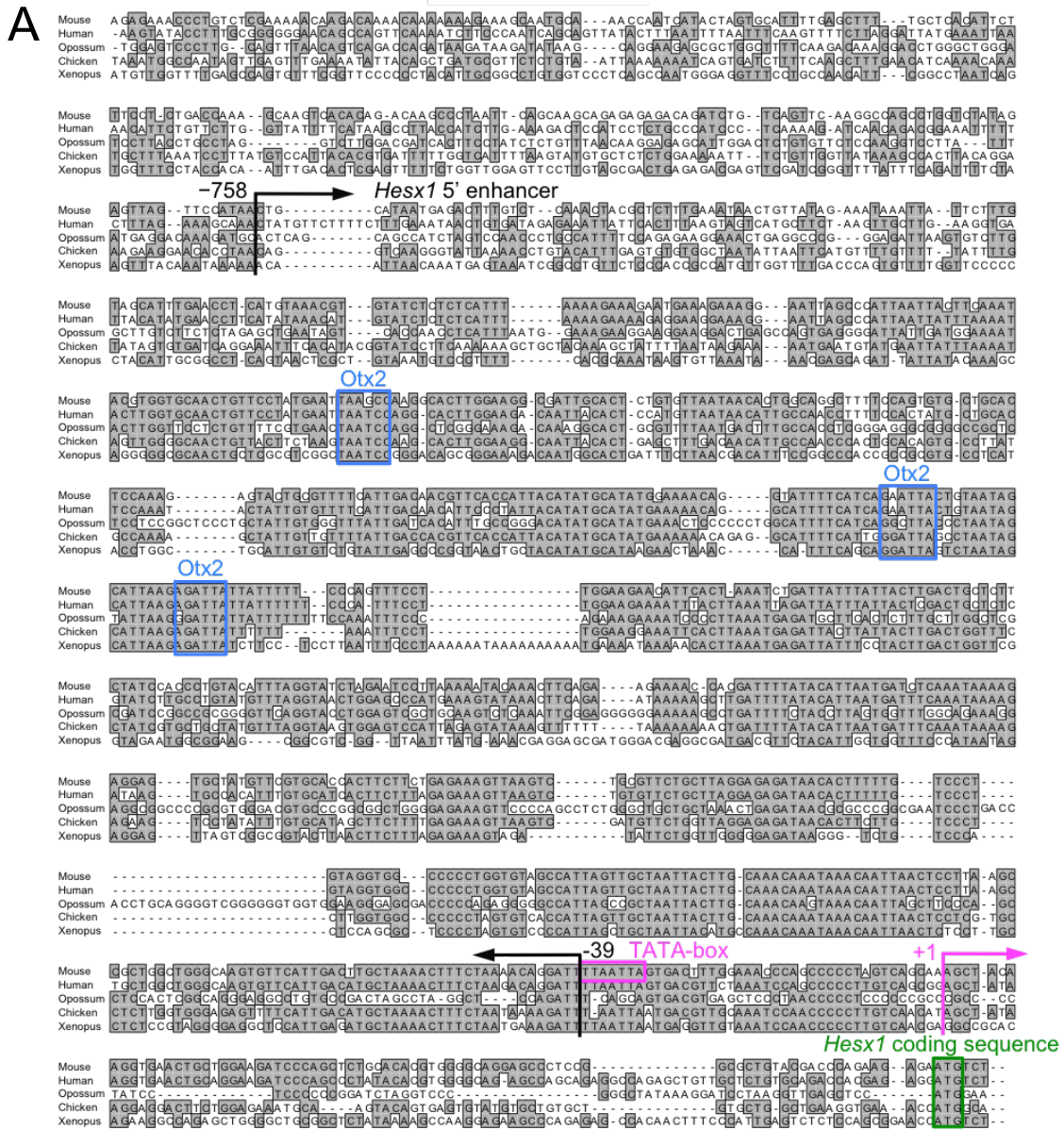
**Figure 10. qRT-PCR analysis during anterior neural plate development derived from EpiSCs under various conditions:** transfection of pCAGGS, pCAGGS-*Dkk1*, treatment with recombinant Dkk1 at 500 ng/μl or 100 ng/μl, or with 5 μM XAV939. Data are average of duplicate cultures, with indication of standard errors.

## 2-3 Characterization of the mouse *Hesx1* 5' enhancer

*Hesx1* is expressed during early mouse development in the anterior-most domain of the visceral endoderm and neural plate. *Hesx1* is expressed in the anterior part of visceral endoderm before E7. Around E7, *Hesx1* expression is initiated in the anterior-most domain of neural plate, the precursor for the anterior forebrain, and this expression continues to the E8 stage. After E8 *Hesx1* expression in the forebrain precursor is gradually turned off and *Hesx1* expression becomes limited to Rathke's pouch, which is the primordium of the pituitary (Chou et al., 2006). It was reported in previous studies that the *Hesx1* expression during these stage is regulated by two distinct enhancers. A 5' *Hesx1* enhancer was suggested to be present in the region from -1 kb to exon 2 (Hermesz et al., 2003), and to regulate the *Hesx1* expression in the anterior forebrain precursor, while the pituitary *Hesx1* expression is regulated by a 3' enhancer (Chou et al., 2006). However the 5' enhancer has not been defined. In order to determine mouse *Hesx1* 5' enhancer and to utilize this enhancer as a reporter of the anterior forebrain precursor development, I analyzed the 5' upstream sequence of the *Hesx1* gene for an enhancer activity by generating the transgenic mouse embryos. *Hesx1* 5' upstream sequences of five vertebrate species; mouse, human, opossum, chicken and *Xenopus* are shown in Fig. 11A. Conserved region is shown in gray and three conserved Otx2 binding sites are shown in blue boxes. I isolated 720 bp *Hesx1* 5' sequence from -758 to -39 as indicated by black arrows.

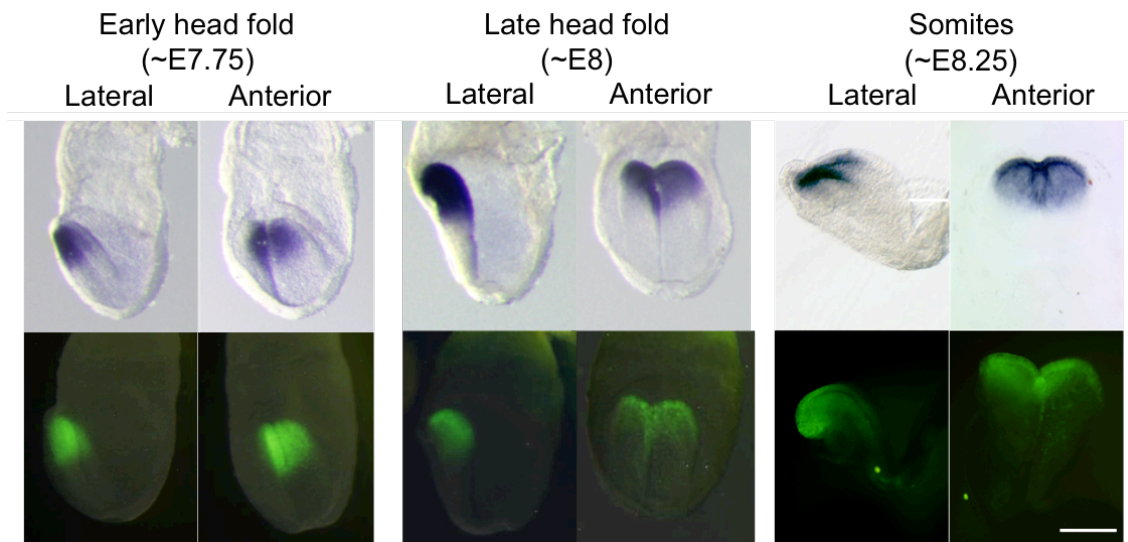
When this 720bp *Hesx1* upstream sequence was linked to the *Hesx1* promoter and EGFP coding sequence, only very weak activity was detected in transgenic mouse embryos (data not shown). Therefore, I dimerized this sequence (Fig. 11B) and found a strong enhancer activity. The primary transgenic embryos, which were injected with transgene carrying dimerized *Hesx1* 5' enhancer EGFP, showed the EGFP expression in the anterior-most domain of the neural plate during the stages E7.75 to E8.25. Expression pattern of the transgene was similar to the *Hesx1* endogenous expression pattern of the corresponding stages (Fig. 12). During the anterior neural plate development, this enhancer appears to regulate the *Hesx1* expression in the anterior forebrain precursor.

Fig. 11



**Figure 11. *Hesx1* 5' enhancer transgene for EGFP expression.** SV40 poly (A)  
 (A) Conserved cis-regulatory sequence of *Hesx1* 5' enhancer in mouse, opossum, chicken and Xenopus. Gray shades show sequences conserved in more than 3 species. Blue boxes show Otx2 core binding sequences. Magenta box shows the TATA-box. Green box shows start codon of *Hesx1* coding sequence. (B) The construction of the transgene carrying the *Hesx1* 5' enhancer dimer that showed a strong enhancer activity.

Fig. 12



**Figure 12. The *Hesx1* 5' enhancer activity recapitulates the *Hesx1* endogenous expression pattern from E7.75 to E8.25.**

The endogenous *Hesx1* expression pattern was detected by in situ hybridization (above). The expression of EGFP indicates the *Hesx1* 5' enhancer activity (bottom). The embryos are shown in lateral and anterior views. Scale bar indicates 200  $\mu$  m.

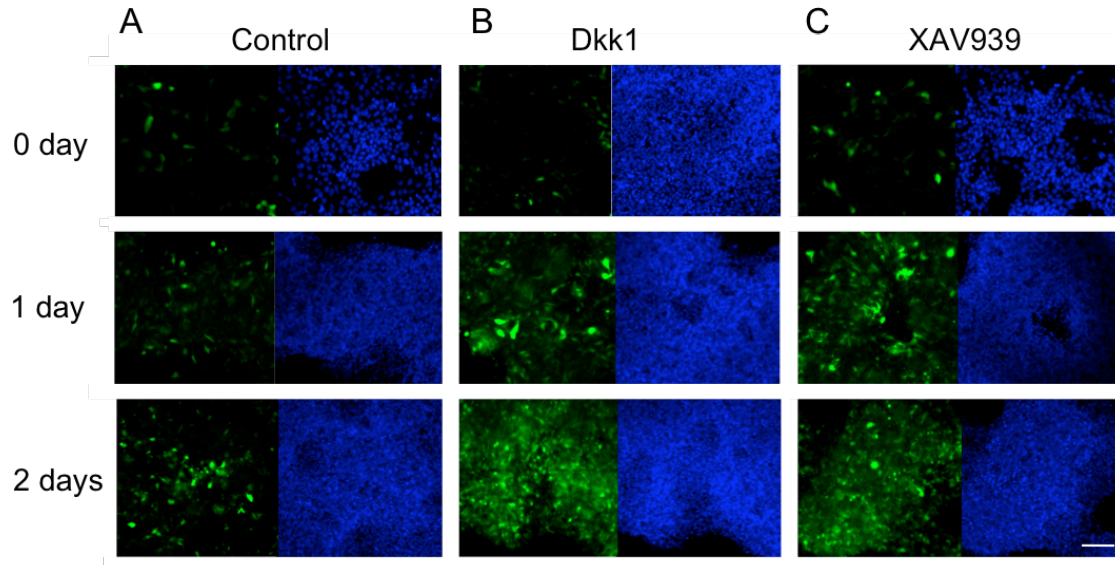
## 2-4 Activation of *Hesx1* 5' enhancer under the inhibition of Wnt signaling

Activation of the *Hesx1* 5' enhancer was investigated using the anterior neural plate cells that developed from EpiSCs in the activin-free culture medium. The enhancer activity was very moderately augmented 2 days after the removal of activin. The time course of the 5' enhancer activation was similar to the endogenous *Hesx1* expression. Inhibition of Wnt signaling strongly augmented the enhancer activity (Fig. 13). The strength of enhancer activity was comparable between the addition of recombinant Dkk1 and of XAV939. However, the augmentation level of endogenous *Hesx1* expression was different between these two procedures of Wnt signal inhibition. This may be partly due to the effect of enhancer dimerization.

Above observations demonstrated that the activation of 5' *Hesx1* enhancer depended on the inhibition of Wnt signaling. This result suggested that in embryos Dkk1 expressed in the AVE or/and AME inhibits the Wnt signaling in the anterior-most part of the neural plate and activates the *Hesx1* expression via its 5' enhancer.



Fig. 13



**Figure 13. The *Hesx1* 5' enhancer activity in EpiSC culture with or without Wnt signal inhibitor**

EpiSCs were transfected with *Hesx1* 5' enhancer dimer-EGFP vector and cultured in the absence of activin (A) without Wnt signal inhibitor, (B) with 500 ng/ml recombinant Dkk1 (C) with 5  $\mu$  M XAV939. The expression of EGFP indicates the activity of dimeric *Hesx1* 5' enhancer (left) at 0 day (epiblastic state), 1 day and 2 days after the removal of activin. The nuclei are indicated by DAPI fluorescence (right). The scale bar indicates 100  $\mu$  m.

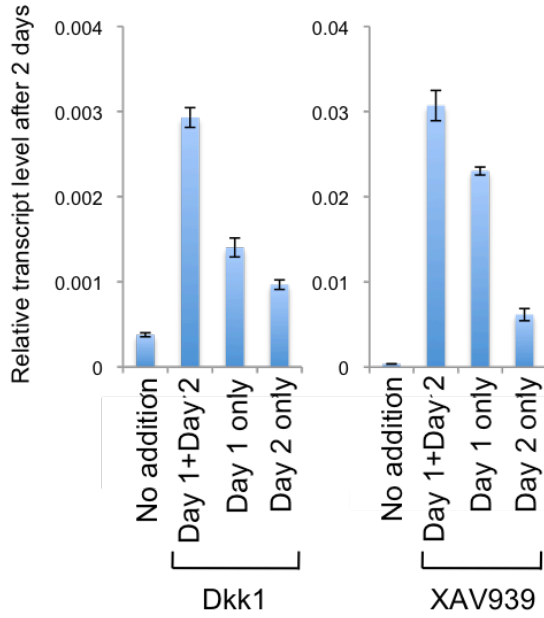
## 2-5 Developmental stage-dependent impact of Wnt signal inhibition on the anterior forebrain precursor development

In ~E7 mouse embryos, *Dkk1* is expressed in the anterior visceral endoderm underlying the anterior-most part of the epiblast. In ~8 embryos, however, *Dkk1* is expressed in the anterior mesendoderm that underlies the anterior-most part of the neural plate replacing the anterior visceral endoderm. I analyzed in which of these stages the effects of *Dkk1* dependent-inhibition of Wnt signaling is more important. Wnt signaling was inhibited during first day or/and second day of EpiSCs culturing without activin. Recombinant *Dkk1* or XAV939 was added to the culture medium and the activation of *Hesx1* 5' enhancer was assessed after 2 days. The expression of *Hesx1* and *Six3* was strongly activated by addition of Wnt inhibitors throughout two days (Fig. 14A). Even by addition of Wnt inhibitors only during the first day, expression of *Hesx1* and *Six3* was significantly activated, although to the level lower than by the continuous addition of the inhibitors. However, by addition of the Wnt inhibitors only on the second day, activation of *Hesx1* and *Six3* was even lower than the addition on the first day. These results suggested that Wnt signal inhibition during the first day is more important than that during the second day to promote the development of anterior forebrain precursor.

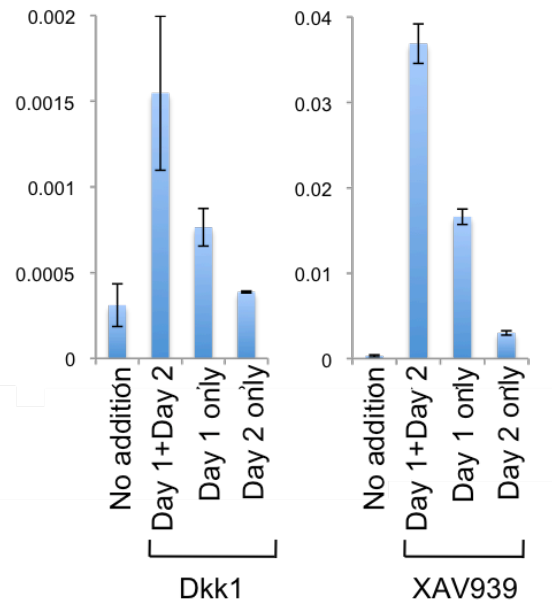
I also analyzed the activation of dimeric *Hesx1* 5' enhancer activity in the same EpiSCs culture system (Fig. 14B). The enhancer activation after 2 days was compared. Inhibition of Wnt signaling either during the first or second day was equally effective in the *Hesx1* 5' enhancer activation, although the activation of endogenous *Hesx1* expression level was higher by the first day inhibition of the Wnt signaling. This may be partly due to the effect of dimerization of the enhancer, which may have made its activation more sensitive to the Wnt signal inhibition. Considering the effects on *Hesx1* and *Six3* expression using our EpiSC culture model, we concluded that the effect of *Dkk1* expressed in the anterior visceral endoderm before E7.5 has a large impact on the development of anterior forebrain precursor than *Dkk1* expressed in the anterior mesendoderm after E7.5, although *Dkk1* effect in either period may be sufficient for the eventual development of the anterior forebrain precursor.

Fig. 14

**A** (a) *Hesx1*

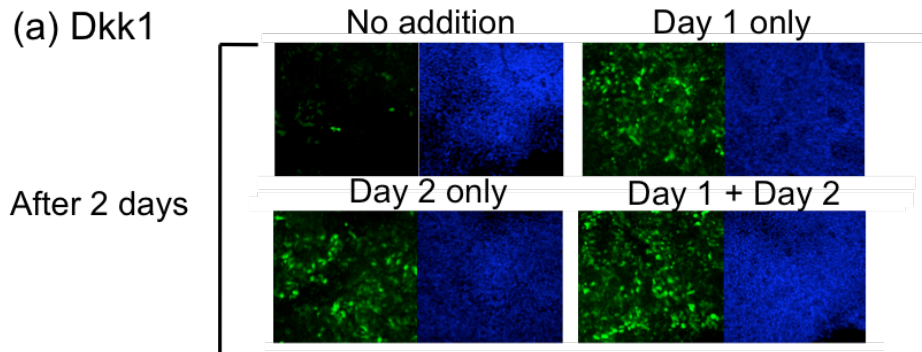


(b) *Six3*

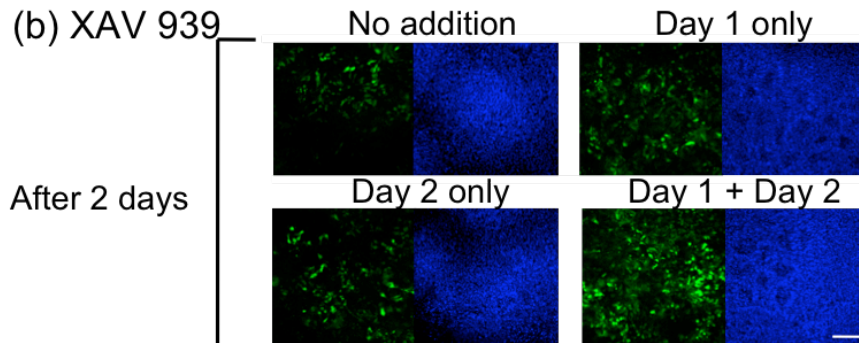


**B**

(a) Dkk1



(b) XAV 939



**Figure 14. The effect of stage-restricted inhibition of Wnt signaling on the anterior forebrain precursor development**

(A) The *Hesx1* and *Six3* expression level is indicated as relative transcription level using qRT-PCR. The expression level is compared with no addition, addition for the consecutive 2 days, addition on day 1 only and addition on day 2 only of 500 ng/ $\mu$ l Dkk1 (left) and 5  $\mu$ M XAV939 (right).

(B) Activation of *Hesx1* 5' enhancer dimer in the transfected cultures under the same condition as A. EGFP fluorescence indicates the activity of *Hesx1* 5' enhancer dimer (left) and DAPI indicates nuclei (right). Scale bar indicates 100  $\mu$ m.

## DISCUSSION

In this part I showed that the inhibition of Wnt signaling by the effect of Dkk1 promoted the development of the anterior forebrain precursor from EpiSCs. In this EpiSC model, the interactions with underlying tissues that occur in embryos are not involved. Therefore, the effect of Dkk1 on epiblast-endogenous Wnt signaling was directly analyzed during the anterior neural plate development. Inhibition of Wnt signaling by Dkk1 significantly up-regulated the expression level of *Hesx1* 2 days after removal of activin. The effect of Wnt signal inhibition by Dkk1 on the *Hesx1* expression was marginal 1 day after the removal of activin. Nevertheless, stage-restricted addition of Dkk1 indicated that the addition of Dkk1 on the first day has a larger contribution to the promotion of the development of anterior forebrain precursor than that the addition on the second day. Day 1 effect of Dkk1 in culture mimics the effect of Dkk1 secreted from the anterior visceral endoderm in E6.5 to E7.5 embryos, and day 2 effect mimics the effect of Dkk1 secreted from the anterior mesendoderm in E7.5 to E8.25 embryos. Taken together, the inhibition of Wnt signaling by Dkk1 expressed in the anterior visceral endoderm is more important for the anterior forebrain precursor development than that that of anterior mesendoderm.

This inhibition of Wnt signaling by Dkk1 on the first day after removal of activin of EpiSCs culture may affect expression of various genes. In order to test this, I performed the microarray analysis of EpiSCs after the removal of activin and with or without Dkk1 addition, namely “NP1 with Dkk1” and “NP1 without Dkk1”. In this microarray analysis, I found that the expression level of transcripts detected by 681 probes expressed in “NP1 with Dkk1” were upregulated more than 1.5 times higher than “NP1 without Dkk1” (a part of analysis is shown in Table 3). In addition, the expression level of transcripts detected by 654 probes were more than 1.5 times downregulated (expression level less than 0.66) in “NP1 with Dkk1” in comparison with “NP1 without Dkk1” (a part of analysis is shown in Table 4). For instance, the transcription factor gene *Pou3f1* was about 1.7 times upregulated in “NP1 with Dkk1” compared to “NP1 without Dkk1”. This transcription factor is known to be involved in the *Sox2* activation during the anterior neural plate development through interaction with the N2 enhancer (Iwafuchi et al., 2011). More in depth analysis of the data will provide important information concerning the regulation of the anterior neural plate.

In a previous study, the 5' regulatory region of mouse *Hesx1* was very

vaguely defined (Hermesz et al., 2003). In this study I isolated the *Hesx1* 5' enhancer of mouse and demonstrated the specific activity of this enhancer. The expression of *Hesx1* in Rathke's pouch after E8.5 is regulated by the distinct 3' enhancer (Chou et al., 2006). I found that the 720 bp 5' *Hesx1* enhancer drives *Hesx1* expression in the anterior-most region of neural plate during the developmental stages E7.5 to E8.25. *Hesx1* 5' enhancer was activated after 2 days in activin-free EpiSCs culture, when the Wnt signal was inhibited. It is still unclear whether this Wnt inhibition-dependent *Hesx1* activation is a direct effect of lowered Wnt signaling or an indirect effect.

In this study I showed that Dkk1-dependent inhibition of Wnt signaling activates expression of *Hesx1* via 5' enhancer and promotes development of the anterior forebrain precursor from EpiSCs. Utilizing this EpiSC culture model representing the development of anterior forebrain precursor, it will be possible to precisely analyze the transcriptional regulatory network involved in the regionalization of the anterior neural plate.

**Table 3. Microarray analysis of gene expression pattern of NP1 with Dkk1 or without Dkk1**

Gene description	GeneSymbol	day 1 (A)	day1 with Dkk1 (B)	B / A
Mus musculus prostaglandin E receptor 3 (subtype EF)	Ptger3	10.97613173	105.1597525	9.58076625
lincRNA:chr6:145647711-145756861 forward strand		3208.019844	15593.57019	4.86080852
Mus musculus lipase, member H (Liph), transcript vari	Liph	56.69178837	268.2892441	4.732418077
lincRNA:chr5:33773382-33776739 reverse strand		113.0033853	515.5559241	4.562305127
lincRNA:chr2:128137419-128141735 reverse strand		28.51720394	128.6657501	4.51186415
Mus musculus stathmin-like 4 (Stmn4), mRNA [NM_01	Stmn4	1213.107934	5099.752371	4.203873561
Mus musculus stathmin-like 4 (Stmn4), mRNA [NM_01	Stmn4	1037.842858	4330.552812	4.172647892
lincRNA:chr15:61984389-62102500 reverse strand		1064.488613	4400.95024	4.134332851
Mus musculus 12 days embryo spinal ganglion cDNA,	Uros	105.8923199	418.0528723	3.9479055
Mus musculus guanine nucleotide binding protein (G p	Gng7	135.1708889	524.0767542	3.877142176
Mus musculus glutamate receptor, ionotropic, AMPA3	Gria3	124.3283049	476.8138715	3.835119218
Mus musculus shisa homolog 6 (Xenopus laevis) (Shis)	Shisa6	94.98517507	359.9188533	3.789210822
Mus musculus lymphotoxin B (Ltb), mRNA [NM_00851	Ltb	701.1469094	2607.615891	3.719072075
Mus musculus solute carrier family 25, member 47 (Sl	Slc25a47	84.68561335	296.6505559	3.502962831
lincRNA:chr1:63264155-63345773 forward strand		5196.95498	18187.63282	3.499671036
Mus musculus ATP-binding cassette, sub-family G (W	Abcg1	410.6784837	1428.844064	3.479227962
Mus musculus retinoid X receptor gamma (Rxrg), tran	Rxrg	88.29704587	305.6627378	3.461754974
Mus musculus RIKEN cDNA A830018L16 gene (A8300	A830018L16Rik	174.2792045	599.815131	3.441690779
Mus musculus kynureninase (L-kynurenine hydrolase)	Kynu	71.62387321	243.1010563	3.39413446
lincRNA:chr2:128137419-128141735 reverse strand		33.72205127	114.2709977	3.388613487
lincRNA:chr3:93150619-93184368 forward strand		123.3002318	417.1819845	3.383464723
Mus musculus early growth response 1 (Egr1), mRNA	Egr1	176.7231041	593.4138604	3.357873683
Mus musculus solute carrier family 22 (organic anion	Slc22a6	135.3665671	448.2913883	3.311684694
lincRNA:chr6:31170350-31287353 forward strand		130.2504872	427.4970164	3.282114528
Mus musculus sprouty-related, EVH1 domain containi	Spred3	37.86945765	123.3232778	3.256536676
Mus musculus arylacetamide deacetylase (esterase) (	Aadac	52.22983881	160.1004922	3.065307032
Mus musculus keratin associated protein 8-2 (Krtap8	Krtap8-2	3029.92355	9143.708059	3.017801574
Mus musculus Hedgehog-interacting protein (Hhip), m	Hhip	36.81956777	110.4347931	2.999350611
lincRNA:chr6:83368261-83407280 forward strand		314.1756934	930.0355907	2.960240433
Mus musculus myelocytomatosis oncogene (Myc), tra	Myc	103.4576439	302.8190689	2.92698594
Mus musculus chemokine (C-X-C motif) ligand 10 (Cx	Cxcl10	1156.459685	3358.172519	2.903838814
Mus musculus Chac, cation transport regulator-like 1	Chac1	11867.91536	34346.54472	2.894067213
Mus musculus dynein, axonemal, heavy chain 7B (Dna	Dnahc7b	74.5316524	212.7398563	2.854355826
lincRNA:chr8:74431707-74442440 forward strand		213.4621147	599.4310624	2.808137937
Mus musculus B cell leukemia/lymphoma 3 (Bcl3), mR	Bcl3	688.9921775	1924.286474	2.792900322
lincRNA:chr1:90340543-90359181 reverse strand		130.31858	362.4536672	2.781289261
Mus musculus deleted in lymphocytic leukemia, 7 (Dle	Dleu7	88.36075918	245.7397502	2.781095958
Mus musculus dual specificity phosphatase 8 (Dusp8)	Dusp8	119.8718107	331.0484163	2.761686958
Mus musculus GLI-Kruppel family member GLI1 (Gli1)	Gli1	139.6620349	384.1194443	2.750349762
Mus musculus 5' nucleotidase, ecto (Nt5e), mRNA [NM	Nt5e	358.29472	980.5616804	2.736746108
lincRNA:chr13:81773237-81783062 reverse strand		83.74955231	227.0969631	2.711620025
Mus musculus cysteine-rich C-terminal 1 (Crot1), mR	Crot1	91.24057898	242.42631	2.657001004
Mus musculus tribbles homolog 3 (Drosophila) (Trib3)	Trib3	16709.2667	44238.45499	2.647540182
lincRNA:chr11:55315017-55322092 reverse strand		51.92164273	136.6683093	2.632203106
Mus musculus VGF nerve growth factor inducible (Vgf	Vgf	2287.244329	5883.909961	2.572488599
Mus musculus cadherin 22 (Cdh22), mRNA [NM_17498	Cdh22	406.0971337	1037.16305	2.553977764
lincRNA:chr8:89996710-90049453 forward strand		144.029083	365.8993398	2.540454554
Mus musculus keratin 32 (Krt32), mRNA [NM_0011593	Krt32	53.3762013	135.1030046	2.531146866
Mus musculus solute carrier family 35, member D3 (S	Slc35d3	307.0220959	770.867096	2.510787029
Mus musculus ankyrin repeat domain 34A (Ankrd34a)	Ankrd34a	256.0272055	641.9591593	2.507386503
Mus musculus WNT1 inducible signaling pathway prote	Wisp1	80.3123141	200.9538297	2.502154644
Mus musculus peptide YY (Pyy), mRNA [NM_145435]	Pyy	125.8147098	311.6517906	2.477069581

**Table 4. Microarray analysis of gene expression pattern of NP1 with Dkk1 or without Dkk1**

Gene description	GeneSymbol	day 1 (A)	day1 with Dkk1 (B)	B / A
MONTH14_08_P15.x1 FH MONTH14 Mus musculus cD	3010033K07Rik	260.1762732	52.80182915	0.202946366
lincRNA:chr11:50994911-51050704 reverse strand		117.7462721	31.37100088	0.266428825
Mus musculus CUGBP, Elav-like family member 3 (Ce	Celf3	450.2163154	132.1091332	0.293434797
lincRNA:chr2:32950586-32984936 reverse strand		345.6523788	109.283002	0.316164472
Mus musculus dickkopf homolog 1 (Xenopus laevis) (D	Dkk1	234.6036672	80.76841137	0.344275997
Mus musculus epidermal growth factor receptor (Egfr)	Egfr	489.6984661	169.5372577	0.346207451
predicted gene 15139 [Source:MGI Symbol;Acc:MGI:3705164] [ENSMUS		502.4412724	174.5846346	0.347472718
Mus musculus RIKEN cDNA 4632428N05 gene (46324	4632428N05Rik	143.0271731	50.3973201	0.352361855
Mus musculus cyclin N-terminal domain containing 1 (	Cntd1	261.2071171	92.40421267	0.353758403
Mus musculus RALBP1 associated Eps domain contai	Reps2	131.1769463	47.94200037	0.365475807
Mus musculus calcium channel, voltage-dependent, T	Cacna1h	317.6116285	116.5392217	0.366923662
lincRNA:chr7:99879368-99889978 forward strand		325.6297593	120.5042027	0.370065079
Mus musculus family with sequence similarity 83, mem	Fam83e	825.1913719	322.3074122	0.390585049
Mus musculus PDZ domain containing 1 (Pdzk1), trans	Pdzk1	177.1834279	69.83805323	0.394156802
lincRNA:chr15:73455424-73477275 reverse strand		504.0661006	200.3474341	0.397462622
potassium voltage-gated channel, subfamily Q, membe	Kcnq1	125.8207826	50.92537266	0.404745318
Mus musculus aarF domain containing kinase 3 (Adck)	Adck3	1167.112225	475.1480028	0.407114237
Mus musculus 16 days neonate cerebellum cDNA, RIK	A630026N12Rik	342.6563064	141.7780068	0.413761557
Mus musculus glial cell line derived neurotrophic fact	Gdnf	291.9719866	123.3454835	0.422456568
Mus musculus cyclin A1 (Ccna1), mRNA [NM_007628]	Ccna1	390.9663723	165.3830706	0.423010986
Mus musculus dual specificity phosphatase 26 (putativ	Dusp26	763.0197494	322.9791309	0.423290657
Mus musculus fibroblast growth factor receptor 2 (Fg	Fgfr2	367.077954	156.8992265	0.427427539
Mus musculus neuron navigator 2 (Nav2), transcript v	Nav2	932.6964054	399.7274551	0.428571883
Mus musculus glutamic-oxaloacetic transaminase 1-li	Got1l1	172.7358802	74.5016377	0.431303778
lincRNA:chr5:123582742-123588202 reverse strand		456.6823936	198.0452688	0.433660836
Mus musculus RIKEN cDNA E130112N10 gene (E130	E130112N10Rik	131.2383751	56.94409437	0.433898197
Mus musculus phosphatidylinositol glycan anchor bios	Pigp	653.9520659	286.2951595	0.43779227
Mus musculus regulator of G-protein signaling 3 (Rgs)	Rgs3	318.1661568	139.8740779	0.439625884
lincRNA:chr19:46422690-46423478 reverse strand		214.5735644	94.75000878	0.441573542
phosphoinositide-3-kinase interacting protein 1 [Sour	Pik3ip1	223.9298903	99.04206856	0.442290524
Mus musculus claudin 11 (Cldn11), mRNA [NM_008770]	Cldn11	1308.735731	579.2948998	0.442637032
Mus musculus large tumor suppressor 2 (Lats2), trans	Lats2	751.5576809	332.7495509	0.442746524
Mus musculus adult male epididymis cDNA, RIKEN full	9230110K08Rik	740.6564406	329.5980987	0.445008078
Mus musculus DIX domain containing 1 (Dixdc1), mRN	Dixdc1	281.3504126	126.612852	0.450018363
lincRNA:chr7:26202452-26224557 forward strand		106.9617278	48.15727774	0.450229056
Mus musculus phosphoinositide-3-kinase interacting p	Pik3ip1	2609.961012	1176.730317	0.450861262
Mus musculus fibroblast growth factor receptor 2 (Fg	Fgfr2	345.8757757	155.9474868	0.450877158
Mus musculus cripto, FRL-1, cryptic family 1 (Cfc1), r	Cfc1	254.8603918	115.172038	0.45190246
Mus musculus selenium binding protein 1 (Selenbp1), r	Selenbp1	275.5453254	125.119653	0.454080115
lincRNA:chr11:68200716-68214458 reverse strand		198.4378352	90.15919416	0.454344778
Mus musculus RIKEN cDNA 4930451C15 gene (49304	4930451C15Rik	177.5869111	81.28322019	0.457709522
Mus musculus cyclin A1 (Ccna1), mRNA [NM_007628]	Ccna1	367.7811408	168.506918	0.45817172
lincRNA:chr12:109994730-109995062 reverse strand		112.7851093	51.73051378	0.458664394
Mus musculus bone morphogenetic protein 7 (Bmp7),	Bmp7	1991.841255	918.2679683	0.461014635
Mus musculus PDZ domain containing 1 (Pdzk1), trans	Pdzk1	765.9324749	353.3610809	0.461347563
RIKEN cDNA 1700047A11 gene [Source:MGI Symbol;Acc:MGI:1923854] [		506.9174395	233.936592	0.461488546
Mus musculus neurotensin receptor 1 (Ntsr1), mRNA	Ntsr1	140.2350951	65.4676554	0.466842165
Mus musculus thioredoxin interacting protein (Txnip),	Txnip	5315.027351	2481.604592	0.466903447
Mus musculus tropomyosin 1, alpha (Tpm1), transcript	Tpm1	33005.94574	15605.08971	0.472796321
Mus musculus adult male spinal cord cDNA, RIKEN full	2900052L18Rik	1093.240423	517.6011127	0.473455886
Mus musculus cyclin A1 (Ccna1), mRNA [NM_007628]	Ccna1	383.8765415	181.8870141	0.473816434
lincRNA:chr11:82593102-82594396 reverse strand		701.8658946	333.7779021	0.475557944



## CONCLUSION

EpiSCs under the culture condition without activin/Nodal signaling mimic the development of anterior neural plate in mouse embryos. Immunocytochemistry of transcription factor expression and microarray analysis indicated that 1 day after the removal of activin EpiSCs develop into the state of anterior neural plate of ~E7.5 embryos and after 2 days into ~E8 anterior neural plate, without specific character of anterior neural plate subdomains. This epiblast stem cells model enables us to analyze the anterior neural plate development instead of using mouse embryo itself.

By using this model, I showed that expression of *Dkk1* significantly activated the *Hesx1* and *Six3* after 2 days in the activin-free EpiSCs culture. Using chemical Wnt inhibitor XAV939, we confirmed that *Dkk1* effect is through the inhibition of Wnt signaling.

I isolated 720 bp mouse *Hesx1* 5' enhancer which was located from -758 to -39 of *Hesx1* gene. This enhancer showed the activity in the anterior-most domain of the anterior neural plate from E7.5 to 8.25 mouse embryos. Activation of this enhancer depended on a low Wnt signal level in EpiSCs. Inhibition of Wnt signal by *Dkk1* and XAV939 activated this enhancer. Taken together, inhibition of Wnt signal during the EpiSC-derived anterior neural plate development activated *Hesx1* expression via its 5' enhancer and promotes the anterior forebrain precursor development.

Finally, I showed the effect of stage-dependent inhibition of Wnt signal on anterior forebrain precursor development. The effect of *Dkk1* expressed in AVE (~E6.5) appeared to have a larger impact on anterior forebrain precursor development rather than that in AME (~E7.5), although both the *Dkk1* effect at either stage somehow activated *Hesx1* expression.

This study suggests that the regionalization of the anterior neural plate depends on the Wnt signal level. Using EpiSCs culture model enables us to further analyze transcriptional regulatory network of anterior neural plate development.

## **MATERIALS AND METHODS**

### ***Cultures of EpiSCs and EpiSC-derived anterior neural plate (ANP) cells***

EpiSCs (Tesar et al., 2007) were cultured in N2B27 medium under two different conditions: one for epiblastic state maintenance with the addition of 20 ng/ml activin and 10 ng/ml Fgf2 and cell plating on fibronectin-coated dishes; and another for the promotion of ANP development with cell plating on gelatin-coated dishes and without the addition of growth factors (Iwafuchi-Doi et al., 2012).

### ***Immunofluorescent staining of cell cultures***

Cell cultures were fixed in 4% paraformaldehyde in PBS, reacted with goat polyclonal antibodies [anti-Sox2 (AF2018, R&D); anti-Oct3/4(sc-8628, Santa Cruz); anti-Otx2 (AF-1979, R&D)] in TBST (150 mM NaCl, 100 mM Tris-HCl [pH7.5], 0.1% Triton-X100), incubated with AlexaFluor-555-conjugated anti-goat IgG (Invitrogen), and observed using a Nikon (ECLIPSE T300) inverted fluorescent microscope. This protocol is modified from Iwafuchi et al. (2011).

### ***Microarray analysis***

Total RNAs were extracted from duplicate cultures under epiblastic-maintenance and the activin-free conditions 1 day and 2 days after the removal of activin, and analyzed using an Agilent SurePrint G3 Mouse GE 8\_60k Microarray. The normalized data using Agilent Feature Extraction were averaged for duplicate samples, and the data for transcription factor genes, selected by gene ontology filtering and itemized inspection, were analyzed using Excel 2010 (Microsoft) functions. This protocol is modified from Iwafuchi et al., 2012.

### ***In situ hybridization detection of *Hex1* expression in embryos and cultured cells***

Embryos were staged according to the morphological criteria (Downs and Davies, 1993) and indicated by chronological stages (e.g., E7.5) that most relevantly represent a morphological feature. The procedures for whole mount in situ hybridization of embryos have been described previously (Uchikawa et al., 2003). Cells in a well of 12-well dish (Falcon 353043) were fixed with 4% paraformaldehyde for 15 min, washed with PBS, incubated with 2 mg/ml Glycine/PBS for 10 min, washed with PBS, treated with 5  $\mu$ l acetic anhydride in 2 ml 0.1 M Triethanolamine-HCl for 15 min,

washed with PBS, treated with 1 ml 0.2 M HCl for 10 min, washed with PBS and treated with pre-hybridized buffer (50% formamide, 5x SSC [pH 5]) for 2 hours. All procedures were carried out at room temperature. Then, cells were hybridized with 1 µg/ml RNA probe in hybridization buffer (50% formamide, 5x SSC [pH 5], 1% SDS, 50 µg/ml heparin, 50 µg/ml yeast tRNA) overnight at 70°C. After this step, the procedure for signal development was processed in the same manner as whole mount in situ hybridization (Uchikawa et al., 2003.). Mouse *Hesx1* probes were either 394 bp *AluI* fragment (113-506 bp) or 354-bp *BglII* fragment (272-625 bp) of the coding sequence (83-640 bp). These probes yielded identical results.

### ***Hesx1 5' enhancer-EGFP vector for mouse embryo transgenesis and EpiSC transfection***

*Hesx1* 5' enhancer covers the genomic region between -758 bp and -39 bp relative to the *Hesx1* transcription start site. *Hesx1* genomic region -758 bp to +61 bp including the 5' enhancer and promoter was joined to an EGFP coding sequence derived from ptkEGFP (the Herpes simplex virus thymidine kinase promoter of original ptkEGFP was removed by digestion with *NcoI* and *HindIII*.) (Uchikawa et al., 2003). Then to dimerize the enhancer sequence, -758 to -39 region was inserted into an upstream *SmaI* site. Resulting *Hesx1* 5' enhancer dimer-EGFP was linearized by digestion with *PvuI* and *SphI*, and used for 1-cell pronucleus injection to produce primary transgenic mouse embryos. For transfection, EpiSCs were dissociated by using Accutase (Sigma) and plated on a fibronectin-coated dish in Activin-Fgf2-containing N2B27 culture medium at the density of  $5.0 \times 10^4$  cells/cm<sup>2</sup>, and added with 125 ng/cm<sup>2</sup> *Hesx1* 5' enhancer dimer-EGFP vector mixed with Lipofectamine 2000 (Invitrogen). In cases indicated, CAGGS-Dkk1 (Takemoto et al., 2006) at 25 ng/cm<sup>2</sup> was also included in transfection. Recombinant Dkk1 (R&D) at 100 or 500 ng/ml or 5 µM XAV939 (SIGMA) were also added at this point. After 8 hours, the culture was freed from Lipofectamin 2000, and replated under the same culture condition, or transferred to the anterior neural palte-promoting condition without supply of activin and Fgf2 on gelatin-coated dishes at the cell density of  $1 \times 10^5$  cells/cm<sup>2</sup>, with re-addition of recombinant Dkk1 or XAV939. After 24 and 48 hours, the cells were fixed with 4% paraformaldehyde for 15 minutes and observed under a confocal microscope (Carl Zeiss LSM 5 PASCAL). All experiments involving recombinant organisms and experimental animals were

performed according to the guidelines of Osaka University.

### ***qRT-PCR analysis***

Total RNAs in a culture were extracted by using Trizol (Ambion), cDNAs were synthesized by using Verso cDNA Synthesis Kit (Thermo), and transcript levels were quantified by PCR (PCR cycles of 5 seconds at 95° C and 30 seconds at 60° C) using the primers indicated in Table 4 and SYBR Premix ExTaq (Takara) in StepOnePlus Real time PCR system (Applied Biosystems), employing the standard curve method using plasmid-cloned cDNA sequences as standards, and normalizing data based on *Gapdh* cDNA abundance of the sample.

**Table 4.**

Target gene	Forward primer	Tm (C)	Reverse primer	Tm (C)	Reference sequence (the range of coding sequence)	Target position	Size of PCR product(bp)	Reference
<i>Gapdh</i>	CATGGCCTTCGTGTTCTTA	60	GCGGCACGTCAGATCCA	59	NM_008084.2 (51-1052)	734-788	55	Iwafuchi-Doi et al., 2012
<i>Hesx1</i>	TCAGCTCCGGGAAAGCAA	59	CCAGTCCTAAAATGCTCTCAATTG	58	MN_010420.2 (359-916)	385-446	62	Iwafuchi-Doi et al., 2012
<i>Six3</i>	ACCGCGACGCCAACAG	59	GCTTTCTGCCCGCAACA	58	NM_011381.4 (407-1408)	1663-1712	50	This study

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Table S4. Microarray analysis of transcription factor gene expression at the epiblastic, NP1 and NP2 states of EpiSC

The relative intensities in NP1 and NP2 cells compared with the epiblastic state are shown in Log2 scale and color-coded according to Table 2.

Gene description	Gene symbol	Signal intensity at the epiblastic state	Log2(NP1/Epi)	Log2(NP2/Epi)
Mus musculus Pbx/knotted 1 homeobox 2 (Pknx2), transcript variant 2, mRNA [NM_001029838]	Pknx2	187.97	4.16	6.28
Mus musculus SRY-box containing gene 9 (Sox9), mRNA [NM_011448]	Sox9	88.38	4.29	6.07
Mus musculus Iroquois related homeobox 3 (Drosophila) (Irx3), mRNA [NM_008393]	Irx3	252.90	3.23	9.06
Mus musculus zinc finger, matrin type 1 (Zmat1), mRNA [NM_175446]	Zmat1	32.56	3.46	3.83
Mus musculus Iroquois related homeobox 5 (Drosophila) (Irx5), mRNA [NM_018826]	Irx5	29.63	4.36	8.17
Mus musculus LIM homeobox protein 6 (Lhx6), transcript variant 1, mRNA [NM_008500]	Lhx6	4491.65	3.25	1.09
Mus musculus teashirt zinc finger family member 2 (Tshz2), mRNA [NM_080455]	Tshz2	12.15	3.22	2.98
Mus musculus thyroid hormone receptor alpha (Thra), mRNA [NM_178060]	Thra	1255.39	1.16	3.12
Mus musculus trinucleotide repeat containing 18 (Tnrc18), transcript variant B, mRNA [NM_17824]	Tnrc18	990.03	1.29	3.51
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfam	Smarca1	737.72	2.28	3.07
Mus musculus neuronal PAS domain protein 1 (Npas1), mRNA [NM_008718]	Npas1	119.28	1.56	5.56
Mus musculus zinc finger, matrin type 4 (Zmat4), mRNA [NM_177086]	Zmat4	85.31	1.87	5.90
Mus musculus zinc finger and BTB domain containing 16 (Zbtb16), mRNA [NM_001033324]	Zbtb16	103.58	1.30	4.67
Mus musculus one cut domain, family member 2 (Onecut2), mRNA [NM_194268]	Onecut2	92.24	2.08	5.19
Mus musculus zinc finger E-box binding homeobox 2 (Zeb2), transcript variant 2, mRNA [NM_015]	Zeb2	248.15	1.04	4.58
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfam	Smarca2	313.67	1.77	3.38
Mus musculus homeobox gene expressed in ES cells (Hesx1), mRNA [NM_010420]	Hesx1	89.19	2.84	5.73
Mus musculus T-cell acute lymphocytic leukemia 2 (Tal2), mRNA [NM_009317]	Tal2	35.87	1.49	10.41
Mus musculus hairy and enhancer of split 3 (Drosophila) (Hes3), mRNA [NM_008237]	Hes3	4.62	1.82	3.60
Mus musculus myelin transcription factor 1-like (Myt1l), transcript variant 1, mRNA [NM_001093]	Myt1l	6.27	2.14	8.03
Mus musculus basic helix-loop-helix family, member e41 (Bhlhe41), mRNA [NM_024469]	Bhlhe41	5.61	1.96	6.64
Mus musculus Iroquois related homeobox 1 (Drosophila) (Irx1), mRNA [NM_010573]	Irx1	38.99	2.27	7.57
Mus musculus LIM homeobox protein 5 (Lhx5), mRNA [NM_008499]	Lhx5	8.84	1.14	5.57
Mus musculus NYN domain and retroviral integrase containing (Nynrin), mRNA [NM_001040072]	Nynrin	19.44	2.43	4.47
Mus musculus cut-like homeobox 2 [Source:MGI Symbol;Acc:MGI:107321] [ENSMUST00000111752]	Cux2	16.59	1.08	5.56
Mus musculus forkhead box D4 (Foxd4), mRNA [NM_008022]	Foxd4	41.42	1.32	3.17
Mus musculus Fez family zinc finger 2 (Fezf2), mRNA [NM_080433]	Fezf2	5.01	1.97	3.32
Mus musculus RAR-related orphan receptor gamma (Rorc), mRNA [NM_011281]	Rorc	46.03	2.87	5.94
Mus musculus 0 day neonate lung cDNA, RIKEN full-length enriched library, clone:E030047N19	Foxf1a	9.28	1.49	3.75
Mus musculus T-cell leukemia, homeobox 2 (Tlx2), mRNA [NM_009392]	Tlx2	55.16	1.96	5.64
Mus musculus Iroquois related homeobox 6 (Drosophila) (Irx6), mRNA [NM_022428]	Irx6	11.27	2.41	4.50
Mus musculus sal-like 3 (Drosophila) (Sall3), mRNA [NM_178280]	Sall3	30.97	1.13	3.46
Mus musculus LIM homeobox transcription factor 1 beta (Lmx1b), mRNA [NM_010725]	Lmx1b	61.91	2.10	4.22
Mus musculus regulatory factor X 8 (Rfx8), mRNA [NM_001145660]	Rfx8	18.27	1.15	4.19
Mus musculus regulatory factor X, 4 (influences HLA class II expression) (Rfx4), transcript variant	Rfx4	16.75	2.82	5.14
Mus musculus zinc finger protein of the cerebellum 2 (Zic2), mRNA [NM_009574]	Zic2	4324.68	1.04	2.01
Mus musculus zinc finger, RAN-binding domain containing 3 (Zranb3), mRNA [NM_027678]	Zranb3	2457.26	1.21	1.01
Mus musculus myeloblastosis oncogene (Myb), transcript variant 1, mRNA [NM_001198914]	Myb	1664.51	1.16	1.44
Mus musculus pre B-cell leukemia transcription factor 3 (Pbx3), mRNA [NM_016768]	Pbx3	4788.44	1.08	1.34
Mus musculus high-mobility group nucleosome binding domain 5 (Hmgn5), mRNA [NM_016710]	Hmgn5	4210.92	1.30	2.51
Mus musculus Wolf-Hirschhorn syndrome candidate 1 (human) (Whsc1), transcript variant 3, mRN	Whsc1	1848.98	1.28	1.69
Mus musculus avian reticuloendotheliosis viral (v-rel) oncogene related B (Relb), mRNA [NM_009]	Relb	1415.85	1.73	2.54
Mus musculus high mobility group box 3 (Hmgb3), mRNA [NM_008253]	Hmgb3	9737.58	1.12	1.94
Mus musculus Kruppel-like factor 11 (Klf11), mRNA [NM_178357]	Klf11	123.05	1.01	1.49
Mus musculus aryl-hydrocarbon receptor repressor (Ahrr), mRNA [NM_009644]	Ahrr	195.82	2.60	2.90
Mus musculus zinc finger and BTB domain containing 20 (Zbtb20), transcript variant 1, mRNA [N]	Zbtb20	197.60	1.35	2.40
Mus musculus BTB and CNC homology 2 (Bach2), mRNA [NM_001109661]	Bach2	102.85	1.29	1.71
Mus musculus trinucleotide repeat containing 18 (Tnrc18), transcript variant A, mRNA [NM_00112]	Tnrc18	228.47	1.57	2.78
Mus musculus zinc finger E-box binding homeobox 1 (Zeb1), mRNA [NM_011546]	Zeb1	415.23	1.06	1.50
Mus musculus RNA binding protein, fox-1 homolog (C. elegans) 3 (Rbfox3), transcript variant 3, m	Rbfox3	102.39	1.68	2.31
Mus musculus forkhead box O6 (Foxo6), mRNA [NM_194060]	Foxo6	463.24	1.21	2.07
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfam	Smarca2	117.05	1.07	1.12
Mus musculus GLI-Kruppel family member GLI2 (Gli2), mRNA [NM_001081125]	Gli2	204.75	2.22	2.07
Mus musculus castor homolog 1, zinc finger (Drosophila) (Casz1), transcript variant 2, mRNA [NM]	Casz1	103.08	1.26	2.48
Mus musculus trans-acting transcription factor 8 (Sp8), mRNA [NM_177082]	Sp8	87.20	1.04	2.42
Mus musculus general transcription factor II I (Gtf2i), transcript variant 2, mRNA [NM_010365]	Gtf2i	453.18	1.26	1.33
Mus musculus LIM homeobox protein 3 (Lhx3), mRNA [NM_001039653]	Lhx3	64.57	1.39	2.82
Mus musculus early B-cell factor 3 (Ebf3), transcript variant 3, mRNA [NM_010096]	Ebf3	23.62	1.04	2.21
Mus musculus paired related homeobox 1 (Prrx1), transcript variant 2, mRNA [NM_175686]	Prrx1	6.27	1.52	2.58
Mus musculus forkhead box E1 (Foxe1), mRNA [NM_183298]	Foxe1	33.27	1.20	1.20
Mus musculus Iroquois related homeobox 2 (Drosophila) (Irx2), mRNA [NM_010574]	Irx2	47.39	1.21	2.54
Mus musculus LIM homeobox protein 2 (Lhx2), mRNA [NM_010710]	Lhx2	43.84	1.15	2.54
Mus musculus retina and anterior neural fold homeobox (Rax), mRNA [NM_013833]	Rax	16.41	1.63	2.65
Mus musculus reproductive homeobox 3H (Rho3h), mRNA [NM_001114157]	Rho3h	21.70	1.43	1.77
Mus musculus nuclear receptor subfamily 2, group F, member 2 (Nr2f2), transcript variant 1, mRN	Nr2f2	25.07	1.06	1.70
Mus musculus Kruppel-like factor 14 (Klf14), mRNA [NM_001135093]	Klf14	42.23	1.02	2.10
Mus musculus doublesex and mab-3 related transcription factor like family A2 (Dmrta2), mRNA [N	Dmrta2	16.88	2.63	2.73
Mus musculus teashirt zinc finger family member 3 (Tshz3), mRNA [NM_172298]	Tshz3	42.37	1.58	2.16
Mus musculus NK-3 transcription factor, locus 1 (Drosophila) (Nkx3-1), mRNA [NM_010921]	Nkx3-1	32.42	1.21	1.84
Mus musculus insulin related protein 2 (Isl2), mRNA [NM_027397]	Isl2	23.28	2.23	2.94
Mus musculus nuclear receptor subfamily 4, group A, member 2 (Nr4a2), transcript variant 1, mRN	Nr4a2	29.42	1.53	1.30
Mus musculus cut-like homeobox 1 (Cux1), transcript variant 2, mRNA [NM_198602]	Cux1	1993.96	1.60	0.91
Mus musculus Ets2 repressor factor (Erf), mRNA [NM_010155]	Erf	10844.56	1.08	0.42
Mus musculus cysteine-serine-rich nuclear protein 3 (Csrnp3), transcript variant 1, mRNA [NM_15]	Csrnp3	580.48	1.02	0.71
Mus musculus zinc finger protein 687 (Zfp687), mRNA [NM_030074]	Zfp687	6644.16	1.08	0.34
Mus musculus zinc finger protein 329 (Zfp329), mRNA [NM_026046]	Zfp329	2711.21	1.11	0.71
Mus musculus myeloblastosis oncogene-like 1 (Mybl1), mRNA [NM_008651]	Mybl1	111.11	1.10	0.77
Mus musculus SRY-box containing gene 1 (Sox1), mRNA [NM_009233]	Sox1	96.57	0.63	6.60

Mus musculus NK6 homeobox 1 (Nkx6-1), mRNA [NM_144955]	Nkx6-1	91.67	0.51	3.81
Mus musculus hairy and enhancer of split 5 (Drosophila) (Hes5), mRNA [NM_010419]	Hes5	375.01	0.81	3.64
Mus musculus early B-cell factor 4 (Ebf4), mRNA [NM_001110513]	Ebf4	138.35	0.58	3.08
Mus musculus zinc finger protein 641 (Zfp641), mRNA [NM_173769]	Zfp641	9.16	0.44	3.95
Mus musculus OTU domain containing 7A (Otud7a), mRNA [NM_130880]	Otud7a	55.38	0.53	4.02
Mus musculus nuclear factor, erythroid derived 2 (Nfe2), mRNA [NM_008685]	Nfe2	46.95	0.70	3.44
one cut domain, family member 1 [Source:MGI Symbol;Acc:MGI:1196423] [ENSMUST00000160]	Onecut1	3.89	0.88	5.24
Mus musculus gastrulation brain homeobox 2 (Gbx2), mRNA [NM_010262]	Gbx2	41.52	0.69	5.67
Mus musculus SKI family transcriptional corepressor 1 (Skor1), transcript variant 1, mRNA [NM_173769]	Skor1	45.83	0.65	4.08
Mus musculus zinc finger protein 536 (Zfp536), mRNA [NM_172385]	Zfp536	28.55	0.82	5.38
Mus musculus lin-28 homolog A (C. elegans) (Lin28a), mRNA [NM_145833]	Lin28a	48581.72	0.58	1.07
Mus musculus chromobox homolog 2 (Drosophila Pc class) (Cbx2), mRNA [NM_007623]	Cbx2	1972.99	0.71	1.21
Mus musculus nuclear receptor subfamily 6, group A, member 1 (Nr6a1), transcript variant 1, mRNA [NM_173769]	Nr6a1	789.07	0.99	2.04
Mus musculus D site albumin promoter binding protein (Dbp), mRNA [NM_016974]	Dbp	2553.19	0.98	1.36
Y box protein 2 [Source:MGI Symbol;Acc:MGI:1096372] [ENSMUST0000018698]	Ybx2	1963.40	0.97	1.75
Mus musculus high mobility group box transcription factor 1 (Hbp1), transcript variant 1, mRNA [NM_173769]	Hbp1	2317.59	0.35	1.63
Mus musculus bromo adjacent homology domain containing 1 (Bahd1), mRNA [NM_001045523]	Bahd1	501.12	0.41	1.19
Mus musculus TEA domain family member 2 (Tead2), mRNA [NM_011565]	Tead2	42696.01	0.70	1.00
Mus musculus MAD homolog 3 (Drosophila) (Smad3), mRNA [NM_016769]	Smad3	3324.53	0.65	1.17
Mus musculus Kruppel-like factor 7 (ubiquitous) (Klf7), mRNA [NM_033563]	Klf7	5172.89	0.79	1.08
Mus musculus zinc finger protein 90 (Zfp90), mRNA [NM_011764]	Zfp90	1107.05	0.60	1.05
Mus musculus AT rich interactive domain 3A (BRIGHT-like) (Arid3a), mRNA [NM_007880]	Arid3a	4367.28	0.73	1.13
Mus musculus protein kinase, DNA activated, catalytic polypeptide (Prkdc), mRNA [NM_011159]	Prkdc	1646.26	0.41	1.33
Mus musculus transformation related protein 53 binding protein 1 (Trp53bp1), mRNA [NM_013733]	Trp53bp1	4769.45	0.64	1.30
SRY-box containing gene 4 [Source:MGI Symbol;Acc:MGI:98366] [ENSMUST00000067230]	Sox4	12072.11	0.58	1.48
Mus musculus SRY-box containing gene 2 (Sox2), mRNA [NM_011443]	Sox2	1273.97	0.94	1.75
Mus musculus enhancer of zeste homolog 1 (Drosophila) (Ezh1), mRNA [NM_007970]	Ezh1	3360.47	0.31	1.57
Mus musculus fos-like antigen 2 (Fosl2), mRNA [NM_008037]	Fosl2	700.56	0.45	1.11
Mus musculus zinc finger protein 423 (Zfp423), mRNA [NM_033327]	Zfp423	546.58	0.91	1.51
Mus musculus sal-like 2 (Drosophila) (Sall2), mRNA [NM_015772]	Sall2	2688.35	0.54	2.00
Mus musculus regulatory factor X-associated ankyrin-containing protein (Rfxank), transcript variant 1, mRNA [NM_016974]	Rfxank	1458.61	0.51	1.04
Mus musculus D site albumin promoter binding protein (Dbp), mRNA [NM_016974]	Dbp	1936.27	0.50	1.37
Mus musculus nuclear factor of kappa light polypeptide gene enhancer in B-cells 2, p49/p100 (Nfkb2), mRNA [NM_016974]	Nfkb2	2297.42	0.39	1.69
Mus musculus zinc finger protein 579 (Zfp579), mRNA [NM_026741]	Zfp579	4049.48	0.59	1.12
Mus musculus amyloid beta (A4) precursor protein (App), transcript variant 1, mRNA [NM_001198]	App	2969.43	0.70	1.05
Mus musculus zinc finger protein 580 (Zfp580), mRNA [NM_026900]	Zfp580	1871.28	0.62	1.33
Mus musculus homeodomain leucine zipper-encoding gene (Homez), transcript variant 2, mRNA [NM_016974]	Homez	2200.29	0.54	1.28
Mus musculus TOX high mobility group box family member 3 (Tox3), mRNA [NM_172913]	Tox3	393.08	0.36	2.57
Mus musculus SET binding protein 1 (Setbp1), mRNA [NM_053099]	Setbp1	329.71	0.88	1.33
Mus musculus progesterone receptor (Pgr), mRNA [NM_008829]	Pgr	114.68	0.96	1.10
Mus musculus transformation related protein 53 binding protein 1 (Trp53bp1), mRNA [NM_013733]	Trp53bp1	264.68	0.31	1.72
Mus musculus zinc finger and BTB domain containing 10 (Zbtb10), mRNA [NM_177660]	Zbtb10	394.35	0.55	1.07
Mus musculus v-erb-b2 erythroblastic leukemia viral oncogene homolog 2, neuro/glioblastoma derived (ErbB2), mRNA [NM_016974]	ErbB2	486.19	0.70	1.33
Mus musculus transformation related protein 73 (Trp73), transcript variant 1, mRNA [NM_011642]	Trp73	402.22	0.40	1.12
Mus musculus SAM pointed domain containing ets transcription factor (Spdef), mRNA [NM_013884]	Spdef	140.90	0.68	1.62
Mus musculus E26 avian leukemia oncogene 1, 5' domain (Ets1), transcript variant 1, mRNA [NM_016974]	Ets1	306.66	0.80	2.00
Mus musculus 0 day neonate eyeball cDNA, RIKEN full-length enriched library, clone: E130305O0	Foxo3	258.15	0.83	1.76
Mus musculus pre-B-cell leukemia homeobox 4 (Pbx4), mRNA [NM_001024954]	Pbx4	131.27	0.78	1.50
Mus musculus transcription factor CP2 (Tcfcp2), mRNA [NM_033476]	Tcfcp2	492.05	0.71	1.08
Mus musculus zinc finger protein 697 (Zfp697), mRNA [NM_172863]	Zfp697	115.43	0.52	1.24
Mus musculus trans-acting transcription factor 6 (Sp6), mRNA [NM_031183]	Sp6	104.08	0.62	1.48
Mus musculus forkhead box R2 (Foxr2), mRNA [NM_001034894]	Foxr2	190.48	0.36	1.14
Mus musculus dachshund 1 (Drosophila) (Dach1), transcript variant 1, mRNA [NM_007826]	Dach1	85.69	0.81	1.58
Mus musculus scratch homolog 1, zinc finger protein (Drosophila) (Sert1), mRNA [NM_130893]	Sert1	180.39	0.51	1.53
Mus musculus transcriptional regulating factor 1 (Trefl), transcript variant 2, mRNA [NM_172622]	Trefl	483.86	0.89	1.16
Mus musculus CXXC finger 4 (Cxxc4), mRNA [NM_001004367]	Cxxc4	18.50	0.54	2.01
Mus musculus aristaless-like homeobox 3 (Alx3), mRNA [NM_007441]	Alx3	47.78	0.43	1.10
Mus musculus sine oculis-related homeobox 3 homolog (Drosophila) (Six3), mRNA [NM_011381]	Six3	8.81	0.31	1.01
Mus musculus zinc finger and BTB domain containing 42 (Zbtb42), mRNA [NM_001100460]	Zbtb42	42.00	0.98	2.32
Mus musculus visual system homeobox 2 (Vsx2), mRNA [NM_007701]	Vsx2	30.68	0.58	1.16
Mus musculus DMC1 dosage suppressor of mck1 homolog, meiosis-specific homologous recombination (Dmcl), mRNA [NM_016974]	Dmcl	36.69	0.87	1.44
Mus musculus doublesex and mab-3 related transcription factor 3 (Dmrt3), mRNA [NM_177360]	Dmrt3	16.12	0.49	1.17
Mus musculus interferon regulatory factor 2 (Irf2), mRNA [NM_008391]	Irf2	41.13	0.71	1.53
Mus musculus synovial sarcoma translocation gene on chromosome 18-like 1 (Ss18l1), mRNA [NM_016974]	Ss18l1	63.36	0.97	1.92
Mus musculus BarH-like homeobox 1 (Barx1), mRNA [NM_007526]	Barx1	17.23	0.37	2.06
Mus musculus paired like homeodomain factor 1 (Prop1), mRNA [NM_008936]	Prop1	18.43	0.59	1.11
Mus musculus neurogenic differentiation 1 (Neurod1), mRNA [NM_010894]	Neurod1	71.96	0.82	1.40
Mus musculus nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent 1 (Nfatc1), transcript variant 1, mRNA [NM_016974]	Nfatc1	40.67	0.55	1.74
Mus musculus NK1 transcription factor related, locus 2 (Drosophila) (Nkx1-2), mRNA [NM_009122]	Nkx1-2	26.08	1.00	2.29
Mus musculus engrailed 1 (En1), mRNA [NM_010133]	En1	5.68	0.60	1.24
Mus musculus NK3 homeobox 2 (Nkx3-2), mRNA [NM_007524]	Nkx3-2	20.46	0.69	1.42
Mus musculus T-box 4 (Tbx4), transcript variant 1, mRNA [NM_011536]	Tbx4	28.68	0.94	1.91
Mus musculus transcriptional regulating factor 1 (Trefl), transcript variant 2, mRNA [NM_172622]	Trefl	52.76	0.98	2.49
Mus musculus E74-like factor 2 (Elf2), mRNA [NM_023502]	Elf2	2007.53	0.33	0.75
Mus musculus zinc finger and SCAN domain containing 21 (Zscan21), transcript variant 1, mRNA [NM_016974]	Zscan21	7251.89	0.31	0.80
Mus musculus zinc finger and BTB domain containing 5 (Zbtb5), transcript variant 1, mRNA [NM_016974]	Zbtb5	4335.08	0.32	0.66
Mus musculus zinc finger protein 219 (Zfp219), mRNA [NM_027248]	Zfp219	1022.37	0.29	0.67
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfamily 1 member 1 (Smarca1), mRNA [NM_016974]	Smarca1	9542.28	0.39	0.35
Mus musculus BTB and CNC homology 1 (Bach1), mRNA [NM_007520]	Bach1	2331.00	0.67	0.87
Mus musculus GDNF-inducible zinc finger protein 1 (Gzf1), mRNA [NM_028986]	Gzf1	2164.64	0.44	0.81
Mus musculus zinc finger protein 238 (Zfp238), transcript variant 2, mRNA [NM_013915]	Zfp238	693.93	0.37	0.56
Mus musculus calmodulin binding transcription activator 2 (Camta2), transcript variant 1, mRNA [NM_016974]	Camta2	3831.04	0.71	0.91
Mus musculus zinc finger and BTB domain containing 22 (Zbtb22), mRNA [NM_020625]	Zbtb22	1133.63	0.28	0.47
Mus musculus transcription factor 3 (Tcf3), transcript variant 8, mRNA [NM_011548]	Tcf3	5135.50	0.28	0.69
Mus musculus zinc finger protein 26 (Zfp26), mRNA [NM_011753]	Zfp26	1042.63	0.41	0.91
Mus musculus lin-28 homolog B (C. elegans) (Lin28b), mRNA [NM_001031772]	Lin28b	18766.43	0.30	0.41
Mus musculus zinc finger protein 414 (Zfp414), transcript variant 1, mRNA [NM_026712]	Zfp414	6964.64	0.35	0.62

Mus musculus purine rich element binding protein A (Pura), mRNA [NM_008989]	Pura	6079.22	0.40	0.71
Mus musculus 5'-3' exonuclease 1 (Xrn1), mRNA [NM_011916]	Xrn1	703.05	0.31	0.36
Mus musculus REST corepressor 3 (Rcor3), mRNA [NM_144814]	Rcor3	715.97	0.62	0.60
Mus musculus hypoxia inducible factor 3, alpha subunit (Hif3a), transcript variant 2, mRNA [NM_011916]	Hif3a	5319.73	0.27	0.59
Mus musculus churchill domain containing 1 (Churc1), mRNA [NM_206534]	Churc1	9887.18	0.29	0.61
Mus musculus GLI-Kruppel family member GLI3 (Gli3), mRNA [NM_008130]	Gli3	4494.09	0.27	0.72
Mus musculus zinc finger protein 691 (Zfp691), transcript variant 1, mRNA [NM_183140]	Zfp691	1336.54	0.46	0.67
Mus musculus helicase-like transcription factor (Hlft), transcript variant 1, mRNA [NM_009210]	Hlft	3565.83	0.33	0.56
Mus musculus serum response factor (Srf), mRNA [NM_020493]	Srf	6242.41	0.28	0.86
Mus musculus zinc finger, BED domain containing 6 (Zbed6), mRNA [NM_001166552]	Zbed6	576.02	0.60	0.66
Mus musculus catenin (cadherin associated protein), beta 1 (Ctnnb1), transcript variant 1, mRNA [NM_011916]	Ctnnb1	13576.55	0.31	0.52
Mus musculus methyl CpG binding protein 2 (Meep2), transcript variant 2, mRNA [NM_010788]	Meep2	589.11	0.34	0.84
Mus musculus Jun oncogene (Jun), mRNA [NM_010591]	Jun	5782.74	0.86	1.00
Mus musculus transcription factor Dp 2 (Tfdp2), transcript variant 1, mRNA [NM_178667]	Tfdp2	780.36	0.63	0.91
Mus musculus estrogen receptor 2 (beta) (Esr2), transcript variant 1, mRNA [NM_207707]	Esr2	4889.97	0.30	0.60
Mus musculus zinc finger protein 664 (Zfp664), mRNA [NM_001081750]	Zfp664	13593.30	0.27	0.73
Mus musculus zinc finger protein 292 (Zfp292), mRNA [NM_013889]	Zfp292	1726.35	0.75	0.82
Mus musculus zinc finger protein 316 (Zfp316), mRNA [NM_017467]	Zfp316	1299.28	0.42	0.84
Mus musculus PHD finger protein 21A (Phf21a), transcript variant 3, mRNA [NM_001109691]	Phf21a	4821.36	0.91	0.88
Mus musculus activity-dependent neuroprotective protein (Adnp), mRNA [NM_009628]	Adnp	10235.88	0.35	0.41
Mus musculus LIM domain binding 1 (Ldb1), transcript variant 3, mRNA [NM_010697]	Ldb1	4504.63	0.71	0.86
Mus musculus nuclear receptor coactivator 2 (Ncoa2), transcript variant 1, mRNA [NM_008678]	Ncoa2	1097.99	0.94	0.99
Mus musculus zinc finger with KRAB and SCAN domains 3 (Zkscan3), transcript variant 1, mRNA [NM_011916]	Zkscan3	2185.75	0.39	0.79
Mus musculus signal transducer and activator of transcription 5B (Stat5b), transcript variant 1, mRNA [NM_011916]	Stat5b	1133.58	0.42	0.64
myocyte enhancer factor 2D [Source:MGI Symbol;Acc:MGI:99533] [ENSMUST0000001455]	Mezf2d	9929.13	0.48	0.53
Mus musculus transcription factor 7-like 1 (T-cell specific, HMG box) (Tcf7l1), transcript variant 1, mRNA [NM_011916]	Tcf7l1	2679.11	0.65	0.70
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfamily 1 member C (Smarcc1), mRNA [NM_011916]	Smarcc1	11725.64	0.60	0.86
Mus musculus 16 days embryo head cDNA, RIKEN full-length enriched library, clone:C130049P13	Myst4	519.73	0.28	0.84
Mus musculus zinc finger protein 41 (Zfp41), transcript variant 1, mRNA [NM_011759]	Zfp41	3196.01	0.39	0.93
Mus musculus myeloid/lymphoid or mixed-lineage leukemia 3 (Mll3), mRNA [NM_001081383]	Mll3	1316.81	0.35	0.67
Mus musculus zinc finger protein 865 (Zfp865), mRNA [NM_001033383]	Zfp865	1056.48	0.34	0.61
Mus musculus HECT, UBA and WWE domain containing 1 (Huwe1), mRNA [NM_021523]	Huwe1	20394.79	0.32	0.34
Mus musculus tripartite motif-containing 33 (Trim33), transcript variant 1, mRNA [NM_053170]	Trim33	1366.42	0.31	0.77
Mus musculus transcription factor 4 (Tcf4), transcript variant 1, mRNA [NM_013685]	Tcf4	2503.83	0.55	0.64
Mus musculus POU domain, class 2, transcription factor 1 (Pou2f1), transcript variant 4, mRNA [NM_011916]	Pou2f1	6363.86	0.27	0.36
Mus musculus paired-like homeobox 2a (Phox2a), mRNA [NM_008887]	Phox2a	2100.66	0.47	0.98
Mus musculus zinc finger protein 652 [Source:MGI Symbol;Acc:MGI:2442221] [ENSMUST00000107717]	Zfp652	7407.31	0.37	0.34
Mus musculus signal transducer and activator of transcription 5B (Stat5b), transcript variant 1, mRNA [NM_011916]	Stat5b	846.40	0.37	0.68
Mus musculus poly(rC) binding protein 4 (Pcbp4), mRNA [NM_021567]	Pcbp4	43165.40	0.48	0.47
Mus musculus thymotroph embryonic factor (Tef), transcript variant 1, mRNA [NM_017376]	Tef	9678.13	0.33	0.84
Mus musculus PC4 and SFRS1 interacting protein 1 (Psp1), mRNA [NM_133948]	Psp1	10717.70	0.70	0.34
Mus musculus CXXC finger 5 (Cxxc5), mRNA [NM_133687]	Cxxc5	5692.68	0.29	0.44
Mus musculus nuclear factor, interleukin 3, regulated (Nfil3), mRNA [NM_017373]	Nfil3	1056.49	0.28	0.93
Mus musculus poly(rC) binding protein 3 (Pcbp3), mRNA [NM_021568]	Pcbp3	6864.20	0.36	0.81
Mus musculus POU domain class 5, transcription factor 2 (Pou5f2), mRNA [NM_029315]	Pou5f2	577.04	0.56	0.88
Mus musculus zinc finger protein 182 (Zfp182), transcript variant 2, mRNA [NM_001111076]	Zfp182	558.43	0.41	0.63
Mus musculus SRY-box containing gene 11 (Sox11), mRNA [NM_009234]	Sox11	2848.06	0.42	0.97
Mus musculus cAMP responsive element binding protein 3-like 1 (Creb3l1), mRNA [NM_011957]	Creb3l1	940.32	0.35	0.29
Mus musculus putative homeodomain transcription factor 1 (Phtf1), transcript variant 1, mRNA [NM_011916]	Phtf1	3822.50	0.35	0.91
LUC7-like 3 (S. cerevisiae) [Source:MGI Symbol;Acc:MGI:1914934] [ENSMUST00000166312]	Luc7l3	1554.52	0.30	0.35
Mus musculus zinc finger protein 821 (Zfp821), transcript variant 1, mRNA [NM_029468]	Zfp821	1326.59	0.35	0.94
Mus musculus Kruppel-like factor 6 (Klf6), mRNA [NM_011803]	Klf6	16758.48	0.49	0.95
Mus musculus orthodenticle homolog 2 (Drosophila) (Otx2), mRNA [NM_144841]	Otx2	25884.32	0.27	0.64
Mus musculus zinc finger protein 710 (Zfp710), transcript variant 1, mRNA [NM_175433]	Zfp710	6438.83	0.27	0.76
Mus musculus Kruppel-like factor 2 (lung) (Klf2), mRNA [NM_008452]	Klf2	630.06	0.89	0.89
Mus musculus zinc finger, AN1-type domain 5 (Zfand5), mRNA [NM_009551]	Zfand5	7608.06	0.30	0.57
Mus musculus MAX gene associated (Mga), transcript variant 1, mRNA [NM_013720]	Mga	723.55	0.41	0.43
Mus musculus SWA-70 protein (Swap70), mRNA [NM_009302]	Swap70	2530.63	0.75	0.92
Mus musculus zinc finger protein 161 (Zfp161), mRNA [NM_009547]	Zfp161	1831.07	0.47	0.58
Mus musculus purine-rich element binding protein G (Purg), transcript variant 2, mRNA [NM_001191]	Purg	1311.77	0.36	0.70
Mus musculus REST corepressor 2 (Rcor2), mRNA [NM_054048]	Rcor2	34311.22	0.50	0.85
Mus musculus nuclear receptor subfamily 2, group C, member 1 (Nr2c1), mRNA [NM_011629]	Nr2c1	1033.12	0.43	0.70
Mus musculus zinc finger protein 395 (Zfp395), mRNA [NM_199029]	Zfp395	159.53	0.58	0.62
Mus musculus zinc finger and BTB domain containing 6 (Zbtb6), mRNA [NM_146253]	Zbtb6	116.83	0.30	0.35
Mus musculus Myb-related transcription factor, partner of profilin (Mypop), mRNA [NM_145579]	Mypop	218.87	0.78	0.96
Mus musculus formin 1 (Fmn1), transcript variant 1, mRNA [NM_010230]	Fmn1	94.80	0.44	0.64
Mus musculus zinc finger protein 3 (Zfp3), mRNA [NM_177565]	Zfp3	363.86	0.40	0.41
Mus musculus SNF2 histone linker PHD RING helicase (Shprh), transcript variant 1, mRNA [NM_011916]	Shprh	381.77	0.37	0.75
Mus musculus ligand dependent nuclear receptor corepressor-like (Lcorl), transcript variant 2, mRNA [NM_011916]	Lcorl	257.89	0.43	0.96
Mus musculus nuclear receptor subfamily 5, group A, member 1 (Nr5a1), mRNA [NM_139051]	Nr5a1	220.23	0.48	0.91
Mus musculus SRY-box containing gene 12 (Sox12), mRNA [NM_011438]	Sox12	217.11	0.83	0.80
Mus musculus regulatory factor X, 3 (influences HLA class II expression) (Rfx3), transcript variant 1, mRNA [NM_011916]	Rfx3	161.13	0.42	0.66
Mus musculus growth factor independent 1B (Gfi1b), transcript variant 1, mRNA [NM_008114]	Gfi1b	81.61	0.43	0.45
Mus musculus zinc finger protein 319 (Zfp319), mRNA [NM_024467]	Zfp319	195.01	0.41	0.64
Mus musculus transcription factor CP2-like 1 (Tcfcp2l1), mRNA [NM_023755]	Tcfcp2l1	212.38	0.43	0.64
Mus musculus snail homolog 1 (Drosophila) (Snai1), mRNA [NM_011427]	Snai1	247.79	0.27	0.76
Mus musculus ash1 (absent, small, or homeotic)-like (Drosophila) (Ash1), mRNA [NM_138679]	Ash1	237.42	0.70	0.89
Mus musculus Kruppel-like factor 12 (Klf12), mRNA [NM_010636]	Klf12	278.56	0.27	0.78
Mus musculus BRCA1 interacting protein C-terminal helicase 1 (Brip1), mRNA [NM_178309]	Brip1	217.63	0.31	0.84
Mus musculus ladybird homeobox homolog 2 (Drosophila) (Lbx2), mRNA [NM_010692]	Lbx2	144.71	0.28	0.38
Mus musculus spermatogenesis associated 24 (Spata24), transcript variant 2, mRNA [NM_029485]	Spata24	173.59	0.37	0.67
Mus musculus POU domain, class 2, transcription factor 2 (Pou2f2), transcript variant 4, mRNA [NM_011916]	Pou2f2	89.80	0.33	0.72
Mus musculus polyhomeotic-like 3 (Drosophila) (Phc3), transcript variant 2, mRNA [NM_153421]	Phc3	371.89	0.29	0.70
Mus musculus BarH-like homeobox 2 (Barx2), mRNA [NM_013800]	Barx2	239.15	0.53	0.44
Mus musculus Max dimerization protein 3 (Mxd3), mRNA [NM_016662]	Mxd3	261.36	0.53	0.96
Mus musculus signal transducer and activator of transcription 5A (Stat5a), transcript variant 1, mRNA [NM_011916]	Stat5a	206.62	0.34	0.80
Mus musculus far upstream element (FUSE) binding protein 1 (Fubp1), mRNA [NM_057172]	Fubp1	493.21	0.40	0.90

Mus musculus GLIS family zinc finger 1 (Glis1), mRNA [NM_147221]	Glis1	464.99	0.40	0.45
Mus musculus retinoid X receptor alpha (Rxra), mRNA [NM_011305]	Rxra	80.68	0.30	0.58
Mus musculus zinc finger and SCAN domains 20 (Zscan20), mRNA [NM_177758]	Zscan20	365.82	0.33	0.35
Mus musculus zinc finger protein 2 (Zfp2), transcript variant 3, mRNA [NM_001044697]	Zfp2	130.89	0.36	0.51
Mus musculus inhibitor of growth family, member 2 (Ing2), mRNA [NM_023503]	Ing2	462.77	0.38	0.46
Mus musculus basic leucine zipper transcription factor, ATF-like 2 (Batf2), mRNA [NM_028967]	Batf2	50.24	0.29	0.32
Mus musculus forkhead box E3 (Foxe3), mRNA [NM_015758]	Foxe3	36.51	0.36	0.74
Mus musculus zinc finger protein 516 (Zfp516), transcript variant 1, mRNA [NM_183033]	Zfp516	48.86	0.30	1.00
Mus musculus paired box gene 6 (Pax6), mRNA [NM_013627]	Pax6	4.99	0.69	0.90
zinc finger and BTB domain containing 1 [Source:MGI Symbol;Acc:MGI:2442326] [ENSMUST000000000000]	Zbtb1	43.81	0.48	0.29
Mus musculus IKAROS family zinc finger 3 (Ikzf3), mRNA [NM_011771]	Ikzf3	58.62	0.41	0.80
Mus musculus E74-like factor 4 (ets domain transcription factor) (Elf4), mRNA [NM_019680]	Elf4	49.21	0.28	0.44
Mus musculus homeobox A7 (Hoxa7), mRNA [NM_010455]	Hoxa7	72.23	0.38	0.75
nuclear factor, erythroid derived 2, like 3 [Source:MGI Symbol;Acc:MGI:1339958] [ENSMUST000000000000]	Nfe2l3	48.80	0.40	0.91
Mus musculus transcription factor AP-2, alpha (Tcfap2a), transcript variant 2, mRNA [NM_001122]	Tcfap2a	25.18	0.51	0.74
Mus musculus NK2 transcription factor related, locus 5 (Drosophila) (Nkx2-5), mRNA [NM_008700]	Nkx2-5	27.34	0.84	0.32
Mus musculus basonuclin 2 (Bnc2), mRNA [NM_172870]	Bnc2	22.75	0.60	0.91
Mus musculus 16 days neonate male medulla oblongata cDNA, RIKEN full-length enriched library	Lbx1	54.12	0.49	0.75
Mus musculus spermatogenesis and oogenesis specific basic helix-loop-helix 1 (Sohlh1), mRNA [NM_001040089]	Sohlh1	19.88	0.79	0.87
Mus musculus reproductive homeobox 3F (Rho3f), mRNA [NM_001040089]	Rho3f	34.24	0.55	0.63
Mus musculus POU domain, class 3, transcription factor 2 (Pou3f2), mRNA [NM_008899]	Pou3f2	4.77	0.92	0.95
Mus musculus homeobox B6 (Hoxb6), mRNA [NM_008269]	Hoxb6	30.00	0.29	0.69
Mus musculus scleraxis (Scx), mRNA [NM_198885]	Scx	22.63	0.58	0.97
Mus musculus distal-less homeobox 5 (Dlx5), transcript variant 1, mRNA [NM_010056]	Dlx5	24.62	0.29	0.45
Mus musculus T-box 3 (Tbx3), transcript variant 1, mRNA [NM_011535]	Tbx3	5.30	0.75	0.96
Mus musculus zinc finger protein 322A (Zfp322a), transcript variant 2, mRNA [NM_172586]	Zfp322a	14329.20	0.47	0.13
zinc finger protein 692 [Source:MGI Symbol;Acc:MGI:2144276] [ENSMUST000000065632]	Zfp692	19163.82	0.31	0.09
Mus musculus hematopoietically expressed homeobox (Hhex), mRNA [NM_008245]	Hhex	1269.99	0.33	-0.26
Mus musculus zinc finger and BTB domain containing 25 (Zbtb25), transcript variant 2, mRNA [NM_001040089]	Zbtb25	2947.57	0.31	-0.02
Mus musculus zinc finger protein 120 (Zfp120), transcript variant 1, mRNA [NM_181266]	Zfp120	688.16	0.36	-0.17
Mus musculus RAB guanine nucleotide exchange factor (GEF) 1 (Rabgef1), transcript variant 1, mRNA [NM_001040089]	Rabgef1	1804.15	0.28	-0.10
Mus musculus leucine-rich PPR-motif containing (Lrpprc), mRNA [NM_028233]	Lrpprc	27540.59	0.48	-0.05
Mus musculus REV3-like, catalytic subunit of DNA polymerase zeta RAD54 like (S. cerevisiae) (Rev3l), mRNA [NM_001040089]	Rev3l	4889.66	0.28	0.08
Mus musculus aryl hydrocarbon receptor nuclear translocator (Arnt), transcript variant 1, mRNA [NM_001040089]	Arnt	3229.16	0.29	0.11
Mus musculus jerky (Jrk), mRNA [NM_008415]	Jrk	890.59	0.31	0.19
Mus musculus mesoderm induction early response 1, family member 2 (Mier2), mRNA [NM_027400]	Mier2	2504.70	0.68	-0.24
even skipped homeotic gene 2 homolog [Source:MGI Symbol;Acc:MGI:95462] [ENSMUST000000000000]	Evx2	649.49	0.58	0.08
Mus musculus SAP domain containing ribonucleoprotein (Sarnp), mRNA [NM_025364]	Sarnp	17667.35	0.35	0.11
Mus musculus MAD homolog 4 (Drosophila) (Smad4), mRNA [NM_008540]	Smad4	14252.16	0.81	0.16
Mus musculus nuclear transcription factor-Y alpha (NfyA), transcript variant 1, mRNA [NM_001110]	NfyA	947.09	0.27	0.16
Mus musculus myoneurin (Mynn), mRNA [NM_030557]	Mynn	752.12	0.39	0.20
Mus musculus E74-like factor 3 (Elf3), transcript variant 2, mRNA [NM_007921]	Elf3	199.90	0.38	0.24
Mus musculus peroxisome proliferator activated receptor gamma (Pparg), transcript variant 2, mRNA [NM_001040089]	Pparg	103.62	0.39	0.17
Mus musculus IWS1 homolog (S. cerevisiae) (Iws1), mRNA [NM_173441]	Iws1	135.12	0.38	-0.05
Mus musculus human immunodeficiency virus type 1 enhancer binding protein 2 (Hivep2), mRNA [NM_001040089]	Hivep2	189.90	0.31	-0.21
Mus musculus H2.0-like homeobox (Hlx), mRNA [NM_008250]	Hlx	36.03	0.27	0.20
Mus musculus orthodenticle homolog 1 (Drosophila) (Otx1), mRNA [NM_011023]	Otx1	4.30	0.48	0.12
Mus musculus nuclear receptor subfamily 3, group C, member 1 (Nr3c1), mRNA [NM_008173]	Nr3c1	2476.69	0.65	-0.94
Mus musculus CXXC finger 1 (PHD domain) (Cxxc1), mRNA [NM_028868]	Cxxc1	3524.53	0.42	-0.32
Mus musculus POU domain, class 3, transcription factor 1 (Pou3f1), mRNA [NM_011141]	Pou3f1	29843.27	0.31	-0.57
Mus musculus tet oncogene 1 (Tet1), mRNA [NM_027384]	Tet1	9361.94	0.62	-0.79
Mus musculus nuclear factor, erythroid derived 2, like 2 (Nfe2l2), mRNA [NM_010902]	Nfe2l2	5336.93	0.60	-0.30
Mus musculus transformation related protein 53 (Trp53), transcript variant 1, mRNA [NM_011640]	Trp53	1956.22	0.30	-0.30
Mus musculus zinc finger protein, multitype 1 (Zfp1), mRNA [NM_009569]	Zfp1	2428.76	0.42	-0.42
Mus musculus cysteine-serine-rich nuclear protein 2 (Csrp2), mRNA [NM_153407]	Csrp2	506.82	0.75	-0.39
Mus musculus hypoxia inducible factor 1, alpha subunit (Hif1a), mRNA [NM_010431]	Hif1a	2781.39	0.75	-0.53
Mus musculus zinc finger and BTB domain containing 1 (Zbtb1), mRNA [NM_178744]	Zbtb1	285.43	0.56	-0.83
Mus musculus zinc finger protein 771 (Zfp771), mRNA [NM_177362]	Zfp771	24716.77	0.52	-1.10
Mus musculus RE1-silencing transcription factor (Rest), mRNA [NM_011263]	Rest	9747.00	0.76	-1.14
Mus musculus SRY-box containing gene 15 (Sox15), mRNA [NM_009235]	Sox15	244.05	0.34	-1.29
Mus musculus diencephalon/mesencephalon homeobox 1 (Dmbx1), transcript variant 1, mRNA [NM_001040089]	Dmbx1	18.47	0.03	5.41
Mus musculus neuronal PAS domain protein 4 (Npas4), mRNA [NM_153553]	Npas4	63.47	0.03	7.15
Mus musculus zinc finger protein 629 (Zfp629), mRNA [NM_177226]	Zfp629	5052.20	-0.09	1.27
Mus musculus activating transcription factor 5 (Atf5), transcript variant 1, mRNA [NM_030693]	Atf5	30005.02	0.19	1.32
Mus musculus zinc finger protein 523 (Zfp523), mRNA [NM_172617]	Zfp523	4686.53	0.11	1.01
Mus musculus cAMP responsive element binding protein 3-like 4 (Creb3l4), mRNA [NM_030080]	Creb3l4	621.44	0.13	1.46
Mus musculus Jun dimerization protein 2 (Jdp2), transcript variant 1, mRNA [NM_030887]	Jdp2	1697.25	0.07	1.02
Mus musculus nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent 4 (Nfatc4), transcript variant 1, mRNA [NM_001040089]	Nfatc4	1882.08	-0.20	2.85
Mus musculus myeloid leukemia factor 1 (Mlf1), transcript variant 2, mRNA [NM_010801]	Mlf1	972.12	0.25	1.25
Mus musculus zinc finger protein 768 (Zfp768), mRNA [NM_146202]	Zfp768	4307.25	0.13	1.09
Mus musculus sal-like 1 (Drosophila) (Sall1), mRNA [NM_021390]	Sall1	765.08	-0.02	1.96
Mus musculus zinc finger protein 784 (Zfp784), mRNA [NM_001039532]	Zfp784	117.80	0.15	1.11
Mus musculus zinc finger protein 30 (Zfp30), mRNA [NM_013705]	Zfp30	261.43	0.26	2.22
Mus musculus cAMP responsive element binding protein-like 2 (Crebl2), mRNA [NM_177687]	Crebl2	211.61	0.22	1.23
Mus musculus POU domain, class 4, transcription factor 2 (Pou4f2), mRNA [NM_138944]	Pou4f2	105.17	0.13	1.34
zinc fingers and homeoboxes 3 [Source:MGI Symbol;Acc:MGI:2444772] [ENSMUST00000103110]	Zhx3	206.49	-0.04	1.04
Mus musculus zinc finger protein 775 (Zfp775), mRNA [NM_173429]	Zfp775	20.30	0.08	1.59
Mus musculus zinc finger protein 575 (Zfp575), mRNA [NM_001033205]	Zfp575	22.85	0.18	1.22
Mus musculus nuclear receptor subfamily 2, group F, member 1 (Nr2f1), mRNA [NM_010151]	Nr2f1	64.07	-0.12	1.11
Mus musculus nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent 1 (Nfatc1), transcript variant 1, mRNA [NM_001040089]	Nfatc1	49.62	0.03	2.53
Mus musculus LIM homeobox transcription factor 1 alpha (Lmx1a), mRNA [NM_033652]	Lmx1a	20.14	-0.14	1.55
Mus musculus myogenic differentiation 1 (Myod1), mRNA [NM_010866]	Myod1	19.68	0.03	2.65
Mus musculus androgen receptor (Ar), mRNA [NM_013476]	Ar	45.64	0.00	2.49
Mus musculus nuclear transcription factor-Y beta (Nfyb), mRNA [NM_010914]	Nfyb	3167.84	0.10	0.54
Mus musculus glial cells missing homolog 1 (Drosophila) (Gcm1), mRNA [NM_008103]	Gcm1	20308.97	0.02	0.41
Mus musculus stimulated by retinoic acid 13 (Stra13), mRNA [NM_016665]	Stra13	6218.19	0.09	0.33
Mus musculus transducin (beta)-like 1X-linked receptor 1 (Tb1xrl), mRNA [NM_030732]	Tb1xrl	1497.55	0.13	0.36

Mus musculus high mobility group nucleosomal binding domain 1 (Hmgn1), mRNA [NM_008251]	Hmgn1	199812.98	0.04	0.28
Mus musculus general transcription factor IIIC, polypeptide 5 (Gtf3c5), mRNA [NM_148928]	Gtf3c5	9814.42	0.03	0.43
Mus musculus E4F transcription factor 1 (E4f1), mRNA [NM_007893]	E4f1	2686.17	0.19	0.61
Mus musculus zinc finger protein 592 (Zfp592), mRNA [NM_178707]	Zfp592	4943.75	0.01	0.43
Mus musculus Kruppel-like factor 8 (Klf8), mRNA [NM_173780]	Klf8	661.26	0.02	0.39
Mus musculus GC-rich promoter binding protein 1-like 1 (Gpbp11), mRNA [NM_029868]	Gpbp11	1563.27	0.25	0.39
Mus musculus zinc finger with KRAB and SCAN domains 1 (Zkscan1), transcript variant 1, mRNA [NM_008628]	Zkscan1	16553.38	0.19	0.28
Mus musculus mutS homolog 2 (E. coli) (Msh2), mRNA [NM_008628]	Msh2	51602.75	0.18	0.52
Mus musculus paired related homeobox 2 (Prrx2), mRNA [NM_009116]	Prrx2	816.45	0.16	0.66
Mus musculus far upstream element (FUSE) binding protein 1 (Fubp1), mRNA [NM_057172]	Fubp1	1790.62	0.12	0.27
Mus musculus nuclear factor, erythroid derived 2,-like 1 (Nfe2l1), transcript variant 1, mRNA [NM_008628]	Nfe2l1	834.87	0.02	0.33
Mus musculus zinc fingerprotein 618 (Zfp618), mRNA [NM_028326]	Zfp618	1175.19	-0.01	0.32
Mus musculus zinc finger protein 146 (Zfp146), mRNA [NM_011980]	Zfp146	1852.62	-0.05	0.85
Mus musculus zinc finger and BTB domain containing 44 (Zbtb44), transcript variant a, mRNA [NM_008628]	Zbtb44	1389.84	0.25	0.48
Mus musculus steroid receptor RNA activator 1 (Sra1), transcript variant 1, mRNA [NM_025291]	Sra1	28567.78	-0.19	0.47
Mus musculus methyl-CpG binding domain protein 4 (Mbd4), mRNA [NM_010774]	Mbd4	783.46	0.16	0.54
Mus musculus Dr1 associated protein 1 (negative cofactor 2 alpha) (Drap1), mRNA [NM_024176]	Drap1	21191.33	-0.08	0.34
Mus musculus F-box protein 18 (Fbxo18), mRNA [NM_015792]	Fbxo18	9201.58	0.25	0.64
Mus musculus leucine rich repeat (in FliJ) interacting protein 1 (Lrrfip1), transcript variant 2, mRNA [NM_008628]	Lrrfip1	3665.85	0.15	0.32
Mus musculus zinc finger protein 653 (Zfp653), mRNA [NM_177318]	Zfp653	2279.85	0.15	0.62
Mus musculus polyhomeotic-like 2 (Drosophila) (Phc2), transcript variant 2, mRNA [NM_0011951]	Phc2	19816.92	0.21	0.36
Mus musculus zinc finger with KRAB and SCAN domains 6 (Zkscan6), mRNA [NM_026107]	Zkscan6	1427.68	0.09	0.52
Mus musculus zinc finger protein 518A (Zfp518a), mRNA [NM_028319]	Zfp518a	904.09	-0.09	0.36
Mus musculus defective in sister chromatid cohesion 1 homolog (S. cerevisiae) (Dsccl), mRNA [NM_008628]	Dsccl	2015.86	0.23	0.38
Mus musculus high mobility group 20 B (Hmg20b), transcript variant 1, mRNA [NM_010440]	Hmg20b	20770.95	0.12	0.39
Mus musculus SRY-box containing gene 13 (Sox13), mRNA [NM_011439]	Sox13	1132.58	0.17	0.52
Mus musculus max binding protein (Mnt), mRNA [NM_010813]	Mnt	12028.74	0.18	0.37
Mus musculus general transcription factor II I (Gtf2i), transcript variant 2, mRNA [NM_010365]	Gtf2i	40983.58	-0.02	0.42
Mus musculus polyhomeotic-like 1 (Drosophila) (Phc1), transcript variant 1, mRNA [NM_007905]	Phc1	8340.53	0.13	0.89
Mus musculus adrenocortical dysplasia (Acd), mRNA [NM_001012638]	Acd	8197.02	-0.02	0.54
Mus musculus protein inhibitor of activated STAT 1 (Pias1), mRNA [NM_019663]	Pias1	2660.79	0.24	0.47
Mus musculus retinoic acid receptor, gamma (Rarg), transcript variant 1, mRNA [NM_011244]	Rarg	10593.25	0.09	0.62
Mus musculus zinc finger protein 82 (Zfp82), mRNA [NM_177889]	Zfp82	2152.88	0.15	0.50
Mus musculus achaete-scute complex homolog 2 (Drosophila) (Ascl2), mRNA [NM_008554]	Ascl2	3373.31	0.15	0.46
Mus musculus zinc finger, matrin-like (Zfml), transcript variant 1, mRNA [NM_008717]	Zfml	5184.19	0.01	0.33
Mus musculus general transcription factor IIIC, polypeptide 5 (Gtf3c5), mRNA [NM_148928]	Gtf3c5	7275.01	0.00	0.36
Mus musculus chromodomain helicase DNA binding protein 7 (Chd7), mRNA [NM_001081417]	Chd7	12615.03	-0.05	0.53
Mus musculus ataxia telangiectasia mutated homolog (human) (Atm), mRNA [NM_007499]	Atm	753.38	0.11	0.33
Mus musculus zinc finger protein 326 (Zfp326), transcript variant 1, mRNA [NM_018759]	Zfp326	2371.21	0.12	0.67
Mus musculus breast cancer 2 (Brca2), transcript variant 2, mRNA [NM_009765]	Brca2	4040.89	0.22	0.59
Mus musculus cyclin D binding myb-like transcription factor 1 (Dmtf1), transcript variant 2, mRNA [NM_008628]	Dmtf1	840.96	0.16	0.34
Mus musculus zinc finger protein 263 (Zfp263), mRNA [NM_148924]	Zfp263	4262.77	0.22	0.29
Mus musculus zinc finger protein 191 (Zfp191), mRNA [NM_021559]	Zfp191	8434.40	0.22	0.28
Mus musculus activating transcription factor 3 (Atf3), mRNA [NM_007498]	Atf3	2903.42	0.22	0.68
Mus musculus zinc finger protein 553 (Zfp553), mRNA [NM_146201]	Zfp553	5086.17	-0.25	0.34
Mus musculus zinc finger protein 512 (Zfp512), mRNA [NM_172993]	Zfp512	2305.77	0.25	0.62
Mus musculus zinc finger protein interacting with K protein 1 (Zik1), mRNA [NM_009577]	Zik1	1059.70	0.00	0.32
Mus musculus zinc finger protein 14 (Zfp14), transcript variant 1, mRNA [NM_011748]	Zfp14	969.89	0.00	0.39
Mus musculus adult male kidney cDNA, RIKEN full-length enriched library, clone:0610023112 protein (Zfp787), mRNA [NM_008628]	Zfp787	3012.94	-0.01	0.72
Mus musculus son of sevenless homolog 2 (Drosophila) (Sos2), mRNA [NM_001135559]	Sos2	659.14	0.08	0.34
Mus musculus forkhead box H1 (Foxh1), mRNA [NM_007989]	Foxh1	6378.60	0.16	0.54
Mus musculus forkhead box N3 (Foxn3), mRNA [NM_183186]	Foxn3	937.90	-0.05	0.44
Mus musculus xeroderma pigmentosum, complementation group C (Xpc), mRNA [NM_009531]	Xpc	1659.59	0.20	0.59
Mus musculus Kruppel-like factor 10 (Klf10), mRNA [NM_013692]	Klf10	4703.04	0.11	0.61
Mus musculus CREB binding protein (Crebbp), mRNA [NM_001025432]	Crebbp	10089.67	0.11	0.33
Mus musculus nuclear factor of kappa light polypeptide gene enhancer in B-cells 1, p105 (Nfkb1), mRNA [NM_008628]	Nfkb1	608.03	0.19	0.36
Mus musculus zinc finger, AN1-type domain 3 (Zfand3), mRNA [NM_148926]	Zfand3	5848.92	0.05	0.60
Mus musculus IKAROS family zinc finger 4 (Ikzf4), mRNA [NM_011772]	Ikzf4	2130.48	0.01	0.32
Mus musculus nuclear receptor coactivator 1 (Ncoa1), mRNA [NM_010881]	Ncoa1	758.22	0.01	0.90
Mus musculus TEA domain family member 1 (Tead1), transcript variant 1, mRNA [NM_001166584]	Tead1	6115.51	0.00	0.43
Mus musculus zinc finger protein 467 (Zfp467), transcript variant 1, mRNA [NM_020589]	Zfp467	2379.65	0.26	0.49
Mus musculus zinc finger protein 426 (Zfp426), transcript variant 1, mRNA [NM_146221]	Zfp426	3076.24	0.15	0.35
Mus musculus FLYWCH-type zinc finger 1 (Flywch1), mRNA [NM_153791]	Flywch1	1963.66	-0.16	0.65
Mus musculus Meis homeobox 3 (Meis3), mRNA [NM_008627]	Meis3	776.57	0.10	0.88
lymphoid enhancer binding factor 1 [Source:MGI Symbol;Acc:MGI:96770] [ENSMUST000000029] (Lef1), mRNA [NM_008628]	Lef1	3883.01	0.25	0.97
MLX interacting protein-like [Source:MGI Symbol;Acc:MGI:1927999] [ENSMUST0000011201] (Mlxipl), mRNA [NM_008628]	Mlxipl	4555.67	0.09	0.38
Mus musculus RAD51-like 3 (S. cerevisiae) (Rad51l3), mRNA [NM_011235]	Rad51l3	3079.33	0.15	0.37
Mus musculus zinc finger and BTB domain containing 33 (Zbtb33), transcript variant 1, mRNA [NM_008628]	Zbtb33	831.35	0.24	0.31
Mus musculus zinc finger protein 36, C3H type-like 1 (Zfp361l), mRNA [NM_007564]	Zfp361l	4864.86	0.23	0.65
Mus musculus PR domain containing 5 (Prdm5), mRNA [NM_027547]	Prdm5	1855.81	-0.03	0.31
Mus musculus zinc finger protein 354C (Zfp354c), mRNA [NM_013922]	Zfp354c	1482.07	-0.14	0.33
Mus musculus LUC7-like 3 (S. cerevisiae) (Luc7l3), mRNA [NM_026313]	Luc7l3	21120.40	0.21	0.44
Mus musculus mesoderm induction early response 1, family member 3 (Mier3), mRNA [NM_172598]	Mier3	659.52	0.23	0.61
Mus musculus zinc finger protein 445 (Zfp445), mRNA [NM_173364]	Zfp445	3064.17	-0.20	0.34
Mus musculus IWS1 homolog (S. cerevisiae) (Iws1), mRNA [NM_173441]	Iws1	1407.48	0.22	0.33
Mus musculus RAD18 homolog (S. cerevisiae) (Rad18), transcript variant 1, mRNA [NM_0011677]	Rad18	1537.80	0.18	0.33
Mus musculus sin3 associated polypeptide (Sap30), mRNA [NM_021788]	Sap30	1864.14	0.22	0.51
Mus musculus zinc finger protein 661 (Zfp661), transcript variant 2, mRNA [NM_001111029]	Zfp661	2127.39	0.16	0.33
Mus musculus GATA binding protein 5 (Gata5), mRNA [NM_008093]	Gata5	540.46	-0.24	0.27
Mus musculus Kruppel-like factor 13 (Klf13), mRNA [NM_021366]	Klf13	4360.36	0.10	0.37
Mus musculus interleukin enhancer binding factor 3 (Ilf3), transcript variant 3, mRNA [NM_001044]	Ilf3	5494.40	0.18	0.42
Mus musculus capicua homolog (Drosophila) (Cic), transcript variant 3, mRNA [NM_001110132]	Cic	28927.38	0.16	0.57
Mus musculus heterochromatin protein 1, binding protein 3 (Hp1bp3), transcript variant 2, mRNA [NM_008628]	Hp1bp3	7732.50	0.14	0.57
Mus musculus WD repeat and HMG-box DNA binding protein 1 (Wdhd1), mRNA [NM_172598]	Wdhd1	1244.01	0.00	0.59
Mus musculus transformation related protein 63 (Trp63), transcript variant 3, mRNA [NM_0011272]	Trp63	4051.68	0.15	0.35
Mus musculus cDNA clone IMAGE:948888. [BC096563]	Rnf141	1196.65	0.05	0.38
Mus musculus THAP domain containing 4 (Thap4), mRNA [NM_025920]	Thap4	6266.12	0.01	0.36



zinc finger protein of the cerebellum 5 [Source:MGI Symbol;Acc:MGI:1929518] [ENSMUST000000000000]	Zic5	7734.98	0.07	0.21
Mus musculus BarH-like 1 (Drosophila) (Barh1), transcript variant 1, mRNA [NM_019446]	Barh1	765.06	0.02	0.07
Mus musculus immunoglobulin mu binding protein 2 (Ighmbp2), mRNA [NM_009212]	Ighmbp2	2916.63	-0.18	-0.22
Mus musculus non-POU-domain-containing, octamer binding protein (Nono), mRNA [NM_023144]	Nono	84370.71	0.21	0.15
Mus musculus prolactin regulatory element binding (Preb), mRNA [NM_016703]	Preb	22790.90	-0.14	-0.10
Mus musculus forkhead box J3 (Foxj3), mRNA [NM_172699]	Foxj3	9619.05	0.04	0.18
Mus musculus zinc finger protein 451 (Zfp451), mRNA [NM_133817]	Zfp451	1584.89	-0.07	-0.11
Mus musculus upstream binding transcription factor, RNA polymerase I (Ubtf), transcript variant 1, mRNA [NM_011164]	Ubtf	88688.55	-0.10	-0.17
Mus musculus pre B-cell leukemia transcription factor 2 (Pbx2), mRNA [NM_017463]	Pbx2	6201.34	-0.04	0.14
Mus musculus Y box protein 1 (Ybx1), mRNA [NM_011732]	Ybx1	96382.80	-0.01	0.05
Mus musculus zinc finger protein 131 (Zfp131), mRNA [NM_028245]	Zfp131	3686.61	0.01	-0.05
Mus musculus zinc finger protein 39 (Zfp39), mRNA [NM_011758]	Zfp39	536.50	-0.08	-0.01
Mus musculus jumonji, AT rich interactive domain 2 (Jarid2), transcript variant 2, mRNA [NM_021164]	Jarid2	7175.79	0.04	0.24
Mus musculus endothelial differentiation-related factor 1 (Edf1), mRNA [NM_021519]	Edf1	88578.67	0.11	0.00
Mus musculus zinc finger, GATA-like protein 1 (Zgfp1), mRNA [NM_001103168]	Zgfp1	2075.15	0.01	-0.05
Mus musculus bromodomain adjacent to zinc finger domain, 2A (Baz2a), mRNA [NM_054078]	Baz2a	2559.97	0.06	0.08
Mus musculus zinc finger protein 11 (Zfp11), mRNA [NM_172462]	Zfp11	512.14	-0.10	-0.03
Mus musculus forkhead box P1 (Foxp1), transcript variant 1, mRNA [NM_053202]	Foxp1	8291.76	-0.17	0.14
Mus musculus interferon regulatory factor 3 (Irf3), mRNA [NM_016849]	Irf3	17525.17	-0.08	-0.22
Mus musculus hairy and enhancer of split 6 (Drosophila) (Hes6), mRNA [NM_019479]	Hes6	6663.15	0.19	0.01
Mus musculus TGFB-induced factor homeobox 1 (Tgif1), transcript variant 1, mRNA [NM_001164]	Tgif1	28750.27	-0.22	-0.26
Mus musculus ELK1, member of ETS oncogene family (Elk1), mRNA [NM_007922]	Elk1	658105.66	0.06	0.26
Mus musculus sulfiredoxin 1 homolog (S. cerevisiae) (Srxn1), mRNA [NM_029688]	Srxn1	8201.18	-0.18	-0.19
Mus musculus general transcription factor II I repeat domain-containing 1 (Gtf2ird1), transcript variant 1, mRNA [NM_011164]	Gtf2ird1	5763.06	0.25	0.26
Mus musculus A/E binding protein 2 (Aebp2), transcript variant 1, mRNA [NM_001005605]	Aebp2	1685.42	0.11	0.15
Mus musculus GTF2I repeat domain containing 2 (Gtf2ird2), mRNA [NM_053266]	Gtf2ird2	1138.64	-0.20	-0.04
Mus musculus zinc finger protein 13 (Zfp13), mRNA [NM_011747]	Zfp13	1492.89	0.03	0.22
Mus musculus activating transcription factor 2 (Atf2), transcript variant 1, mRNA [NM_001025093]	Atf2	8338.49	-0.12	-0.11
Mus musculus zinc finger protein 507 (Zfp507), mRNA [NM_177739]	Zfp507	1019.57	0.06	0.20
Mus musculus regulatory factor X, 1 (influences HLA class II expression) (Rfx1), mRNA [NM_009116]	Rfx1	1986.47	0.05	0.16
Mus musculus SET and MYND domain containing 1 (Smyd1), transcript variant 2, mRNA [NM_009116]	Smyd1	655.30	-0.02	0.05
Mus musculus zinc finger protein 46 (Zfp46), mRNA [NM_009557]	Zfp46	1919.37	-0.04	0.09
Mus musculus ets variant gene 3 (Etv3), transcript variant 1, mRNA [NM_001083318]	Etv3	601.67	0.13	0.13
Mus musculus BCL2-associated transcription factor 1 (Bclaf1), transcript variant 1, mRNA [NM_009116]	Bclaf1	23880.12	0.05	0.23
homeobox containing 1 [Source:MGI Symbol;Acc:MGI:2445066] [ENSMUST0000002544]	Hmbox1	948.09	0.25	-0.03
Mus musculus RanBP-type and C3HC4-type zinc finger containing 1 (Rbck1), transcript variant 1, mRNA [NM_012020]	Rbck1	20906.74	-0.06	-0.03
Mus musculus forkhead box L2 (Foxl2), mRNA [NM_012020]	Foxl2	42855.61	0.06	0.01
Mus musculus distal-less homeobox 3 (Dlx3), mRNA [NM_010055]	Dlx3	1790.09	0.06	0.19
Mus musculus POZ (BTB) and AT hook containing zinc finger 1 (Patz1), mRNA [NM_019574]	Patz1	1189.42	0.09	0.22
Mus musculus zinc finger protein 532 (Zfp532), mRNA [NM_207255]	Zfp532	1568.36	0.15	-0.21
Mus musculus general transcription factor III A (Gtf3a), mRNA [NM_025652]	Gtf3a	7721.11	0.00	0.24
Mus musculus nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent 3 (Nfatc3), mRNA [NM_011164]	Nfatc3	1350.09	-0.19	-0.27
Mus musculus transcription factor B1, mitochondrial (Tfb1m), nuclear gene encoding mitochondria, mRNA [NM_011164]	Tfb1m	4364.27	0.11	0.12
Mus musculus transcription factor AP-2, gamma (Tcfap2c), transcript variant 1, mRNA [NM_009333]	Tcfap2c	654.90	-0.08	-0.17
Mus musculus SET domain, bifurcated 2 (Setdb2), mRNA [NM_001081024]	Setdb2	1202.58	-0.14	-0.19
Mus musculus SWI/SNF related, matrix associated, actin dependent regulator of chromatin, subfamily 4 (Smarca4), mRNA [NM_011164]	Smarca4	75560.98	0.04	0.16
Mus musculus ADNP homeobox 2 (Adnp2), mRNA [NM_175028]	Adnp2	1012.88	0.21	0.25
Mus musculus SWI/SNF-related, matrix-associated actin-dependent regulator of chromatin, subfamily 1 (Smarca1), mRNA [NM_011164]	Smarca1	2523.85	0.03	-0.10
Mus musculus nuclear receptor co-repressor 2 (Ncor2), mRNA [NM_011424]	Ncor2	31703.92	0.07	0.09
Mus musculus trans-acting transcription factor 1 (Sp1), mRNA [NM_013672]	Sp1	7783.31	-0.17	-0.13
Mus musculus zinc finger protein 652 (Zfp652), mRNA [NM_201609]	Zfp652	884.44	-0.08	-0.19
Mus musculus B-cell leukemia/lymphoma 3 (Bcl3), mRNA [NM_033601]	Bcl3	729.58	-0.06	0.11
Mus musculus AT-hook transcription factor (Akna), mRNA [NM_001045514]	Akna	617.36	0.02	-0.20
Mus musculus E2F transcription factor 7 (E2f7), mRNA [NM_178609]	E2f7	4603.53	-0.07	-0.02
Mus musculus general transcription factor IIB (Gtf2b), mRNA [NM_145546]	Gtf2b	6784.90	-0.10	-0.08
Mus musculus LAG1 homolog, ceramide synthase 2 (Lass2), mRNA [NM_029789]	Lass2	3662.01	-0.16	-0.24
Mus musculus coiled-coil and C2 domain containing 1A (Cc2d1a), mRNA [NM_145970]	Cc2d1a	4566.48	0.09	-0.04
Mus musculus protein inhibitor of activated STAT 4 (Pias4), mRNA [NM_021501]	Pias4	1765.96	0.04	0.14
Mus musculus TAR DNA binding protein (Tardbp), transcript variant 1, mRNA [NM_145556]	Tardbp	117248.00	-0.07	0.15
Mus musculus zinc finger protein 280C (Zfp280c), transcript variant 1, mRNA [NM_153532]	Zfp280c	5110.88	-0.03	-0.14
Mus musculus CTF8, chromosome transmission fidelity factor 8 homolog (S. cerevisiae) (Chtf8), mRNA [NM_011164]	Chtf8	50280.15	0.07	0.18
Mus musculus zinc finger protein 1 (Zfp1), transcript variant 2, mRNA [NM_011742]	Zfp1	7500.09	0.14	0.23
Mus musculus Pbx/knotted 1 homeobox (Pknx1), transcript variant 1, mRNA [NM_016670]	Pknx1	948.50	0.03	-0.02
Mus musculus zinc finger, matrix type 2 (Zmat2), mRNA [NM_025594]	Zmat2	25685.86	0.23	0.27
Mus musculus TAF10 RNA polymerase II, TATA box binding protein (TBP)-associated factor (Taf10), mRNA [NM_011164]	Taf10	65394.88	0.02	0.25
Mus musculus metal response element binding transcription factor 2 (Mtf2), mRNA [NM_013827]	Mtf2	8881.84	0.16	0.26
Mus musculus Kruppel-like factor 3 (basic) (Klf3), mRNA [NM_008453]	Klf3	3908.59	0.20	0.21
Mus musculus zinc finger and BTB domain containing 24 (Zbtb24), mRNA [NM_153398]	Zbtb24	705.46	0.12	0.21
Mus musculus mediator complex subunit 26 (Med26), mRNA [NM_027485]	Med26	3229.84	0.12	-0.24
Mus musculus transcriptional regulator, SIN3A (yeast) (Sin3a), transcript variant 1, mRNA [NM_011164]	Sin3a	3330.54	0.16	0.23
Mus musculus BTG3 associated nuclear protein (Banp), transcript variant 2, mRNA [NM_016812]	Banp	11985.28	-0.13	-0.06
Mus musculus methyl-CpG binding domain protein 1 (Mbd1), mRNA [NM_013594]	Mbd1	1094.87	0.10	0.08
Mus musculus male-specific lethal 3 homolog (Drosophila) (Msl3), mRNA [NM_010832]	Msl3	1604.02	-0.10	0.09
Mus musculus lin-54 homolog (C. elegans) (Lin54), transcript variant 1, mRNA [NM_001115010]	Lin54	2213.41	0.07	-0.08
Mus musculus general transcription factor III C 1 (Gtf3c1), mRNA [NM_207239]	Gtf3c1	4272.15	0.24	-0.10
Mus musculus SUB1 homolog (S. cerevisiae) (Sub1), mRNA [NM_011294]	Sub1	150223.28	-0.09	0.09
Mus musculus zinc finger protein 513 (Zfp513), transcript variant 1, mRNA [NM_175311]	Zfp513	7256.15	0.11	-0.01
Mus musculus GC-rich promoter binding protein 1 (Gpbp1), transcript variant 2, mRNA [NM_028414]	Gpbp1	13339.47	-0.14	-0.15
Mus musculus myocyte enhancer factor 2A (Mef2a), mRNA [NM_001033713]	Mef2a	1211.90	-0.04	-0.04
Mus musculus methyl-CpG binding domain protein 3 (Mbd3), mRNA [NM_013595]	Mbd3	51562.62	-0.19	-0.25
Mus musculus zinc finger, ZZ domain containing 3 (Zzz3), transcript variant 2, mRNA [NM_001081024]	Zzz3	10358.62	0.03	-0.22
Mus musculus zinc finger protein 574 (Zfp574), transcript variant 1, mRNA [NM_175477]	Zfp574	2565.52	-0.04	0.04
Mus musculus chromodomain helicase DNA binding protein 4 (Chd4), mRNA [NM_145979]	Chd4	72198.79	0.12	0.19
Mus musculus AT hook containing transcription factor 1 (Ahctf1), mRNA [NM_026375]	Ahctf1	5986.52	-0.05	-0.04
Mus musculus general transcription factor II A, 1 (Gtf2a1), transcript variant 1, mRNA [NM_031391]	Gtf2a1	4546.07	-0.03	0.23
Mus musculus E2F transcription factor 6 (E2f6), transcript variant 1, mRNA [NM_033270]	E2f6	13412.09	0.11	-0.19
Mus musculus TATA box binding protein (Tbp)-associated factor, RNA polymerase I, D (Taf1d), transcript variant 1, mRNA [NM_011164]	Taf1d	3730.28	-0.05	-0.01



Mus musculus down-regulator of transcription 1 (Dr1), mRNA [NM_026106]	Dr1	2168.67	0.07	-0.12
Mus musculus PHD finger protein 20 (Phf20), mRNA [NM_172674]	Phf20	3212.76	-0.23	-0.01
Mus musculus DEK oncogene (DNA binding) (Dek), mRNA [NM_025900]	Dek	21788.56	0.08	0.07
Mus musculus partner and localizer of BRCA2 (Palb2), mRNA [NM_001081238]	Palb2	547.69	-0.20	-0.14
Mus musculus aryl hydrocarbon receptor nuclear translocator-like (Arntl), mRNA [NM_007489]	Arntl	896.05	0.00	0.01
Mus musculus nuclear receptor subfamily 2, group C, member 2 (Nr2c2), mRNA [NM_011630]	Nr2c2	1492.92	-0.01	0.26
Mus musculus zinc finger protein 422 (Zfp422), mRNA [NM_026057]	Zfp422	1927.28	0.00	0.26
Mus musculus PR domain containing 4 (Prdm4), mRNA [NM_181650]	Prdm4	1690.63	0.04	-0.08
Mus musculus SRY-box containing gene 3 (Sox3), mRNA [NM_009237]	Sox3	9966.31	-0.18	-0.02
Mus musculus transcription factor 25 (basic helix-loop-helix) (Tcf25), transcript variant 2, mRNA [NM_001081238]	Tcf25	39639.99	0.11	0.26
Mus musculus zinc finger protein 521 (Zfp521), mRNA [NM_145492]	Zfp521	1821.92	0.24	0.13
Mus musculus sterol regulatory element binding factor 2 (Srebf2), mRNA [NM_033218]	Srebf2	3005.85	0.10	0.26
Mus musculus TAF6-like RNA polymerase II, p300/CBP-associated factor (PCAF)-associated factor 1 (Taf6l), mRNA [NM_001081238]	Taf6l	1010.23	-0.04	0.06
Mus musculus nuclear receptor co-repressor 1 (Ncor1), mRNA [NM_011308]	Ncor1	2961.97	0.07	0.24
Mus musculus AT hook, DNA binding motif, containing 1 (Ahdc1), mRNA [NM_146155]	Ahdc1	3507.93	0.00	-0.07
Mus musculus polybromo 1 (Pbrm1), mRNA [NM_001081251]	Pbrm1	2898.28	-0.04	0.24
Mus musculus activating transcription factor 4 (Atf4), mRNA [NM_009716]	Atf4	211686.49	-0.09	0.21
Mus musculus interferon regulatory factor 9 (Irf9), transcript variant 1, mRNA [NM_001159417]	Irf9	827.21	-0.11	-0.19
Mus musculus ovo-like 2 (Drosophila) (Ovol2), transcript variant A, mRNA [NM_026924]	Ovol2	3156.17	-0.19	0.11
Mus musculus bobby sox homolog (Drosophila) (Bbx), mRNA [NM_027444]	Bbx	2883.20	-0.05	0.17
Mus musculus peroxisome proliferator activator receptor delta (Ppard), mRNA [NM_011145]	Ppard	2824.24	-0.11	0.20
Mus musculus bromodomain containing 4 (Brd4), transcript variant 2, mRNA [NM_198094]	Brd4	33519.54	-0.17	-0.09
Mus musculus cAMP responsive element binding protein 3 (Creb3), mRNA [NM_013497]	Creb3	2127.22	0.10	0.06
Mus musculus ets variant gene 6 (TEL oncogene) (Etv6), mRNA [NM_007961]	Etv6	516.49	-0.15	0.07
Mus musculus apoptosis-inducing, TAF9-like domain 1 (Apid1), mRNA [NM_027263]	Apid1	3179.49	0.00	0.09
Mus musculus DEAH (Asp-Glu-Ala-His) box polypeptide 9 (Dhx9), mRNA [NM_007842]	Dhx9	944.36	0.05	0.13
Mus musculus transcription factor 7-like 2, T-cell specific, HMG-box (Tcf7l2), transcript variant 7, mRNA [NM_001081238]	Tcf7l2	713.83	-0.02	0.00
Mus musculus zinc finger with KRAB and SCAN domains 17 (Zkscan17), transcript variant 1, mRNA [NM_001081238]	Zkscan17	17911.48	-0.03	-0.04
Mus musculus adult male olfactory brain cDNA, RIKEN full-length enriched library, clone:643052 (Fbx19), mRNA [NM_001081238]	Fbx19	23619.45	-0.10	0.20
Mus musculus zinc finger protein 386 (Kruppel-like) (Zfp386), transcript variant 1, mRNA [NM_001081238]	Zfp386	3027.92	-0.06	0.26
Mus musculus fusion, derived from t(12;16) malignant liposarcoma (human) (Fus), mRNA [NM_133271]	Fus	77408.99	0.03	0.05
Mus musculus ring finger and CCCH-type zinc finger domains 2 (Rc3h2), mRNA [NM_001100591]	Rc3h2	3711.11	-0.17	-0.23
Mus musculus zinc finger protein 93 (Zfp93), mRNA [NM_009567]	Zfp93	2112.20	0.10	-0.03
Mus musculus forkhead box K2 (Foxk2), mRNA [NM_001080932]	Foxk2	6897.97	-0.11	-0.16
Mus musculus zinc finger protein 524 (Zfp524), mRNA [NM_025324]	Zfp524	2046.57	-0.10	0.12
Mus musculus forkhead box M1 (Foxm1), mRNA [NM_008021]	Foxm1	3426.27	-0.02	0.26
Mus musculus sal-like 4 (Drosophila) (Sall4), transcript variant a, mRNA [NM_175303]	Sall4	11309.85	-0.06	0.11
SRY-box containing gene 5 [Source:MGI Symbol;Acc:MGI:98367] [ENSMUST00000038815] (Sox5), mRNA [NM_001081238]	Sox5	57226.29	0.05	0.20
Mus musculus glucocorticoid receptor DNA binding factor 1 (Grif1), mRNA [NM_172739]	Grif1	19865.73	-0.15	0.06
Mus musculus transcription elongation factor A (SII) 1 (Tcea1), transcript variant 2, mRNA [NM_001081238]	Tcea1	1895.70	0.05	-0.12
Mus musculus WW domain binding protein 7 (Wbp7), mRNA [NM_029274]	Wbp7	5685.06	0.11	0.25
Mus musculus Jun proto-oncogene related gene d (Jund), mRNA [NM_010592]	Jund	33491.80	-0.07	-0.21
Mus musculus THAP domain containing 11 (Thap11), mRNA [NM_021513]	Thap11	11311.32	-0.08	-0.06
Mus musculus zinc finger protein 770 (Zfp770), mRNA [NM_175466]	Zfp770	2966.01	0.12	0.11
Mus musculus hairy and enhancer of split 7 (Drosophila) (Hes7), mRNA [NM_033041]	Hes7	1070.72	-0.02	0.12
Mus musculus zinc finger protein 488 (Zfp488), mRNA [NM_001013777]	Zfp488	2043.93	-0.06	0.09
Mus musculus AT rich interactive domain 5A (MRF1-like) (Arid5a), transcript variant 1, mRNA [NM_001081238]	Arid5a	1038.01	-0.07	-0.06
Mus musculus upstream binding protein 1 (Ubp1), transcript variant 2, mRNA [NM_013699]	Ubp1	509.18	-0.07	0.27
Mus musculus zinc finger protein 410 (Zfp410), mRNA [NM_144833]	Zfp410	2039.51	-0.05	-0.04
Mus musculus zinc finger protein (C2H2 type) 276 (Zfp276), mRNA [NM_020497]	Zfp276	719.67	-0.22	0.04
Mus musculus zinc finger protein 143 (Zfp143), mRNA [NM_009281]	Zfp143	1025.84	0.03	0.12
Mus musculus endothelial PAS domain protein 1 (Epas1), mRNA [NM_010137]	Epas1	7871.35	0.00	0.17
Mus musculus poly(rC) binding protein 1 (Pcbp1), mRNA [NM_011865]	Pcbp1	145069.58	-0.10	-0.04
Mus musculus poly(rC) binding protein 2 (Pcbp2), transcript variant 1, mRNA [NM_001103165]	Pcbp2	58351.66	-0.17	-0.21
Mus musculus zinc finger protein 184 (Kruppel-like) (Zfp184), mRNA [NM_183014]	Zfp184	1911.38	0.16	0.20
Mus musculus X-ray repair complementing defective repair in Chinese hamster cells 6 (Xrcc6), mRNA [NM_001081238]	Xrcc6	34378.09	0.05	-0.03
Mus musculus replication factor C (activator 1) 2 (Rfc2), mRNA [NM_020022]	Rfc2	15348.78	-0.05	0.00
Mus musculus YY1 transcription factor (Yy1), mRNA [NM_009537]	Yy1	4538.88	-0.15	0.01
Mus musculus v-maf musculoaponeurotic fibrosarcoma oncogene family, protein G (avian) (Mafg), mRNA [NM_001081238]	Mafg	21929.08	0.03	0.12
Mus musculus zinc finger and BTB domain containing 9 (Zbtb9), mRNA [NM_001005916]	Zbtb9	2208.92	0.05	-0.15
Mus musculus germ cell-specific gene 2 (Gsg2), mRNA [NM_010353]	Gsg2	3629.10	-0.27	-0.25
Mus musculus v-maf musculoaponeurotic fibrosarcoma oncogene family, protein A (avian) (Mafa), mRNA [NM_001081238]	Mafa	3148.56	0.16	0.26
Mus musculus zinc finger protein 628 (Zfp628), mRNA [NM_170759]	Zfp628	524771.31	0.15	0.21
Mus musculus IKAROS family zinc finger 5 (Ikzf5), mRNA [NM_175115]	Ikzf5	746.06	-0.04	0.07
Mus musculus retinoid X receptor gamma (Rxrg), transcript variant 1, mRNA [NM_009107]	Rxrg	3604.51	-0.18	0.17
Mus musculus zinc finger, CCCH-type with G patch domain (Zgpat), transcript variant 1, mRNA [NM_001081238]	Zgpat	1264.43	-0.20	-0.06
Mus musculus zinc finger and AT hook domain containing (Zfat), transcript variant 1, mRNA [NM_001081238]	Zfat	759.90	0.01	-0.07
Mus musculus general transcription factor IIH, polypeptide 5 (Gtf2h5), mRNA [NM_181392]	Gtf2h5	12206.25	0.12	0.16
Mus musculus transcription factor E3 (Tcf3), transcript variant 1, mRNA [NM_172472]	Tcf3	18123.11	-0.25	0.19
Mus musculus GATA binding protein 1 (Gata1), mRNA [NM_008089]	Gata1	137.41	-0.25	0.09
Mus musculus zinc finger protein 654 (Zfp654), mRNA [NM_028059]	Zfp654	196.19	-0.09	-0.17
Mus musculus regulatory factor X-associated protein (Rfxap), mRNA [NM_133231]	Rfxap	213.99	0.23	0.26
Mus musculus nuclear receptor subfamily 1, group H, member 3 (Nr1h3), transcript variant 1, mRNA [NM_001081238]	Nr1h3	384.93	0.17	-0.18
Mus musculus SRY-box containing gene 21 (Sox21), mRNA [NM_177753]	Sox21	194.33	-0.18	0.21
Mus musculus signal transducer and activator of transcription 4 (Stat4), mRNA [NM_011487]	Stat4	382.53	-0.17	-0.21
Mus musculus zinc finger and BTB domain containing 8b (Zbtb8b), mRNA [NM_153541]	Zbtb8b	392.99	0.16	0.18
Mus musculus scratch homolog 2, zinc finger protein (Drosophila) (Sert2), mRNA [NM_001160410]	Sert2	117.35	0.09	0.17
Mus musculus NK2 transcription factor related, locus 9 (Drosophila) (Nkx2-9), mRNA [NM_008700]	Nkx2-9	196.65	0.21	0.00
Mus musculus T-box 22 (Tbx22), transcript variant 2, mRNA [NM_181319]	Tbx22	117.89	-0.07	0.10
Mus musculus FBI osteosarcoma oncogene B (Fosb), mRNA [NM_008036]	Fosb	97.23	-0.13	0.01
Mus musculus peroxisome proliferator activated receptor alpha (Ppara), transcript variant 1, mRNA [NM_001081238]	Ppara	364.19	0.25	0.15
Mus musculus GATA binding protein 3 (Gata3), mRNA [NM_008091]	Gata3	189.95	-0.20	-0.22
aryl hydrocarbon receptor nuclear translocator-like 2 [Source:MGI Symbol;Acc:MGI:2684845] (Arntl2), mRNA [NM_001081238]	Arntl2	326.67	-0.25	-0.18
Mus musculus mesoderm induction early response 1 homolog (Xenopus laevis) (Mier1), transcript variant 1, mRNA [NM_001081238]	Mier1	284.72	-0.09	0.15
Mus musculus glucocorticoid modulatory element binding protein 2 (Gmeb2), mRNA [NM_198169]	Gmeb2	468.69	-0.15	-0.11
Mus musculus nuclear factor of activated T-cells 5 (Nfat5), transcript variant a, mRNA [NM_133950]	Nfat5	135.19	-0.20	-0.07
Mus musculus FBI osteosarcoma oncogene (Fos), mRNA [NM_010234]	Fos	120.73	0.01	-0.19

Mus musculus THAP domain containing 7 (Thap7), mRNA [NM_026909]	Thap7	237.55	-0.02	-0.13
Mus musculus forkhead box S1 (Foxs1), mRNA [NM_010226]	Foxs1	83.21	0.05	0.12
Mus musculus endothelial PAS domain protein 1 (Epas1), mRNA [NM_010137]	Epas1	416.18	-0.01	0.18
Mus musculus sex comb on midleg-like 4 (Drosophila) (Scml4), mRNA [NM_172938]	Scml4	99.90	-0.19	-0.03
Mus musculus pogo transposable element with KRAB domain (Pogk), transcript variant 1, mRNA [NM_010137]	Pogk	147.99	-0.14	0.24
Mus musculus cAMP responsive element binding protein 1 (Creb1), transcript variant B, mRNA [NM_010137]	Creb1	347.04	0.08	0.10
Mus musculus transcription factor AP4 (Tcfap4), mRNA [NM_031182]	Tcfap4	483.91	0.00	0.09
Mus musculus nuclear receptor subfamily 1, group D, member 1 (Nr1d1), mRNA [NM_145434]	Nr1d1	124.50	-0.24	-0.05
Mus musculus basic helix-loop-helix family, member a9 (Bhlha9), mRNA [NM_177182]	Bhlha9	132.54	-0.23	-0.18
Mus musculus forkhead box I3 (Foxi3), mRNA [NM_001101464]	Foxi3	166.70	-0.01	-0.17
Mus musculus THO complex 1 (Thoc1), mRNA [NM_153552]	Thoc1	170.88	-0.14	0.06
Mus musculus zinc finger protein 382 (Zfp382), mRNA [NM_001081007]	Zfp382	82.12	0.04	0.12
Mus musculus zinc finger and BTB domain containing 41 homolog (Zbtb41), mRNA [NM_172643]	Zbtb41	216.01	0.08	-0.01
Mus musculus DNA fragmentation factor, beta subunit (Dffb), mRNA [NM_007859]	Dffb	494.49	0.03	-0.01
Mus musculus forkhead box A3 (Foxa3), mRNA [NM_008260]	Foxa3	115.14	-0.20	-0.02
Mus musculus cAMP responsive element binding protein 3-like 2 (Creb3l2), mRNA [NM_178661]	Creb3l2	187.75	-0.12	0.02
Mus musculus highly divergent homeobox (Hdx), mRNA [NM_001080549]	Hdx	250.12	0.06	0.08
Mus musculus Kruppel-like factor 4 (gut) (Klf4), mRNA [NM_010637]	Klf4	339.28	0.01	0.07
Mus musculus activating transcription factor 7 (Atf7), mRNA [NM_146065]	Atf7	91.81	0.18	0.17
Mouse zinc finger protein (mkr5) mRNA, 3' end. [M36516]	Zfp28	157.72	-0.06	-0.12
Mus musculus zinc finger protein 786 (Zfp786), mRNA [NM_177882]	Zfp786	184.79	0.26	0.06
Mus musculus DEXH (Asp-Glu-X-His) box polypeptide 58 (Dhx58), mRNA [NM_030150]	Dhx58	99.76	-0.05	0.09
Mus musculus sterol regulatory element binding transcription factor 1 (Srebf1), mRNA [NM_011488]	Srebf1	390.19	-0.02	-0.04
Mus musculus SRY-box containing gene 10 (Sox10), mRNA [NM_011437]	Sox10	104.60	0.00	-0.13
Mus musculus B-cell CLL/lymphoma 6, member B (Bcl6b), mRNA [NM_007528]	Bcl6b	388.34	-0.04	0.18
Mus musculus myeloid/lymphoid or mixed-lineage leukemia 2 (Mll2), mRNA [NM_001033276]	Mll2	340.18	-0.10	-0.04
Mus musculus zinc fingers and homeoboxes 1 (Zhx1), transcript variant 2, mRNA [NM_001042438]	Zhx1	199.99	-0.12	-0.15
Mus musculus homeobox, msh-like 2 (Msx2), mRNA [NM_013601]	Msx2	130.08	-0.01	0.06
Mus musculus nuclear receptor subfamily 1, group D, member 2, mRNA (cDNA clone MGC:10614)	Nr1d2	370.00	0.14	0.20
Mus musculus zinc finger protein 583 (Zfp583), mRNA [NM_001033249]	Zfp583	354.72	-0.19	-0.04
Mus musculus NK2 transcription factor related, locus 6 (Drosophila) (Nkx2-6), mRNA [NM_010922]	Nkx2-6	90.29	-0.08	0.16
Mus musculus circadian locomotor output cycles kaput (Clock), mRNA [NM_007715]	Clock	188.27	-0.12	-0.06
Mus musculus forkhead box G1 (Foxg1), transcript variant 2, mRNA [NM_001160112]	Foxg1	31.38	-0.14	-0.16
Mus musculus TOX high mobility group box family member 2 (Tox2), mRNA [NM_001098799]	Tox2	43.37	0.13	0.23
Mus musculus POU domain, class 3, transcription factor 4 (Pou3f4), mRNA [NM_008901]	Pou3f4	7.52	-0.05	0.27
Mus musculus Iroquois related homeobox 4 (Drosophila) (Irx4), mRNA [NM_018885]	Irx4	78.55	0.10	0.20
Mus musculus UNC homeobox (Uncx), mRNA [NM_013702]	Uncx	65.76	-0.24	-0.22
Mus musculus forkhead box I1 (Foxi1), mRNA [NM_023907]	Foxi1	40.18	0.01	-0.13
Mus musculus lymphoblastic leukemia 1 (Lyl1), mRNA [NM_008535]	Lyl1	71.69	-0.18	-0.20
Mus musculus trans-acting transcription factor 3 (Sp3), transcript variant 1, mRNA [NM_00101804]	Sp3	60.70	0.04	0.13
Mus musculus paired box gene 2 (Pax2), mRNA [NM_011037]	Pax2	28.88	0.02	0.03
Mus musculus paired box gene 3 (Pax3), transcript variant 1, mRNA [NM_008781]	Pax3	22.08	0.15	0.12
Mus musculus zinc finger and SCAN domain containing 2 (Zscan2), mRNA [NM_009553]	Zscan2	60.88	0.21	0.09
Mus musculus paired box gene 5 (Pax5), mRNA [NM_008782]	Pax5	5.87	-0.01	0.11
Mus musculus reproductive homeobox 1 (Rhox1), mRNA [NM_001025084]	Rhox1	33.20	0.21	0.06
Mus musculus homeobox A9 (Hoxa9), mRNA [NM_010456]	Hoxa9	34.77	0.12	0.15
Mus musculus forkhead box C1 (Foxc1), mRNA [NM_008592]	Foxc1	33.08	-0.11	-0.18
Mus musculus THAP domain containing, apoptosis associated protein 2 (Thap2), mRNA [NM_025000]	Thap2	37.79	0.03	0.17
Mus musculus transition protein 1 (Tnp1), mRNA [NM_009407]	Tnp1	42.92	-0.05	-0.07
Mus musculus zinc finger protein 354B (Zfp354b), mRNA [NM_013744]	Zfp354b	36.59	-0.03	-0.07
Mus musculus zinc finger protein 39 (Zfp39), mRNA [NM_011758]	Zfp39	37.07	0.04	0.09
Mus musculus developing brain homeobox 1 (Dbx1), mRNA [NM_001005232]	Dbx1	4.68	-0.08	0.12
Mus musculus DMRT-like family B with proline-rich C-terminal, 1 (Dmrtb1), mRNA [NM_019872]	Dmrtb1	43.09	-0.12	-0.22
Mus musculus runt related transcription factor 3 (Runx3), mRNA [NM_019732]	Runx3	62.72	-0.25	-0.06
Mus musculus SRY-box containing gene 14 (Sox14), mRNA [NM_011440]	Sox14	31.98	0.01	-0.22
Mus musculus proliferation-associated 2G4 (Pa2g4), mRNA [NM_011119]	Pa2g4	17181.37	0.07	-0.30
Mus musculus surfeit gene 6 (Surf6), mRNA [NM_009298]	Surf6	19012.23	-0.08	-0.69
Mus musculus purine rich element binding protein B (Purb), mRNA [NM_011221]	Purb	3769.91	-0.21	-0.42
Mus musculus polycomb group ring finger 2 (Pcgf2), transcript variant 1, mRNA [NM_009545]	Pcgf2	1067.15	-0.01	-0.49
Mus musculus zinc finger protein 57 (Zfp57), transcript variant 3, mRNA [NM_001168502]	Zfp57	794.99	-0.08	-0.29
Mus musculus PHD finger protein 5A (Phf5a), mRNA [NM_026737]	Phf5a	43709.16	-0.06	-0.43
Mus musculus single-minded homolog 2 (Drosophila) (Sim2), mRNA [NM_011377]	Sim2	811.48	0.12	-0.31
Mus musculus transcription factor-like 5 (basic helix-loop-helix) (Tcf15), mRNA [NM_178254]	Tcf15	2110.36	-0.08	-0.33
Mus musculus E2F transcription factor 3 (E2f3), mRNA [NM_010093]	E2f3	4695.96	-0.20	-0.33
Mus musculus myb-like, SWIRM and MPN domains 1 (Mysm1), mRNA [NM_177239]	Mysm1	1247.73	-0.26	-0.29
Mus musculus MAX-like protein X (Mlx), transcript variant 3, mRNA [NM_011550]	Mlx	2683.69	-0.21	-0.31
Mus musculus coiled-coil domain containing 124 (Ccdc124), mRNA [NM_026964]	Ccdc124	20497.84	-0.20	-0.42
Mus musculus GA repeat binding protein, alpha (Gabpa), mRNA [NM_008065]	Gabpa	2113.25	-0.26	-0.53
Mus musculus nuclear factor related to kappa B binding protein (Nfkb), mRNA [NM_172766]	Nfkb	1134.50	-0.05	-0.38
Mus musculus nuclear transcription factor-Y gamma (Nfyc), transcript variant 1, mRNA [NM_008600]	Nfyc	29314.69	-0.12	-0.31
Mus musculus ras responsive element binding protein 1 (Rreb1), transcript variant 6, mRNA [NM_010137]	Rreb1	2378.14	-0.22	-0.63
Mus musculus zinc finger protein 511 (Zfp511), mRNA [NM_027201]	Zfp511	9117.17	-0.22	-0.40
Mus musculus GLIS family zinc finger 2 (Glis2), mRNA [NM_031184]	Glis2	10395.91	-0.21	-0.77
Mus musculus zinc finger protein 672 (Zfp672), transcript variant 2, non-coding RNA [NR_028331]	Zfp672	878.58	-0.15	-0.31
Mus musculus protein inhibitor of activated STAT 2 (Pias2), transcript variant 5, mRNA [NM_001101]	Pias2	5645.40	-0.16	-0.27
Mus musculus apurinic/apyrimidinic endonuclease 1 (Apex1), nuclear gene encoding mitochondrial isoform, mRNA [NM_001101]	Apex1	41502.35	-0.22	-0.49
Mus musculus forkhead box J1 (Foxj1), mRNA [NM_008240]	Foxj1	578.92	0.19	-0.72
Mus musculus death effector domain-containing DNA binding protein 2 (Dedd2), mRNA [NM_207000]	Dedd2	7021.66	-0.22	-0.79
Mus musculus HMG box domain containing 3 (Hmgxb3), transcript variant 1, mRNA [NM_178277]	Hmgxb3	13082.25	0.24	-0.29
Mus musculus nuclear factor of activated T-cells, cytoplasmic, calcineurin-dependent 2 (Nfatc2), transcript variant 1, mRNA [NM_001101]	Nfatc2	582.05	-0.23	-0.31
Mus musculus forkhead box P4 (Foxp4), transcript variant 1, mRNA [NM_00110824]	Foxp4	8759.96	0.07	-0.66
Mus musculus DEAD/H (Asp-Glu-Ala-Asp/His) box polypeptide 3, X-linked (Ddx3x), mRNA [NM_001101]	Ddx3x	50546.94	-0.19	-0.61
Mus musculus Sp2 transcription factor (Sp2), transcript variant 1, mRNA [NM_030220]	Sp2	1669.66	0.01	-0.34
Mus musculus zinc finger protein 689 (Zfp689), mRNA [NM_175163]	Zfp689	3336.53	-0.10	-0.34
Mus musculus general transcription factor II E, polypeptide 2 (beta subunit) (Gtf2e2), transcript variant 1, mRNA [NM_001101]	Gtf2e2	15760.91	-0.24	-0.41
Mus musculus retinoic acid receptor, alpha (Rara), transcript variant 2, mRNA [NM_001177302]	Rara	6115.10	0.08	-0.31
Mus musculus transcription factor 7, T-cell specific (Tcf7), mRNA [NM_009331]	Tcf7	1449.86	0.26	-0.58

Mus musculus activating transcription factor 6 beta (Atf6b), mRNA [NM_017406]	Atf6b	926.04	0.15	-0.29
Mus musculus high mobility group nucleosomal binding domain 3 (Hmgn3), transcript variant b, m	Hmgn3	2230.11	-0.23	-0.43
Mus musculus estrogen related receptor, alpha (Esrra), mRNA [NM_007953]	Esrra	6146.18	0.05	-0.34
Mus musculus telomeric repeat binding factor 1 (Terf1), mRNA [NM_009352]	Terf1	20151.09	-0.17	-0.82
Mus musculus ankyrin repeat and BTB (POZ) domain containing 2 (Abtb2), mRNA [NM_178890]	Abtb2	1283.01	0.03	-0.30
Mus musculus zinc finger protein 473 (Zfp473), mRNA [NM_178734]	Zfp473	5067.81	-0.05	-0.33
Mus musculus v-maf musculoaponeurotic fibrosarcoma oncogene family, protein K (avian) (Mafk),	Mafk	1020.32	0.02	-0.33
Mus musculus runt-related transcription factor 1; translocated to, 1 (cyclin D-related) (Runx1t1), tra	Runx1t1	1400.65	0.22	-0.77
Mus musculus engrailed 2 (En2), mRNA [NM_010134]	En2	107.22	-0.15	-0.76
Mus musculus zinc finger protein 667 (Zfp667), mRNA [NM_001024928]	Zfp667	82.98	-0.19	-0.38
Mus musculus early growth response 2 (Egr2), mRNA [NM_010118]	Egr2	123.22	-0.16	-0.90
Mus musculus distal-less homeobox 4 (Dlx4), mRNA [NM_007867]	Dlx4	129.81	0.26	-0.65
Mus musculus Spi-B transcription factor (Spi-1/PU.1 related) (Spib), mRNA [NM_019866]	Spib	231.43	-0.05	-0.61
reproductive homeobox 10 [Source:MGI Symbol;Acc:MGI:3580249] [ENSMUST0000066636]	Rhox10	355.81	0.07	-0.34
Mus musculus transcription factor EB (Tcf7l1), transcript variant 2, mRNA [NM_001161722]	Tcf7l1	106.97	-0.26	-0.69
Mus musculus MLX interacting protein (Mlxip), transcript variant 2, mRNA [NM_133917]	Mlxip	499.57	-0.22	-0.35
Mus musculus snail homolog 2 (Drosophila) (Snai2), mRNA [NM_011415]	Snai2	190.61	-0.20	-0.69
Mus musculus zinc finger protein 35 (Zfp35), mRNA [NM_011755]	Zfp35	126.67	-0.08	-0.39
Mus musculus FEV (ETS oncogene family) (Fev), mRNA [NM_153111]	Fev	41.90	-0.26	-0.47
Mus musculus NK2 transcription factor related, locus 4 (Drosophila) (Nkx2-4), mRNA [NM_02350]	Nkx2-4	24.22	0.00	-0.30
Mus musculus thymocyte selection-associated high mobility group box (Tox), mRNA [NM_145711]	Tox	59.74	0.03	-0.43
Mus musculus Kruppel-like factor 1 (erythroid) (Klf1), mRNA [NM_010635]	Klf1	75.65	-0.21	-0.81
Mus musculus paired box gene 7 (Pax7), mRNA [NM_011039]	Pax7	11.07	-0.14	-0.58
Mus musculus homeobox B9 (Hoxb9), mRNA [NM_008270]	Hoxb9	44.53	-0.04	-0.65
Mus musculus aryl-hydrocarbon receptor (Ahr), mRNA [NM_013464]	Ahr	1720.84	0.10	-1.31
Mus musculus grainyhead-like 3 (Drosophila) (Grhl3), mRNA [NM_001013756]	Grhl3	514.67	-0.02	-1.10
Mus musculus POU domain, class 5, transcription factor 1 (Pou5f1), mRNA [NM_013633]	Pou5f1	64092.23	-0.18	-1.34
Mus musculus TATA box binding protein (Tbp)-associated factor, RNA polymerase I, C (Taf1c), m	Taf1c	2072.44	-0.05	-1.07
Mus musculus AE binding protein 1 (Aebp1), mRNA [NM_009636]	Aebp1	11828.56	0.24	-1.84
Mus musculus Kruppel-like factor 16 (Klf16), mRNA [NM_078477]	Klf16	2363.95	-0.14	-1.23
Mus musculus NF-kappaB repressing factor (Nkrf), mRNA [NM_029891]	Nkrf	1221.18	0.22	-1.24
Mus musculus v-myc myelocytomatosis viral related oncogene, neuroblastoma derived (avian) (Myc	Mycn	18132.28	-0.16	-1.30
Mus musculus THAP domain containing, apoptosis associated protein 1 (Thap1), mRNA [NM_199]	Thap1	1708.61	0.09	-1.04
Mus musculus signal transducer and activator of transcription 3 (Stat3), transcript variant 1, mRNA	Stat3	4184.71	-0.15	-1.42
Mus musculus sine oculis-related homeobox 4 homolog (Drosophila) (Six4), mRNA [NM_011382]	Six4	1066.50	-0.12	-1.50
Mus musculus zinc finger homeobox 3 (Zfhx3), mRNA [NM_007496]	Zfhx3	630.41	0.18	-1.62
Mus musculus E2F transcription factor 8 (E2f8), mRNA [NM_001013368]	E2f8	4620.87	-0.05	-1.01
Mus musculus chromodomain helicase DNA binding protein 9 (Chd9), mRNA [NM_177224]	Chd9	3402.00	-0.21	-1.06
Mus musculus TGFB-induced factor homeobox 2 (Tgif2), mRNA [NM_173396]	Tgif2	1078.90	-0.17	-1.16
Mus musculus breast cancer 1 (Brca1), mRNA [NM_009764]	Brca1	162.60	-0.21	-1.07
Mus musculus POU domain, class 4, transcription factor 1 (Pou4f1), mRNA [NM_011143]	Pou4f1	187.25	-0.05	-1.17
Mus musculus hairless (Hr), mRNA [NM_021877]	Hr	273.63	-0.16	-1.37
Mus musculus myelocytomatosis oncogene (Myc), transcript variant 1, mRNA [NM_010849]	Myc	3027.36	0.03	-3.45
Mus musculus BTB (POZ) domain containing 11 (Btb11), transcript variant 1, mRNA [NM_02870]	Btb11	698.79	-0.60	3.77
Mus musculus forkhead box B1 (Foxb1), mRNA [NM_022378]	Foxb1	125.07	-0.32	3.84
Mus musculus neuronal PAS domain protein 3 (Npas3), mRNA [NM_013780]	Npas3	6.17	-0.38	4.30
Mus musculus Max dimerization protein 4 (Mxd4), mRNA [NM_010753]	Mxd4	262.28	-0.34	1.81
Mus musculus aryl hydrocarbon receptor nuclear translocator 2 (Arnt2), mRNA [NM_007488]	Arnt2	139.34	-0.27	1.44
Mus musculus zinc finger homeobox 2 (Zfhx2), mRNA [NM_001039198]	Zfhx2	65.31	-0.38	1.86
Mus musculus CCAAT/enhancer binding protein (C/EBP), gamma (Cebpg), mRNA [NM_009884]	Cebpg	857.46	-0.76	0.49
Mus musculus zinc finger and BTB domain containing 8a (Zbtb8a), mRNA [NM_028603]	Zbtb8a	613.34	-0.38	0.40
Mus musculus zinc finger protein 647 (Zfp647), transcript variant 2, mRNA [NM_172817]	Zfp647	1285.26	-0.36	0.59
Mus musculus zinc finger protein 367 (Zfp367), mRNA [NM_175494]	Zfp367	1028.33	-0.44	0.54
Mus musculus X-box binding protein 1 (Xbp1), mRNA [NM_013842]	Xbp1	15179.01	-0.51	0.29
Mus musculus zinc finger protein 239 (Zfp239), transcript variant 1, mRNA [NM_001001792]	Zfp239	1668.58	-0.27	0.39
Mus musculus high mobility group 20A (Hmg20a), mRNA [NM_025812]	Hmg20a	2923.46	-0.44	0.72
Mus musculus zinc finger protein 260 (Zfp260), mRNA [NM_011981]	Zfp260	10621.69	-0.83	0.58
Mus musculus LAG1 homolog, ceramide synthase 6 (Lass6), mRNA [NM_172856]	Lass6	96.27	-0.35	0.38
Mus musculus single-stranded DNA binding protein 1 (Ssbp1), nuclear gene encoding mitochondria	Ssbp1	35788.31	-0.38	0.02
Mus musculus zinc finger protein 668 (Zfp668), mRNA [NM_146259]	Zfp668	7881.04	-0.31	-0.12
Mus musculus v-rel reticuloendotheliosis viral oncogene homolog A (avian) (Rela), mRNA [NM_00	Rela	17356.58	-0.55	0.09
Mus musculus zinc finger and BTB domain containing 7B (Zbtb7b), mRNA [NM_009565]	Zbtb7b	21779.48	-0.87	-0.04
Mus musculus mediator complex subunit 1 (Med1), transcript variant 2, mRNA [NM_134027]	Med1	7328.70	-0.42	0.11
Mus musculus general transcription factor IIIC, polypeptide 6, alpha (Gtf3c6), mRNA [NM_02611	Gtf3c6	18184.34	-0.28	-0.18
Mus musculus zinc finger protein 64 (Zfp64), mRNA [NM_009564]	Zfp64	10843.92	-0.70	-0.27
Mus musculus AT rich interactive domain 1A (SWI-like) (Arid1a), mRNA [NM_001080819]	Arid1a	10069.32	-0.27	0.01
Mus musculus zinc finger protein 35 (Zfp35), mRNA [NM_011755]	Zfp35	9052.87	-0.29	-0.05
Mus musculus TATA box binding protein (Tbp), mRNA [NM_013684]	Tbp	3283.20	-0.29	0.07
Mus musculus PAP associated domain containing 5 (Papd5), transcript variant 1, mRNA [NM_0011	Papd5	5205.27	-0.41	-0.23
Mus musculus TATA box binding protein-like 1 (Tbpl1), mRNA [NM_011603]	Tbpl1	7787.61	-0.32	-0.25
Mus musculus retinoid X receptor beta (Rxb), transcript variant 1, mRNA [NM_001205214]	Rxb	21069.73	-0.33	-0.21
Mus musculus zinc finger and SCAN domain containing 10 (Zscan10), mRNA [NM_001033425]	Zscan10	13261.83	-0.31	-0.23
Mus musculus E2F transcription factor 1 (E2f1), mRNA [NM_007891]	E2f1	3736.36	-0.28	0.01
Mus musculus transcription factor 12 (Tcf12), mRNA [NM_011544]	Tcf12	1759.58	-0.28	0.27
Mus musculus zinc finger protein 518B (Zfp518b), transcript variant 1, mRNA [NM_001081144]	Zfp518b	1544.25	-0.58	0.23
Mus musculus zinc finger, BED domain containing 4 (Zbed4), mRNA [NM_181412]	Zbed4	4564.28	-0.28	0.13
Mus musculus zinc finger and BTB domain containing 49 (Zbtb49), mRNA [NM_029162]	Zbtb49	119.58	-0.30	-0.03
Mus musculus SPEN homolog, transcriptional regulator (Drosophila) (Spen), mRNA [NM_019763]	Spen	6130.69	-0.30	-0.45
Mus musculus surfeit gene 6 (Surf6), mRNA [NM_009298]	Surf6	6918.97	-0.37	-0.60
Mus musculus forkhead box N2 (Foxn2), mRNA [NM_180974]	Foxn2	763.25	-0.46	-0.81
Mus musculus nuclear receptor subfamily 1, group H, member 2 (Nr1h2), mRNA [NM_009473]	Nr1h2	17637.63	-0.47	-0.67
Mus musculus E2F transcription factor 3 (E2f3), mRNA [NM_010093]	E2f3	671.13	-0.32	-0.37
Mus musculus ventral anterior homeobox containing gene 2 (Vax2), mRNA [NM_011912]	Vax2	1165.76	-0.49	-0.49
Mus musculus MYB binding protein (P160) 1a (Mybbp1a), mRNA [NM_016776]	Mybbp1a	122085.54	-0.45	-0.50
Mus musculus RING1 and YY1 binding protein (Rybp), mRNA [NM_019743]	Rybp	16464.84	-0.53	-0.59
Mus musculus cellular nucleic acid binding protein (Cnbp), transcript variant 1, mRNA [NM_01349	Cnbp	80426.60	-0.27	-0.55
Mus musculus CCAAT/enhancer binding protein (C/EBP), beta (Cebpb), mRNA [NM_009883]	Cebpb	4586.68	-0.74	-0.60

Mus musculus zinc finger protein, multitype 1 (Zfp1), mRNA [NM_009569]	Zfp1	2426.97	-0.59	-0.52
Mus musculus basic helix-loop-helix family, member e40 (Bhlhe40), mRNA [NM_011498]	Bhlhe40	1411.29	-0.52	-0.43
Mus musculus polycomb group ring finger 6 (Pcgf6), mRNA [NM_027654]	Pcgf6	4736.11	-0.54	-0.35
Mus musculus zinc finger protein 148 (Zfp148), mRNA [NM_011749]	Zfp148	2876.82	-0.29	-0.38
Mus musculus v-maf musculoaponeurotic fibrosarcoma oncogene family, protein F (avian) (Maff), mRNA [NM_011749]	Maff	1838.15	-0.35	-0.41
Mus musculus strawberry notch homolog 2 (Drosophila) (Sbno2), mRNA [NM_183426]	Sbno2	742.15	-0.72	-0.41
Mus musculus myeloblastosis oncogene-like 2 (Mybl2), mRNA [NM_008652]	Mybl2	26200.13	-0.29	-0.36
Mus musculus putative homeodomain transcription factor 2 (Phtf2), mRNA [NM_172992]	Phtf2	5199.52	-0.29	-0.56
Mus musculus E26 avian leukemia oncogene 2, 3' domain (Ets2), mRNA [NM_011809]	Ets2	3294.35	-0.30	-0.46
Mus musculus AT rich interactive domain 3B (BRIGHT-like) (Arid3b), mRNA [NM_019689]	Arid3b	7253.95	-0.29	-0.34
Mus musculus cDNA clone IMAGE:30537733, with apparent retained intron. [BC082312]	Arid5b	856.76	-0.41	-0.99
Mus musculus nuclear transcription factor, X-box binding 1 (Nfx1), mRNA [NM_023739]	Nfx1	3739.41	-0.39	-0.70
Mus musculus nucleolar and coiled-body phosphoprotein 1 (Nolc1), transcript variant 3, mRNA [NM_011809]	Nolc1	44422.64	-0.47	-0.97
Mus musculus GLI-Kruppel family member GLI1 (Gli1), mRNA [NM_010296]	Gli1	837.12	-0.34	-0.87
Mus musculus PAP associated domain containing 7 (Papd7), transcript variant 1, mRNA [NM_198618]	Papd7	2475.50	-0.55	-0.63
Mus musculus UPF1 regulator of nonsense transcripts homolog (Upf1), transcript variant 2, mRNA [NM_011809]	Upf1	6053.58	-0.33	-0.62
Mus musculus mediator of RNA polymerase II transcription, subunit 6 homolog (yeast) (Med6), mRNA [NM_011809]	Med6	4612.09	-0.79	-0.57
Mus musculus Kruppel-like factor 9 (Klf9), mRNA [NM_010638]	Klf9	5210.67	-0.60	-0.40
Mus musculus zinc finger protein 36, C3H type-like 2 (Zfp36l2), mRNA [NM_001001806]	Zfp36l2	12446.00	-0.30	-0.30
Mus musculus tripartite motif-containing 27 (Trim27), mRNA [NM_009054]	Trim27	24338.99	-0.32	-0.48
Mus musculus heat shock factor 1 (Hsf1), mRNA [NM_008296]	Hsf1	3647.02	-0.98	-0.28
Mus musculus zinc finger protein 110 (Zfp110), mRNA [NM_022981]	Zfp110	2478.60	-0.41	-0.98
Mus musculus activating transcription factor 1 (Atf1), mRNA [NM_007497]	Atf1	5617.15	-0.50	-0.70
Mus musculus Max protein (Max), transcript variant 1, mRNA [NM_008558]	Max	13260.28	-0.34	-0.95
Mus musculus transcriptional adaptor 2A (Tada2a), mRNA [NM_172562]	Tada2a	10909.15	-0.27	-0.29
Mus musculus nuclear receptor subfamily 2, group F, member 6 (Nr2f6), mRNA [NM_010150]	Nr2f6	16120.32	-0.48	-0.29
Mus musculus zinc finger protein 593 (Zfp593), mRNA [NM_024215]	Zfp593	3453.68	-0.56	-0.45
Mus musculus metal response element binding transcription factor 1 (Mtf1), mRNA [NM_008636]	Mtf1	442.06	-0.32	-0.47
Mus musculus Meis homeobox 1 (Meis1), transcript variant B, mRNA [NM_001193271]	Meis1	157.88	-0.29	-0.28
Mus musculus E74-like factor 1 (Elf1), mRNA [NM_007920]	Elf1	223.68	-0.43	-0.80
Mus musculus microphthalmia-associated transcription factor (Mitf), transcript variant 1, mRNA [NM_011809]	Mitf	362.37	-0.49	-0.41
Mus musculus hairy and enhancer of split 1 (Drosophila) (Hes1), mRNA [NM_008235]	Hes1	250.08	-0.56	-0.93
Mus musculus Yy2 transcription factor (Yy2), mRNA [NM_001098723]	Yy2	269.13	-0.28	-0.56
Mus musculus Kruppel-like factor 15 (Klf15), mRNA [NM_023184]	Klf15	354.36	-0.68	-0.75
Mus musculus regulatory factor X, 6 (Rfx6), transcript variant 1, mRNA [NM_001159389]	Rfx6	83.19	-0.37	-0.61
Mus musculus LIM domain only 2 (Lmo2), transcript variant 1, mRNA [NM_008505]	Lmo2	344.41	-0.30	-0.45
Mus musculus goosecoid homeobox 2 (Gsc2), mRNA [NM_029469]	Gsc2	34.97	-0.47	-0.74
Mus musculus twist homolog 1 (Drosophila) (Twist1), mRNA [NM_011658]	Twist1	32.02	-0.60	-0.70
Mus musculus AT rich interactive domain 3C (BRIGHT-like) (Arid3c), mRNA [NM_001017362]	Arid3c	47.59	-0.36	-0.38
Mus musculus NK2 transcription factor related, locus 3 (Drosophila) (Nkx2-3), mRNA [NM_008699]	Nkx2-3	38.68	-0.27	-0.77
Mus musculus son of sevenless homolog 1 (Drosophila) (Sos1), mRNA [NM_009231]	Sos1	59.87	-0.50	-0.37
Mus musculus high mobility group AT-hook 2 (Hmga2), mRNA [NM_010441]	Hmga2	6467.79	-0.71	-1.72
Mus musculus cysteine-serine-rich nuclear protein 1 (Csrnp1), mRNA [NM_153287]	Csrnp1	6358.09	-0.43	-1.49
Mus musculus ELK3, member of ETS oncogene family (Elk3), transcript variant 1, mRNA [NM_011809]	Elk3	851.78	-0.93	-2.28
Mus musculus forkhead box D3 (Foxd3), mRNA [NM_010425]	Foxd3	1809.60	-0.84	-2.35
Mus musculus zinc finger and BTB domain containing 32 (Zbtb32), mRNA [NM_021397]	Zbtb32	3898.44	-0.45	-2.03
Mus musculus nuclear factor I/C (Nfic), transcript variant 1, mRNA [NM_008688]	Nfic	1979.80	-0.96	-1.34
Mus musculus CCAAT/enhancer binding protein (C/EBP), delta (Cebpd), mRNA [NM_007679]	Cebpd	16133.05	-0.41	-2.02
Mus musculus upstream transcription factor 1 (Usf1), mRNA [NM_009480]	Usf1	1402.82	-0.65	-1.02
Mus musculus tripartite motif-containing 24 (Trim24), mRNA [NM_145076]	Trim24	8749.34	-0.42	-1.04
Mus musculus calmodulin binding transcription activator 2 (Camta2), transcript variant 1, mRNA [NM_011809]	Camta2	1093.90	-0.76	-2.42
Mus musculus basic leucine zipper transcription factor, ATF-like 3 (Batz3), mRNA [NM_030060]	Batz3	855.17	-0.38	-2.23
Mus musculus teashirt zinc finger family member 1 (Tshz1), mRNA [NM_001081300]	Tshz1	1053.39	-0.76	-1.96
Mus musculus early growth response 1 (Egr1), mRNA [NM_007913]	Egr1	4382.11	-0.38	-1.54
Mus musculus ets variant gene 5 (Etv5), mRNA [NM_023794]	Etv5	56641.40	-0.39	-1.72
Mus musculus ets variant gene 1 (Etv1), transcript variant 1, mRNA [NM_007960]	Etv1	8781.91	-0.67	-1.29
Mus musculus eomesodermin homolog (Xenopus laevis) (Eomes), transcript variant 1, mRNA [NM_011809]	Eomes	3099.15	-0.27	-2.91
Mus musculus HMG box domain containing 4 (Hmgxb4), mRNA [NM_178017]	Hmgxb4	9715.41	-0.83	-1.52
Mus musculus reproductive homeobox 5 (Rhox5), mRNA [NM_008818]	Rhox5	2127.44	-0.84	-1.61
Mus musculus Kruppel-like factor 5 (Klf5), mRNA [NM_009769]	Klf5	5332.67	-0.44	-2.15
Mus musculus methyl-CpG binding domain protein 2 (Mbd2), mRNA [NM_010773]	Mbd2	1257.70	-0.65	-2.00
Mus musculus transcription factor AP-2, epsilon (Tcfap2e), mRNA [NM_198960]	Tcfap2e	94.22	-0.33	-2.40
Mus musculus homeobox, msh-like 1 (Msx1), mRNA [NM_010835]	Msx1	95.18	-0.69	-1.25
Mus musculus snail homolog 3 (Drosophila) (Snai3), mRNA [NM_013914]	Snai3	438.03	-0.87	-2.26
Mus musculus CCAAT/enhancer binding protein (C/EBP), alpha (Cebpa), mRNA [NM_007678]	Cebpa	99.23	-0.86	-1.82
Mus musculus B-cell leukemia/lymphoma 6 (Bcl6), mRNA [NM_009744]	Bcl6	136.82	-0.71	-1.21
Mus musculus PR domain containing 1, with ZNF domain (Prdm1), mRNA [NM_007548]	Prdm1	102.78	-0.82	-2.94
Mus musculus POU domain, class 6, transcription factor 2 (Pou6f2), mRNA [NM_175006]	Pou6f2	109.74	-0.82	-2.72
Mus musculus grainyhead-like 1 (Drosophila) (Grhl1), transcript variant 2, mRNA [NM_145890]	Grhl1	334.28	-0.74	-1.27
Mus musculus T-cell acute lymphocytic leukemia 1 (Tal1), mRNA [NM_011527]	Tal1	87.57	-0.64	-2.16
Mus musculus mohawk homeobox (Mxk), mRNA [NM_177595]	Mxk	261.26	-0.62	-2.31
Mus musculus sine oculis-related homeobox 2 homolog (Drosophila) (Six2), mRNA [NM_011380]	Six2	142.07	-0.98	-2.70
Mus musculus cold shock domain containing C2, RNA binding (Csdc2), mRNA [NM_145473]	Csdc2	219.22	-0.89	-1.43
Mus musculus zinc finger protein 36 (Zfp36), mRNA [NM_011756]	Zfp36	72.13	-0.31	-1.91
Mus musculus T-box 20 (Tbx20), transcript variant 1, mRNA [NM_194263]	Tbx20	48.54	-0.67	-2.44
Mus musculus zinc finger protein 42 (Zfp42), mRNA [NM_009556]	Zfp42	61.60	-0.32	-1.96
Mus musculus POU domain, class 2, transcription factor 3 (Pou2f3), mRNA [NM_011139]	Pou2f3	44.79	-0.62	-1.30
Mus musculus POU domain, class 4, transcription factor 3 (Pou4f3), mRNA [NM_138945]	Pou4f3	56.76	-0.78	-1.49
Mus musculus paired box gene 1 (Pax1), mRNA [NM_008780]	Pax1	27.70	-0.37	-1.06
Mus musculus zinc finger protein, multitype 2 (Zfp2), mRNA [NM_011766]	Zfp2	343.29	-0.33	-3.83
Mus musculus NK6 homeobox 2 (Nkx6-2), transcript variant 1, mRNA [NM_183248]	Nkx6-2	57.93	-0.87	-3.24
Mus musculus RAR-related orphan receptor alpha (Rora), mRNA [NM_013646]	Rora	43.65	-2.06	3.51
Mus musculus sine oculis-related homeobox 5 homolog (Drosophila) (Six5), mRNA [NM_011383]	Six5	644.90	-1.97	2.82
Mus musculus special AT-rich sequence binding protein 1 (Satb1), transcript variant 2, mRNA [NM_011809]	Satb1	1037.90	-1.57	0.93
Mus musculus transcription factor Dp 1 [Source:MGI Symbol;Acc:MGI:101934] [ENSMUST00000170302]	Tfdp1	6694.41	-1.10	-0.56
Mus musculus zinc finger, AN1-type domain 6 (Zfand6), mRNA [NM_022985]	Zfand6	1567.59	-1.63	-0.30
Mus musculus cold shock domain protein A (CsdA), transcript variant 1, mRNA [NM_139117]	CsdA	80936.03	-1.04	-1.00

Mus musculus T-box 1 (Tbx1), mRNA [NM_011532]	Tbx1	57.72	-1.14	-0.65
Mus musculus reproductive homeobox 2H (Rhox2h), mRNA [NM_001100465]	Rhox2h	66.89	-1.73	-0.51
Mus musculus nuclear receptor subfamily 5, group A, member 2 (Nr5a2), transcript variant 1, mRNA [NM_011532]	Nr5a2	10888.48	-1.40	-1.59
Mus musculus E2F transcription factor 4 (E2f4), mRNA [NM_148952]	E2f4	608.79	-1.55	-1.27
Mus musculus estrogen related receptor, beta (Esrrb), transcript variant 2, mRNA [NM_001159500]	Esrrb	501.84	-1.45	-2.07
Mus musculus RIKEN cDNA C230052I12 gene (C230052I12Rik), mRNA [NM_178643]	C230052I12Rik	1151.42	-1.09	-2.10
Mus musculus promyelocytic leukemia (Pml), transcript variant 2, mRNA [NM_178087]	Pml	5474.35	-1.52	-1.81
Mus musculus grainyhead-like 2 (Drosophila) (Grhl2), mRNA [NM_026496]	Grhl2	4532.06	-1.08	-1.69
Mus musculus PTPRF interacting protein, binding protein 2 (liprin beta 2) (Ppifbp2), transcript variant 1, mRNA [NM_011532]	Ppifbp2	990.14	-2.30	-1.67
Mus musculus basic helix-loop-helix family, member a15 (Bhlha15), mRNA [NM_010800]	Bhlha15	602.42	-1.93	-1.75
Mus musculus forkhead box O1 (Foxo1), mRNA [NM_019739]	Foxo1	8821.04	-1.09	-1.79
Mus musculus HOP homeobox (Hopx), transcript variant 1, mRNA [NM_175606]	Hopx	1856.32	-1.97	-1.60
Mus musculus oligonucleotide/oligosaccharide-binding fold containing 2A (Obfc2a), mRNA [NM_011532]	Obfc2a	242.27	-1.05	-1.74
Mus musculus TEA domain family member 4 (Tead4), transcript variant 1, mRNA [NM_011567]	Tead4	443.87	-1.52	-2.30
Mus musculus hepatic leukemia factor (Hlf), mRNA [NM_172563]	Hlf	385.68	-1.07	-2.56
Mus musculus homeobox A1 (Hoxa1), mRNA [NM_010449]	Hoxa1	178.22	-2.49	-2.95
Mus musculus Jun-B oncogene (Junb), mRNA [NM_008416]	Junb	202.47	-1.51	-1.65
Mus musculus ISL1 transcription factor, LIM/homeodomain (Isl1), mRNA [NM_021459]	Isl1	431.82	-1.03	-1.95
Mus musculus SRY-box containing gene 17 (Sox17), mRNA [NM_011441]	Sox17	163.60	-1.65	-2.93
Mus musculus forkhead box A1 (Foxa1), mRNA [NM_008259]	Foxa1	361.18	-2.94	-2.86
Mus musculus twist homolog 2 (Drosophila) (Twist2), mRNA [NM_007855]	Twist2	350.35	-1.89	-2.62
Mus musculus runt related transcription factor 1 (Runx1), transcript variant 2, mRNA [NM_001111]	Runx1	191.05	-1.11	-1.68
Mus musculus nuclear factor I/B (Nfib), transcript variant 1, mRNA [NM_001113209]	Nfib	480.00	-1.56	-1.64
Mus musculus T-box 21 (Tbx21), mRNA [NM_019507]	Tbx21	110.15	-1.96	-1.67
Mus musculus fos-like antigen 1 (Fosl1), mRNA [NM_010235]	Fosl1	136.93	-1.08	-2.85
Mus musculus E74-like factor 5 (Elf5), transcript variant 1, mRNA [NM_010125]	Elf5	29.64	-1.54	-2.49
Mus musculus developing brain homeobox 2 (Dbx2), mRNA [NM_207533]	Dbx2	41.76	-2.12	-1.13
Mus musculus ets homologous factor (Ehf), mRNA [NM_007914]	Ehf	29.13	-1.02	-1.15
Mus musculus trans-acting transcription factor 5 (Sp5), mRNA [NM_022435]	Sp5	1797.36	-1.05	-3.22
Mus musculus ets variant gene 4 (E1A enhancer binding protein, E1AF) (Etv4), mRNA [NM_008852]	Etv4	30745.61	-1.52	-3.11
Mus musculus transcription factor 15 (Tcf15), mRNA [NM_009328]	Tcf15	3136.20	-2.34	-3.60
Mus musculus goosecoid homeobox (Gsc), mRNA [NM_010351]	Gsc	709.98	-2.01	-4.67
Mus musculus forkhead box Q1 (Foxq1), mRNA [NM_008239]	Foxq1	230.66	-1.79	-3.86
Mus musculus Mix1 homeobox-like 1 (Xenopus laevis) (Mixl1), mRNA [NM_013729]	Mixl1	85.56	-1.13	-4.08
Mus musculus paired-like homeodomain transcription factor 3 (Pitx3), mRNA [NM_008852]	Pitx3	473.91	-1.43	-3.85
Mus musculus GATA binding protein 6 (Gata6), mRNA [NM_010258]	Gata6	144.79	-2.36	-3.06
Mus musculus interferon induced with helicase C domain 1 (Ifih1), transcript variant 1, mRNA [NM_011532]	Ifih1	337.66	-2.19	-3.73
Mus musculus OVO homolog-like 1 (Drosophila) (Ovo1), mRNA [NM_019935]	Ovo1	114.96	-2.76	-3.31
Mus musculus Z-DNA binding protein 1 (Zbp1), transcript variant 2, mRNA [NM_001139519]	Zbp1	321.12	-1.02	-3.62
Mus musculus v-myc myelocytomatosis viral oncogene homolog 1, lung carcinoma derived (avian) (Myc1)	Myc1	214.67	-3.96	-1.65
Mus musculus brachyury (T), mRNA [NM_009309]	T	3045.69	-3.26	-4.17
Mus musculus paired-like homeodomain transcription factor 2 (Pitx2), transcript variant 3, mRNA [NM_011532]	Pitx2	1367.16	-3.99	-4.32
Mus musculus interferon regulatory factor 1 (Irf1), transcript variant 1, mRNA [NM_008390]	Irf1	19808.68	-4.30	-3.58
Mus musculus forkhead box A2 (Foxa2), mRNA [NM_010446]	Foxa2	4256.48	-3.19	-4.12
LIM homeobox protein 1 [Source:MGI Symbol;Acc:MGI-99783] [ENSMUST00000018842]	Lhx1	472.29	-4.84	-6.19
Mus musculus even skipped homeotic gene 1 homolog (Evx1), mRNA [NM_007966]	Evx1	28.37	-4.73	-3.06