

## **Module 4: Function and Expression (ZFIN)**

### **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.

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

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

The image shows a screenshot of the ZFIN (Zebrafish Information Network) Gene Expression Data search form. The form is titled "Search for Gene Expression Data (New Features) NEW" and includes several search criteria and filters. Annotations in yellow boxes with black borders point to specific features on the form:






- Search by gene symbol**: Points to the "Gene/EST name" search field.
- Search for gene expression in a particular genetic background**: Points to the "Genetic background name" search field.
- Search by stage range**: Points to the "Between stages:" dropdown menu, which is currently set to "Zygote:1-cell" and "Adult".
- Click here to browse the anatomical dictionary**: Points to the "Anatomy" link in the "Expression in:" section.
- Search by anatomical structure(s)**: Points to the "Expression in:" section, which includes a dropdown menu and radio buttons for "Every term entered" and "Any term entered".
- Limit results to**: Points to the "Filters:" section, which includes checkboxes for "Only show figures with images", "Show direct submission data", and "Show published literature".

The form also includes a "Search" button and a "Results per page" dropdown set to "25". The footer of the page contains copyright information: "Copyright © University of Oregon, 1994-2005, Eugene, Oregon. ZFIN logo design by Kari Pape, University of Oregon".

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

**Expression Pattern Search Results for *bmp2b***  
(35 figure(s) with expression from 28 publication(s) )

[Modify Search](#)  
Your Input Welcor

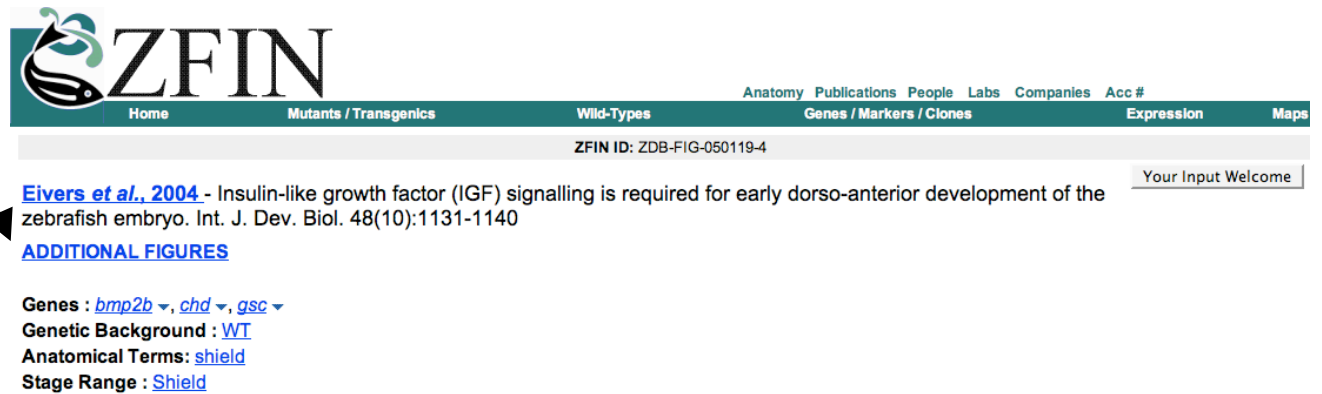
| Publication (current status)                          | Data   | Background(s)                           | Stage Range                  | Anatomy  |
|---|--|---|------------------------------|--|
| <a href="#">Dutta et al., 2005</a>                    | <a href="#">Fig. 2</a>    | WT                                      | Bud                          | non neural ectoderm  |
| <a href="#">Leung et al., 2005</a>                    | <a href="#">Fig. 7</a>   | WT                                      | Prim-5                       |  |
| <a href="#">Londin et al., 2005</a>                   | <a href="#">Fig. 5</a>   | TL                                      | Sphere to Shield             | embryo   |
|   | <a href="#">Fig. 7</a>   | TL                                      | Sphere                       |  |
| <a href="#">Shimizu et al., 2005</a>                  | <a href="#">Fig. 3</a>   | WT                                      | Bud                          | tail bud   |
|   | text only  | WT                                      | 75%-epiboly                  | embryo   |
| <a href="#">Yimlamai et al., 2005</a>                 | <a href="#">Fig. 7</a>   | AB                                      | 50%-epiboly                  |  |
| <a href="#">Cao et al., 2004</a>                      | text only  | AB                                      | Shield                       |  |
| <a href="#">Crotwell et al., 2004</a>                 | <a href="#">Fig. 4</a>   | WT                                      | Days 7-13 to Days 21-29      | fins   |
| <a href="#">Eivers et al., 2004</a>                   | <a href="#">Fig. 5</a>    | WT                                      | Shield                       | shield   |
| <a href="#">Fürthauer et al., 2004</a>                | text only  | WT                                      | Sphere to Shield             |  |
| <a href="#">Gilardelli et al., 2004</a>               | text only  | WT                                      | 50%-epiboly to Prim-5        |  |
| <a href="#">Kudoh et al., 2004</a>                    | text only  | WT                                      | 75%-epiboly                  |  |
| <a href="#">Ramel et al., 2004</a>                    | text only  | AB,<br><i>D(LG14)wnt8a<sup>w8</sup></i> | Shield                       |  |
| <a href="#">Rentzsch et al., 2004</a>                 | <a href="#">Fig. 1</a>   | WT                                      | 75%-epiboly                  | ectoderm, germ ring  |
| <a href="#">Fischer et al., 2003</a>                  | text only  | <i>ika<sup>t22030</sup></i> , WT        | Prim-15                      |  |
| <a href="#">Leung et al., 2003</a>                    | text only  | <i>boz<sup>m168</sup></i> , WT          | Sphere                       |  |
| <a href="#">Thisse et al., 2001 - Present [cb670]</a> | <a href="#">Fig. 1</a>  | AB/TU                                   | 50%-epiboly to Bud           | axis, margin, presumptive epidermis, ventral mesoderm, YSL |
|   | <a href="#">Fig. 2</a>  | AB/TU                                   | 1-4 somites to 10-13 somites | Kupffers vesicle, periderm, ventral mesoderm               |

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

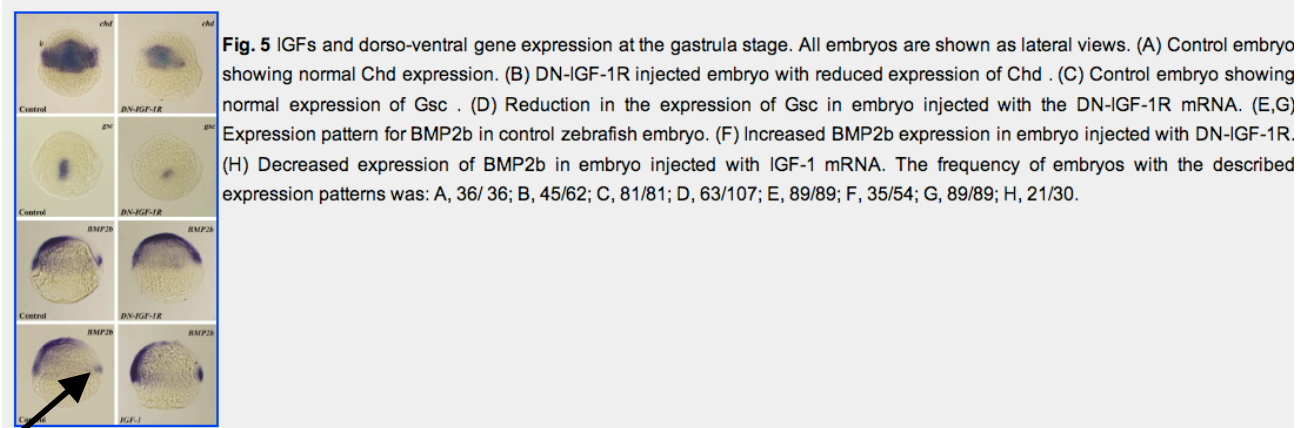


**ZFIN**  
 Anatomy Publications People Labs Companies Acc#  
 Home Mutants / Transgenics Wild-Types Genes / Markers / Clones Expression Maps  
 ZFIN ID: ZDB-FIG-050119-4  
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[Eivers et al., 2004](#) - Insulin-like growth factor (IGF) signalling is required for early dorso-anterior development of the zebrafish embryo. *Int. J. Dev. Biol.* 48(10):1131-1140

[ADDITIONAL FIGURES](#)

Genes : [bmp2b](#) ▾, [chd](#) ▾, [gsc](#) ▾  
 Genetic Background : [WT](#)  
 Anatomical Terms: [shield](#)  
 Stage Range : [Shield](#)



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 |
|-------------------------|--------------------|------------------------|------------------------|-------|
| <a href="#">bmp2b</a> ▲ | <a href="#">WT</a> | <a href="#">Shield</a> | <a href="#">shield</a> | ISH   |
| <a href="#">chd</a> ▲   | <a href="#">WT</a> | <a href="#">Shield</a> | <a href="#">shield</a> | ISH   |
| <a href="#">gsc</a> ▲   | <a href="#">WT</a> | <a href="#">Shield</a> | <a href="#">shield</a> | ISH   |

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

**ZFIN**    Anatomy    Publications    People    Labs    Companies    Acc#

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

Search for Gene Expression Data [\(New Features\)](#) NEW    Your Input Welcome

Gene/EST name | contains |

Genetic background name | contains |

MO knockdown: Gene name | contains |

Author | contains |

[Anatomy](#)    [Enter one anatomical term per line]

Include substructures

**Expression in:**

Every term entered

Any term entered

**Between stages:**

Zygote:1-cell & Adult

[Developmental Staging Series](#)

**Assay Type** | ANY

**Filters:**

Only show figures with images

Show direct submission data

Show published literature

25 results per page


Search    Reset

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**Enter the symbol of the targeted gene**

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



[Anatomy](#) [Publications](#) [People](#) [Labs](#) [Companies](#) [Acc#](#)  
[Home](#) [Mutants / Transgenics](#) [Wild-Types](#) [Genes / Markers / Clones](#) [Expression](#)

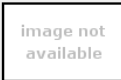
[Modify Search](#)  
 Your Input Wel

**Expression Pattern Search Results**  
(17 genes with expression)

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

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.



**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 |
|-------------------------|------------------------------------|-------------------------------|--|--|-------|
| <a href="#">cmyb</a> ▲  | <a href="#">TU, MO:gata2</a>       | <a href="#">20-25 somites</a> |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         | <a href="#">TU, MO:gata1</a>       | <a href="#">20-25 somites</a> |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         | <a href="#">TU, MO:gata1.gata2</a> | <a href="#">20-25 somites</a> |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         | <a href="#">TU</a>                 | <a href="#">20-25 somites</a> |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
| <a href="#">hbbe1</a> ▲ | <a href="#">TU, MO:gata1</a>       | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         | <a href="#">TU</a>                 | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
| <a href="#">lcp1</a> ▲  | <a href="#">TU, MO:gata2</a>       | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">Prim-5</a>        |  | <a href="#">unspecified</a>                        | ISH   |
|                         | <a href="#">TU, MO:gata1</a>       | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">Prim-5</a>        |  | <a href="#">unspecified</a>                        | ISH   |
|                         | <a href="#">TU, MO:gata1.gata2</a> | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">Prim-5</a>        |  | <a href="#">unspecified</a>                        | ISH   |
|                         | <a href="#">TU</a>                 | <a href="#">Prim-5</a>        |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">Prim-5</a>        |  | <a href="#">unspecified</a>                        | ISH   |
| <a href="#">mpx</a> ▲   | <a href="#">TU, MO:gata2</a>       | <a href="#">26+ somites</a>   | <i>Not detected</i>                                | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">26+ somites</a>   |  | <a href="#">unspecified</a>                        | ISH   |
|                         | <a href="#">TU, MO:gata1</a>       | <a href="#">26+ somites</a>   |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">26+ somites</a>   |  | <a href="#">unspecified</a>                        | ISH   |
|                         | <a href="#">TU, MO:gata1.gata2</a> | <a href="#">26+ somites</a>   |  | <a href="#">intermediate cell mass of mesoderm</a> | ISH   |
|                         |                                    | <a href="#">26+ somites</a>   |  | <a href="#">unspecified</a>                        | ISH   |
| <a href="#">TU</a>      | <a href="#">26+ somites</a>        | <i>Not detected</i>           | <a href="#">intermediate cell mass of mesoderm</a> | ISH  |       |
|                         | <a href="#">26+ somites</a>        |                               | <a href="#">unspecified</a>                        | ISH  |       |

**Click here to view morpholino details**



**Morpholino Name: MO1-gata1**

Previous Names: [MO\(T\)-gata1 \(1\)](#); [gata1 MO \(1\)](#); [Gata1 morpholino \(1\)](#)

Your Input Welcome

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**

**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**

The screenshot shows the ZFIN website's Anatomical Ontology Browser. The top navigation bar includes links for Home, Mutants / Transgenics, Wild-Types, Genes / Markers / Clones, and Expression. Below this, there are links for Anatomy, Publications, People, Labs, Companies, and Acc #. The main content area features a search box labeled 'Search Anatomical Ontology:' and three buttons: 'Browse by Stage', 'Search', and 'Complete List'. A footer contains links for Home, Email ZFIN, About ZFIN, Helpful Hints, and Citing ZFIN, along with a copyright notice for the University of Oregon.

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

**Click here for structure details**

**Click here for expression data**

The screenshot shows the search results for 'neural plate' on the ZFIN website. The search box contains 'neural plate' and the results are listed below. Each result includes a link to the structure details and a link to the expression data. The results are:

- [neural plate](#) [284 gene(s) expressed in all stages] (synonym(s): [presumptive central nervous system](#))
- [presumptive neural plate](#) [10 gene(s) expressed in all stages]
- [presumptive spinal cord](#) [30 gene(s) expressed in all stages] (synonym(s): [presumptive spinal cord neural rod](#), [presumptive spinal cord neural keel](#), [presumptive spinal cord neural plate](#))
- [primary neurons trunk](#) [81 gene(s) expressed in all stages] (synonym(s): [primary neurons spinal cord](#), [presumptive neurons neural rod](#), [primary neurons neural plate](#), [primary neurons neural keel](#), [primary neurons neural rod](#))

The footer of the page includes links for Home, Email ZFIN, About ZFIN, Helpful Hints, and Citing ZFIN, along with a copyright notice for the University of Oregon and a note about the ZFIN logo design.

Looking at the **neural plate** anatomy page, [http://zfin.org/cgi-bin/webdriver?Mlval=aa-anatomy\\_item.apg&OID=ZDB-ANAT-010921-5060](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.

**Name:** *neural plate*

**Synonyms:** presumptive central nervous system  
**Definition:** The earliest recognizable dorsal ectodermal primordium of the central nervous system present near the end of gastrulation before infolding to neural keel; consists of a thickened pseudostratified epithelium. [Kimmel et al., 1995.](#)

| Appears at  | Evident until  |
|---|--|
| <a href="#">Gastrula:90%-epiboly</a> (9.00h-10.00h) | <a href="#">Segmentation:5-9 somites</a> (11.66h-14.00h) |

**Expresses (284) Genes , first 10:**  
[abca1a](#) [akap1](#) [alcam](#) [arhe](#) [ar3l1](#) [atlc](#) [atp1b1a](#) [bckdk](#) [boc](#) [btg3](#) , [All \(284\)](#)

**Relationships**  
 Contained by: [neuroectoderm](#)  
 Contains:

**(117) Publication(s)** with "neural plate" occurring in the abstract.

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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.