

Module 4: Function and Expression

ii. How can I find gene expression data?

Aims

- Introduce gene expression data at ZFIN
- Suggest starting points for various queries
- Discuss morpholino curation at ZFIN

Introduction

ZFIN displays three kinds of gene expression data:

- annotated images that have been directly submitted to ZFIN by researchers
- annotated data from the current literature, figures and legends are included when copyright permissions are available.
- an index of gene expression data from older publications

ZFIN began to include published figures in 2004. We are currently able to add figures from older publications only on an ad hoc basis. A more complete incorporation of figures from the older literature is a long-term goal.


The zebrafish anatomical dictionary, <http://zfin.org/cgi-bin/webdriver?Mlval=aa-anatdict.apg&mode=search>, plays a central role in our curation of gene expression data.

Finding gene expression data

There are three methods for finding gene expression data in ZFIN.

1. Gene Expression data may be found by following the links provided on a gene page.

Locate this information using our Genes/Markers/Clones query form, <http://zfin.org/cgi-bin/webdriver?Mlval=aa-newmrkrselect.apg>. Search by specifying your gene of interest.

 **ZFIN**

Site Search:

BLAST Anatomy Publications People Labs Companies Acc #

Home Mutants / Transgenics Wild-Types Genes / Markers / Clones Expression Maps

Search for Genes / Markers / Clones

Name / Symbol:

Types: (Choose one or more)

- All
- Gene
- Pseudogene
- Morpholino
- EST
- cDNA
- BAC
- PAC
- BAC_END
- PAC_END
- RAPD
- SSLP
- STS

LG:

Display results in groups of

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Enter gene symbol

Click on the search button
or hit the "enter" key

Scroll to the **Gene Expression** section of the gene page.

GENE EXPRESSION: [\(current status\)](#)

All expression data:

[42 figure\(s\)](#) from 33 publications

Directly submitted expression data:

[6 figure\(s\) \(47 images\)](#) from Thisse *et al.*, 2001 [cb670]

Follow the links to view
gene expression data

2. Gene expression data may also be found using the ZFIN expression query form.

Search by gene symbol

Search for gene expression in a particular genetic background

Search by stage range

The screenshot shows the ZFIN website's search interface. The ZFIN logo is at the top left. A navigation bar includes links for Home, Mutants / Transgenics, Wild Types, Genes / Markers / Clones, Expression, and Maps. A 'Site Search' box is at the top right. The main section is titled 'Search for Gene Expression Data' and contains several input fields: 'Gene/EST name' with a 'contains' dropdown, 'Genetic background name' with a 'contains' dropdown, 'MO knockdown: Gene name' with a 'contains' dropdown, and 'Author' with a 'contains' dropdown. Below these is an 'Anatomy' section with a text input and a link to the 'Anatomical Dictionary'. To the right, there are 'Between stages' dropdowns (set to 'Zygote:1-cell' and 'Adult'), an 'Assay Type' dropdown (set to 'ANY'), and a 'Filters' section with checkboxes for 'Show only figures with images', 'Show direct submission data', and 'Show published literature'. At the bottom right of the form are 'Search' and 'Reset' buttons. The footer contains links for Home, Email ZFIN, About ZFIN, Helpful Hints, and Citing ZFIN, along with copyright information for the University of Oregon (1994-2006) and a note about the ZFIN logo design by Karl Pape.

Click here to browse the anatomical dictionary

Search by anatomical structure(s)
A word completion feature will provide you with a list of structures matching what you have entered. Select the desired structure from the list.

Limit results to

- figures with images
- direct submission data
- published literature

A portion of the return results for a *bmp2b* gene expression search is shown below.

Search matched on current symbol: *bmp2b*






[Modify Search](#)

Your Input Welcome

Expression Pattern Search Results for *bmp2b*

(42 figure(s) with expression from 33 publication(s))

[\[Show only figures with images \]](#)

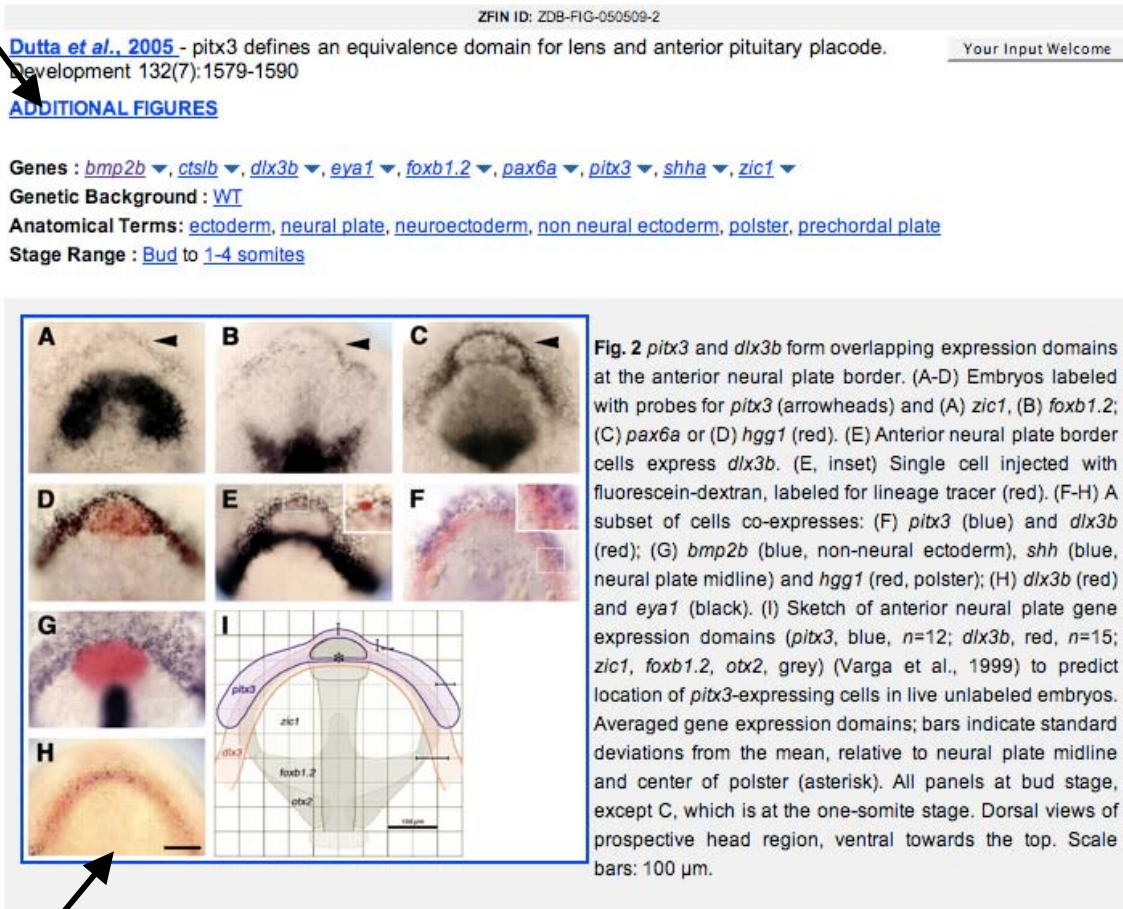
Publication <small>(current status)</small>	Data		Background(s)	Stage Range	Anatomy
Dutta et al., 2005	Fig. 2		WT	Bud to 1-4 somites	non neural ectoderm
Ghiselli et al., 2005	Fig. 3		AB	50%-epiboly to 5-9 somites	
	Fig. 4		AB	Shield to Prim-5	tail
Holzschuh et al., 2005	Fig. 5		cas^{ts56} , WT	26+ somites to Prim-25	pharyngeal pouch
Leung et al., 2005	Fig. 7		WT	Prim-5	
London et al., 2005	Fig. 5		TL	Sphere to Shield	embryo
	Fig. 7		TL	Sphere to Shield	
Lynn-Gingerich et al., 2005	Fig. 2		AB , hec^{t280}	Sphere to 75%-epiboly	ectoderm
Norton et al., 2005	Fig. 3		dae^{fbvbo} , WT	Prim-5 to Prim-25	pectoral fin , pectoral fin bud

Click here to view the publication abstract

Click on the figure number or thumbnail to view expression data

Click on the Fig.5 link of the Eivers et al. publication for figure image, legend and annotations.

Click here to view all expression data from this publication



Click here to view a larger image

Continue to scroll down this page. You will find a tabular summary of the expression data discussed in this figure. This table is always available, even when we do not have privileges to display the figure's image and legend.

Gene expression details

Gene	Fish	Stage	Anatomy	Assay
bmp2b ▲	WT	Bud	non neural ectoderm	ISH
ctslb ▲	WT	Bud	polster	ISH
dlx3b ▲	WT	Bud	non neural ectoderm	ISH
eva1 ▲	WT	Bud	ectoderm	ISH
foxb1.2 ▲	WT	Bud	neuroectoderm	ISH
pax6a ▲	WT	1-4 somites	neuroectoderm	ISH
pitx3 ▲	WT	Bud	ectoderm	ISH
		1-4 somites	ectoderm	ISH
shha ▲	WT	Bud	neural plate	ISH
		Bud	prechordal plate	ISH
zic1 ▲	WT	Bud	neural plate	ISH

Acknowledgments:

ZFIN wishes to thank the journal [Development](#) for permission to reproduce figures from this article. Please note that this material may be protected by copyright.

The gene expression query form can also be used to locate expression patterns from studies using knockdown reagents.

The screenshot shows the ZFIN (Zebrafish Information Network) website. The main navigation bar includes links for Home, Mutants / Transgenics, Wild-Types, Genes / Markers / Clones, Expression, and Maps. A site search bar is located in the top right. Below the navigation bar is the 'Search for Gene Expression Data' section, which includes several search criteria: Gene/EST name, Genetic background name, MO knockdown: Gene name, and Author. There is also a section for 'Between stages' with dropdowns for 'Zygote:1-cell' and 'Adult', and a link to 'Developmental Staging Series'. The 'Assay Type' is set to 'ANY'. A 'Filters' section allows users to select 'Show only figures with images', 'Show direct submission data', and 'Show published literature'. The 'Added in last' field is set to '25' days, and the 'results per page' is set to '25'. A 'Search' button and a 'Reset' button are at the bottom right of the search form. A black arrow points from a yellow box at the bottom to the 'Gene/EST name' search field.

Enter the symbol of the targeted gene

A search for *gata1* targeted knockdowns returns the following:

Expression Pattern Search Results
(17 genes with expression)

[Modify Search](#)
Your Input Welcome

Gene	Expression Data <small>(current status)</small>	Stage Range	Matching Text
alas2	1 figure(s) from Galloway <i>et al.</i> , 2005	20-25 somites	MO symbol: gata1
cahz	1 figure(s) from Galloway <i>et al.</i> , 2005	20-25 somites	MO symbol: gata1
cmyb	1 figure(s) from Galloway <i>et al.</i> , 2005	20-25 somites	MO symbol: gata1
gata1	2 figure(s) from 2 publications	20-25 somites	MO symbol: gata1
glcci1	1 figure(s) from Galloway <i>et al.</i> , 2005	10-13 somites to 26+ somites	MO symbol: gata1
hbae1	1 figure(s) from Rhodes <i>et al.</i> , 2005	Prim-15	MO symbol: gata1
hbbe1	3 figure(s) from Galloway <i>et al.</i> , 2005	20-25 somites to Prim-5	MO symbol: gata1
kiaa0650l	1 figure(s) from Galloway <i>et al.</i> , 2005	10-13 somites to 26+ somites	MO symbol: gata1
klf4	1 figure(s) from Galloway <i>et al.</i> , 2005	10-13 somites to 20-25 somites	MO symbol: gata1
krpc	1 figure(s) from Galloway <i>et al.</i> , 2005	10-13 somites	MO symbol: gata1
lcp1	3 figure(s) from 2 publications	Prim-5 to Day 4	MO symbol: gata1
lmo2	1 figure(s) from Rhodes <i>et al.</i> , 2005	26+ somites	MO symbol: gata1
mpx	3 figure(s) from 2 publications	26+ somites to Day 4	MO symbol: gata1
runx1	2 figure(s) from 2 publications	20-25 somites to 26+ somites	MO symbol: gata1
spi1	3 figure(s) from 2 publications	14-19 somites to Prim-5	MO symbol: gata1
tal1	1 figure(s) from Rhodes <i>et al.</i> , 2005	26+ somites	MO symbol: gata1
znfn1a1	1 figure(s) from Galloway <i>et al.</i> , 2005	20-25 somites	MO symbol: gata1

Click here to view expression data

Copyright privileges have not been granted to ZFIN by this journal, however, a detailed table describes the gene expression data presented in this figure. A portion of this table is depicted below.

image not available

Fig. 1 ZFIN is incorporating published figure images and captions as part of an ongoing project. Figures from some publications have not yet been curated, or are not available for display because of copyright restrictions.

Gene expression details

Gene	Fish	Stage	Qualifier	Anatomy	Assay
cmyb ▲	TU, MO:gata2	20-25 somites		intermediate cell mass of mesoderm	ISH
	TU, MO:gata1	20-25 somites		intermediate cell mass of mesoderm	ISH
	TU, MO:gata1.gata2	20-25 somites		intermediate cell mass of mesoderm	ISH
	TU	20-25 somites		intermediate cell mass of mesoderm	ISH
hbbe1 ▲	TU, MO:gata1	Prim-5		intermediate cell mass of mesoderm	ISH
	TU	Prim-5		intermediate cell mass of mesoderm	ISH
lcp1 ▲	TU, MO:gata2	Prim-5		intermediate cell mass of mesoderm	ISH
		Prim-5		unspecified	ISH
	TU, MO:gata1	Prim-5		intermediate cell mass of mesoderm	ISH
		Prim-5		unspecified	ISH
	TU, MO:gata1.gata2	Prim-5		intermediate cell mass of mesoderm	ISH
		Prim-5		unspecified	ISH
	TU	Prim-5		intermediate cell mass of mesoderm	ISH
		Prim-5		unspecified	ISH
mpx ▲	TU, MO:gata2	26+ somites	<i>Not detected</i>	intermediate cell mass of mesoderm	ISH
		26+ somites		unspecified	ISH
	TU, MO:gata1	26+ somites		intermediate cell mass of mesoderm	ISH
		26+ somites		unspecified	ISH
	TU, MO:gata1.gata2	26+ somites		intermediate cell mass of mesoderm	ISH
		26+ somites		unspecified	ISH
	TU	26+ somites	<i>Not detected</i>	intermediate cell mass of mesoderm	ISH
		26+ somites		unspecified	ISH

Click here to view morpholino details



ZFIN

Site Search:

[BLAST](#) [Anatomy](#) [Publications](#) [People](#) [Labs](#) [Companies](#) [Acc #](#)

[Home](#) [Mutants / Transgenics](#) [Wild-Types](#) [Genes / Markers / Clones](#) [Expression](#) [Maps](#)

ZFIN ID: ZDB-MRPHLNO-050208-10

Morpholino Name: MO1-gata1

Previous Names: MO(T)-gata1 (1) ; gata1 MO (1) ; Gata1 morpholino (1)

Sequence: 5' - CTGCAAGTGTAGTATTGAAGATGTC - 3' [BLAST IT](#)

(Although ZFIN verifies reagent sequence data, we recommend that you conduct independent sequence analysis before ordering any reagent.)

Target Gene: [gata1](#) (1)

Note: A translation blocking morpholino targeting [gata1](#). This morpholino sequence was reported with an additional nucleotide in Rhodes et al. 2005 and is correct as displayed here confirmed by author.

[CITATIONS](#) (3)

3. Gene expression data may also be found by browsing the anatomical dictionary, <http://zfin.org/cgi-bin/webdriver?Mlval=aa-anatdict.apg&mode=search>

Browse the anatomical dictionary by developmental stage

The screenshot shows the ZFIN website's 'Anatomical Ontology Browser' section. At the top, there is a 'Site Search' box and a navigation bar with links: Home, Mutants / Transgenics, Wild-Types, Genes / Markers / Clones, Expression, and Maps. Below this, the 'Anatomical Ontology Browser' section contains two links: '[Search]' and '[Complete List]'. A search box is present with the label 'Anatomical Term' and a 'Search' button. To the right of the search box is an 'or' separator and a 'Developmental Stage' dropdown menu with the text 'Select a stage'. At the bottom of the page, there is a footer with links: Home, Email ZFIN, About ZFIN, Helpful Hints, and Citing ZFIN. Copyright information for the University of Oregon (1994-2006) and the ZFIN logo design by Karl Pape are also visible.

Search by anatomical structure(s)
A word completion feature will provide you with a list of structures matching what you have typed. Select the desired structure from the list.

View complete alphabetical list of all entries in the anatomical dictionary

A search for **neural plate** returns the following list:

The screenshot shows the ZFIN (Zebrafish Information Network) website. At the top is the ZFIN logo and a navigation bar with links: Home, Mutants / Transgenics, Wild-Types, Genes / Markers / Clones, Expression, and Maps. A site search bar is located in the top right. Below the navigation bar is the 'Anatomical Ontology Browser' section, which includes a search box and a dropdown for 'Developmental Stage'. The search results are for 'neural plate' in all stages. The results list several terms with the number of genes expressed and substructures included, along with synonyms. The terms are: 'neural plate' (385 genes), 'presumptive neural plate' (13 genes), 'presumptive spinal cord' (2 genes), 'spinal cord neural plate' (2 genes), and 'primary neurons trunk' (78 genes). Arrows point from the 'neural plate' and 'presumptive neural plate' links to yellow boxes at the bottom of the page.

Site Search:

BLAST Anatomy Publications People Labs Companies Acc #

Home Mutants / Transgenics Wild-Types Genes / Markers / Clones Expression Maps

Anatomical Ontology Browser [[Search](#)] [[Complete List](#)]

[Search]

Anatomical Term Search or Developmental Stage

Results for **neural plate** in all stages

[neural plate](#) [385 gene(s) expressed (385 if substructures included)] (synonym(s): [presumptive central nervous system](#))

[presumptive neural plate](#) [13 gene(s) expressed (13 if substructures included)]

[presumptive spinal cord](#) [2 gene(s) expressed (2 if substructures included)] (synonym(s): [presumptive spinal cord neural rod](#) , [presumptive spinal cord neural plate](#) , [presumptive spinal cord neural keel](#))

[primary neurons trunk](#) [78 gene(s) expressed (101 if substructures included)] (synonym(s): [presumptive neurons neural rod](#) , [primary neurons neural rod](#) , [primary neurons neural plate](#) , [primary neurons spinal cord](#) , [primary neurons neural keel](#))

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ZFIN Inception by Karl Rane, University of Oregon

Click here for structure details

Click here for expression data

Looking at the **neural plate** anatomy page, http://zfin.org/cgi-bin/webdriver?Mlval=aa-anatomy_item.apg&OID=ZDB-ANAT-010921-5060, notice synonyms and a definition for neural plate, the stages in which the neural plate is present, links to genes expressed in the neural plate, related structures and a list of publications with neural plate in their abstract.

 **ZFIN**

Site Search:

BLAST Anatomy Publications People Labs Companies Acc #

Home Mutants / Transgenics Wild-Types Genes / Markers / Clones Expression Maps

ZFIN ID: ZDB-ANAT-010921-560

Your Input Welcome

Name: *neural plate*
Synonyms: presumptive central nervous system
Definition: The earliest recognizable dorsal ectodermal primordium of the central nervous system; appears during gastrulation before infolding to form the neural keel; consists of a thickened pseudoneural plate.

Appears at	Evident until
Gastrula:90%-epiboly (9.00h-10.00h)	Segmentation:5-9 somites (11.66h-14.00h)

Relationships

Contained by:	neuroectoderm
Contains:	
Develops from:	presumptive spinal cord
Develops into:	neural keel

High Quality Probes: ([Thisse et al., 2001](#)) ([Thisse et al., 2004](#)) ([Thisse et al., 2005](#))
[ascl1b](#) [eu104], [cdx4](#) [cb546], [cyp26a1](#) [cb24], [dlx3b](#) [eu221], [fezl](#) [eu185], [fgf8](#) [cb110], [foxb1.2](#) [cb114], [gbx1](#) [cb619], [gdf6a](#) [cb278] ... (all 38) ▶

All Expressed Genes
[abca1a](#) [akap1](#) [alcam](#) [ar13l1](#) [ar14l](#) [arr3](#) [ascl1b](#) [atic](#) [atp1b1a](#) [axin2](#) **385 total** (385 if substructures included)

[131] Publication(s) with "neural plate" occurring in the abstract.

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 ZFIN logo design by Karl Rabe, University of Oregon

Click on a gene link to find a possible probe for this structure

Click on a gene link to find gene expression data

Exercises

- How can you find expression patterns for your marker in early wildtype development to determine if the observed change is due to misexpression or a delay in development?
- Can you find any knockdown studies for a gene you are studying?
- Use the gene expression query form to find expression data for an anatomical structure during a specified developmental stage range.