# How to use the ZeFiRST database

The **ZeFiRST** (**Ze**bra **Finch Retina Single-cell and Spatial Transcriptome**) database is an online resource that allows researchers to explore gene expression profiles of the zebra finch eye in single cells and tissue space. Below are practical guidelines for using the database.

#### Accessing and navigating the Database

Use the tabs at the top of the page to switch between the database's sections: Introduction, Spatial RNAseq Expression, scRNA seq Expression, and Help Page.



#### **Database intro**

Birds have exceptionally sharp vision, facilitated by the retina, a specialised neural tissue in the eye involved in photoreception and -transduction. In addition, the bird is unique in its lack of internal blood vessels, a key characteristic of neural tissues in other endothermic animals. Thus, the bird retina represents a key tissue for understanding mechanisms associated with visual function and metabolic physiology.

The bird retina is housed within the bird eye, confined within the scleral connective tissue and the choroid behind the retina, and the vitreous and cornea on the light-facing side of the retina. Within the vitreous, a vascular structure called the pecten oculi is involved in supplying nutrients to the retina.

The ZeFiRST database allows researchers to explore gene expression of the zebra finch retina in individual cell types (single cell transcriptomics) and spatial gene expression in the entire eye (spatial transcriptomics).

Please cite the database as:

Citation will be updated.

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## How to Use The Spatial RNAseq Expression Tab

The Spatial RNAseq Expression tab in the ZeFIRST database provides detailed information on gene expression profiles across different regions of the zebra finch eye. Here's a practical guide on how to use this feature effectively:

### Accessing Spatial RNAseq Expression Data

Select the Spatial RNAseq Expression Tab: Click the "Spatial RNAseq Expression" tab on the top navigation bar to open the Spatial gene expression interface.

#### 1. Spatial gene expression: Spatial plot

- Input Gene Symbol by typing the gene symbol of interest (e.g., "CA4") and click search.
- Spatial Plot: a visual representation of the gene expression in a spatial context.
- Adjust the dot size using the slider to change the visualization resolution.
- Download the spatial plot as a PDF or PNG file by setting the desired dimensions and clicking the download buttons.

# Spatial gene expression: Spatial plot





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#### 2. Spot information vs gene expression on reduced dimensions

- Dimension Reduction Plot: Visualization of Spot information and gene expression side-by-side on low-dimensional representations.
- Select the axes for dimension reduction (e.g., UMAP1 and UMAP2).
- Toggle between different spot information and gene expression views.
- Download the plots as PDF or PNG files.



### 3. Co-expression of Two Genes

- Co-expression Plot: Co-expression of two genes on reduced dimensions.
- Select the genes to be analyzed (e.g., "CA4" and "SLC16A1").
- The plot shows the distribution of spots expressing both genes.
- Download the co-expression plot as a PDF or PNG file.



#### 4. Spot information / gene expression violin and box

- Violin and blox plots visualise spot information or gene expression across samples.
- Select the X-axis and Y-axis parameters, and choose the plot type (violin or boxplot).
- Toggle between showing data points and adjusting graphics controls.
- Download the plots as PDF or PNG files.



#### 5. Gene Expression as Bubbleplots or Heatmaps

- This section allows you to visualize gene expression patterns of multiple genes across samples.
- Enter a list of gene names.
- Choose the plot type (bubbleplot or heatmap).
- Cluster rows (genes) and columns (samples) for better visualization.
- Download the plots as PDF or PNG files.



## How to Use The scRNAseq Expression Tab

The scRNAseq Expression tab in the ZeFIRST database provides detailed information on gene expression profiles cell types in the zebra finch retina. Here's a practical guide on how to use this feature effectively:

#### Accessing scRNAseq Expression Data

Select the scRNAseq Expression Tab: Click the "scRNAseq Expression" tab on the top navigation bar to open the single-cell gene expression interface.

#### 1. Cell information vs gene expression on reduced dimensions

- Dimension Reduction Plot: Visualization of cell information and gene expression side-by-side on low-dimensional representations.
- Select the axes for dimension reduction (e.g., UMAP1 and UMAP2).
- Toggle between different cell information and gene expression views. Cell types are provided in the cell information "cell\_class".
- Download the plots as PDF or PNG files.



#### Cell information vs gene expression on reduced dimensions

#### 2. Co-expression of Two Genes

- Co-expression Plot: Co-expression of two genes on reduced dimensions.
- Select the genes to be analyzed (e.g., "SLC2A1" and "SLC16A1").
- The plot shows the distribution of spots expressing both genes.
- Download the co-expression plot as a PDF or PNG file.



#### 3. Cell information / gene expression violin and box

- Violin and blox plots provide a visualization of spot information or gene expression across samples or cell types.
- Select the X-axis and Y-axis parameters and choose the plot type (violin or boxplot).
- Toggle between showing data points and adjusting graphics controls.
- Download the plots as PDF or PNG files.



#### Cell information / gene expression violin plot / box plot

### 4. Proportion / cell numbers across cell types

- Stacked bar plot representing the proportion of cell types across samples
- Select the X-axis and Y-axis parameters and choose the plot values (proportion or absolute cell numbers).



• Download the plots as PDF or PNG files.

#### 5. Gene Expression as Bubbleplots or Heatmaps

- This section allows you to visualize gene expression patterns of multiple genes across samples.
- Enter a list of gene names.
- Choose the plot type (bubbleplot or heatmap).
- Cluster rows (genes) and columns (cell types) for better visualization.
- Download the plots as PDF or PNG files.



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