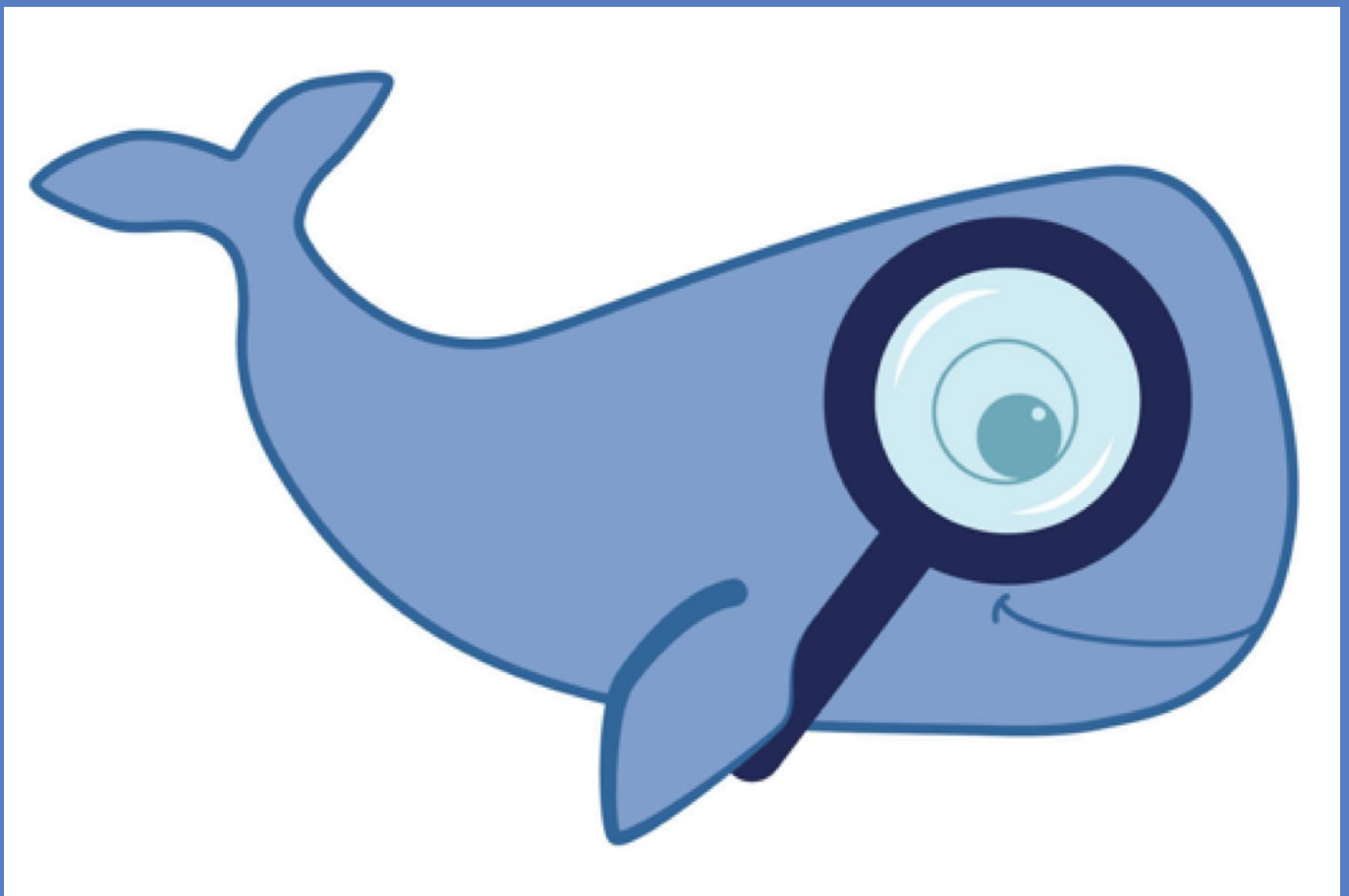


Using MoBIE in Fiji

A guide to the MoBIE plugin



About EMBL

EMBL is Europe's leading laboratory for the life sciences. We are an intergovernmental organisation supported by 27 member states and operating across six sites in Europe.

EMBL performs fundamental research in molecular biology, studying the story of life. Our research drives the development of new technology and methods in the life sciences, and we work to transfer this knowledge for the benefit of society.

About Science Education and Public Engagement

EMBL's Science Education and Public Engagement (SEPE) office leads and coordinates the institute's science education programmes and public engagement efforts.

Formerly known as European Learning Laboratory for the Life Sciences, ELLS, the office now not only leads the institute's science education activities but also coordinates its efforts in outreach and public engagement. We are building on EMBL's long history of science education and public engagement, and support EMBL's commitment of sharing and discussing our research with young learners, teachers and diverse publics.

The Science Education team of SEPE shares the scientific discoveries of EMBL through inspiring teaching and learning experiences with school science teachers, and to young people of all backgrounds aged between 10 and 19 years.

Our programmes convey complex, cutting-edge topics in life science research in an exciting and insightful way, fostering the discovery of current research trends, the scientific method, and scientific career paths. Our activities are developed and run in close collaboration with EMBL scientists.

Visit our website for further information about our activities: embl.org/ells

Introduction

Advances in cell biology research are heavily dependent on the development of imaging techniques, which provide ways to understand structures and biological functions at different scales. These tools are multidisciplinary and are being expanded constantly. From obtaining an image to the different ways it can be processed, these techniques are at the heart of state-of-the-art research at EMBL and are made available to the rest of the international scientific community. This resource will introduce you to one of the latest tools developed by EMBL scientists and show you how they use it to conduct cutting edge research. We hope that you will find this tool interesting and will use this resource to design your own activities for students on the topic of cell biology.

Overview

Modern electron microscopy (EM) and light microscopy (LM) produce vast amounts of images, which are then compiled into datasets to be later studied. The ability to visualise, explore and share these huge amounts of data both during and after the completion of a project was a challenge for the scientist working with them, so they developed MoBIE.

MoBIE (**M**ultimodal **B**ig **I**mage **D**ata **E**xploration) is an open-source framework for sharing and interactive browsing of multi-modal cloud-hosted big image data. It works as a plugin for [Fiji](#), which is an image processing package.

This guide was created for the use of this software and the plugin MoBIE. The information in it is divided into two sections: "Setting up the working environment" and "Opening data for visualisation".

MoBIE is the result of a collaborative effort with the participation of members of the Developmental Biology Unit at EMBL, Heidelberg. By using electron microscopy, they generated a cellular atlas ("**PlatyBrowser**") of the marine worm *Platynereis dumerilii*, which enabled detailed analyses of the link between cells' morphology and the genes that are specifically expressed in them.



Since the size of the atlas data exceeded 2 TB, effective working with it was a challenge, so scientists developed MoBIE. The data used to generate the atlas was acquired in this study: [Whole-body integration of gene expression and single-cell morphology](#)¹ (Vergara et al., 2021) and the open-source project code can be found [here](#).

Overall, MoBIE enables life scientists to seamlessly access, explore and share their often massive microscopy data through all stages of the lifetime of a project in a convenient Fiji plugin².

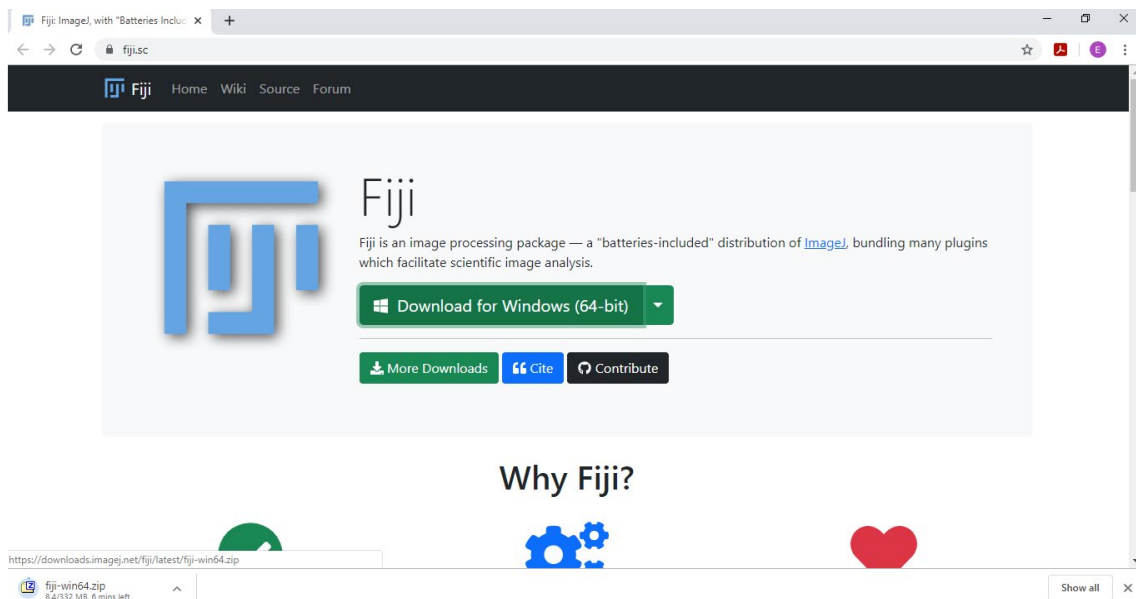
In the classroom, MoBIE is a great tool to visualise real-life images interactively manner, engaging students in identifying different cellular structures and giving a lot of flexibility to the teacher to tailor what activities they would like to have with their class.



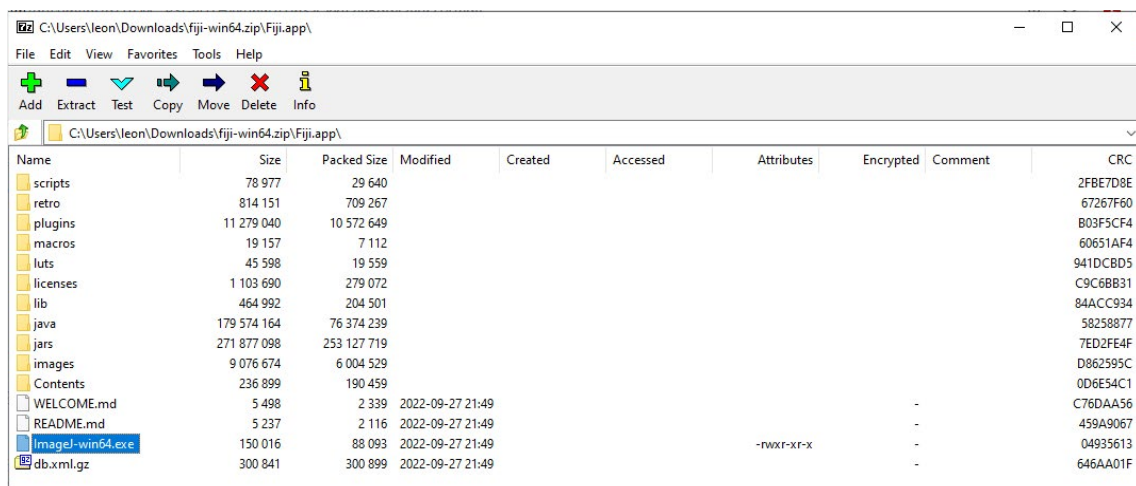
How to use MoBIE

Setting up the working environment

1. Download Fiji via this link: <https://fiji.sc/>. You will need a stable internet connection. The downloaded zip file contains the installation file, in our case it will be called “ImageJ-win64.exe”, since we downloaded the Windows 64-bit version.



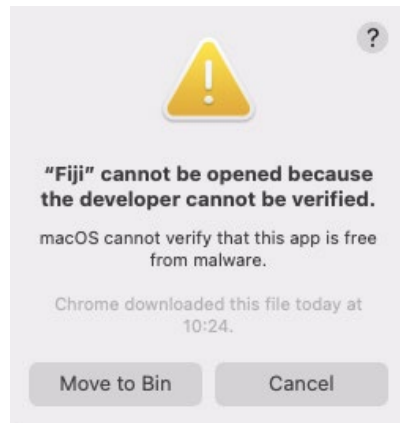
2. Use your desired file archiver/extractor to extract the files inside the zipped folder. If you do not have one installed in your computer, you can use 7-Zip (<https://www.7-zip.org/>, free and open source).



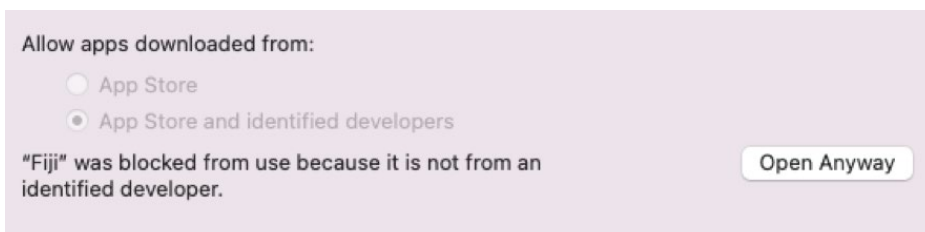
3. Install Fiji by running the installation file, in our case “ImageJ-win64.exe”.

Tips for MAC

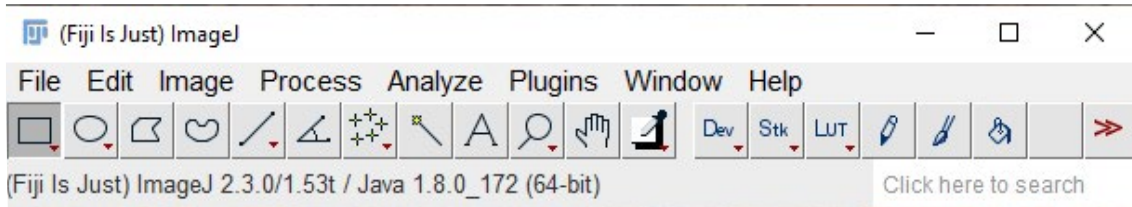
In case you are working with a Mac OS, once you download "fiji-macosx.zip", double click on it to unzip it. The application Fiji will appear as a new file. Next, copy/paste the Fiji to the Application folder. Next double click on the application. You might get the message below upon running the Fiji application for the first time.



You will need to allow opening for the application to open, by going to **System preferences...** found under the apple icon in the top left corner. Next, click on the **Security & Privacy** icon and on the bottom part of the window you will see the message as shown in the window below. Click the button **Open Anyway** and the Fiji application will open.

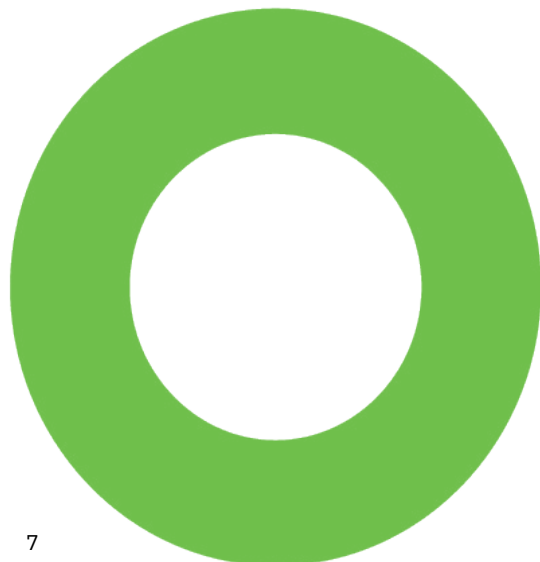
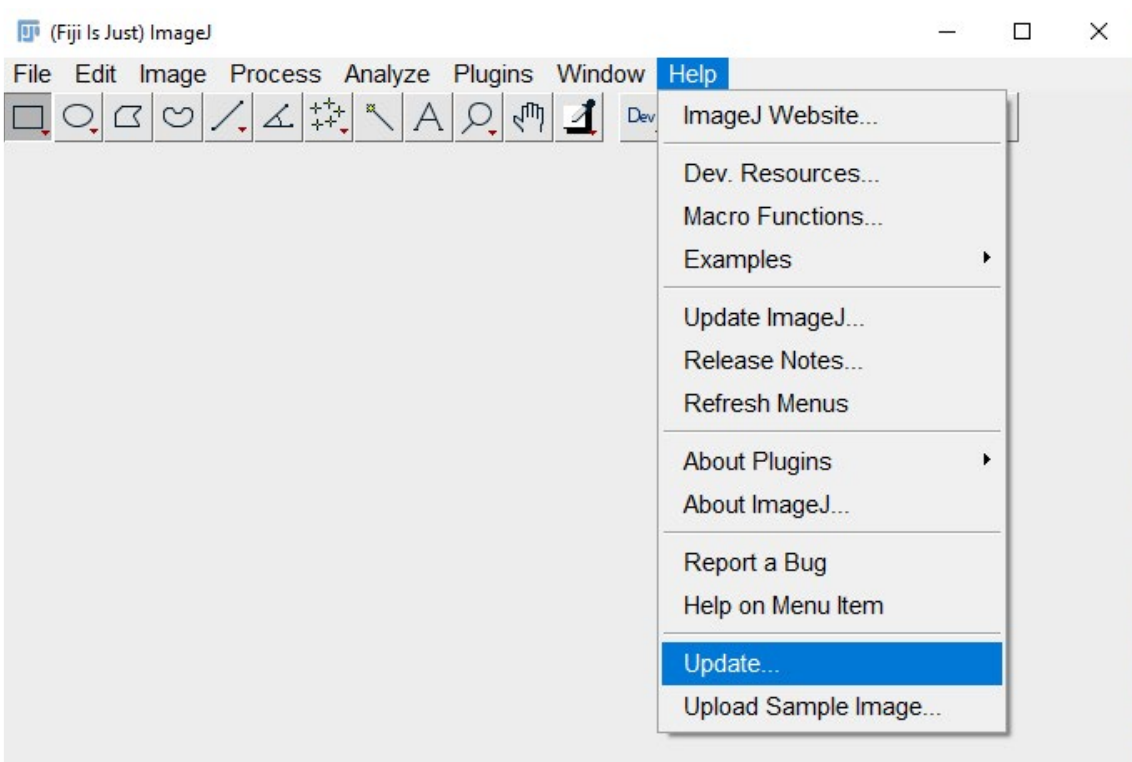


4. Open the programme. You may be prompted to run some updates, and it is always advisable to keep the software up to date

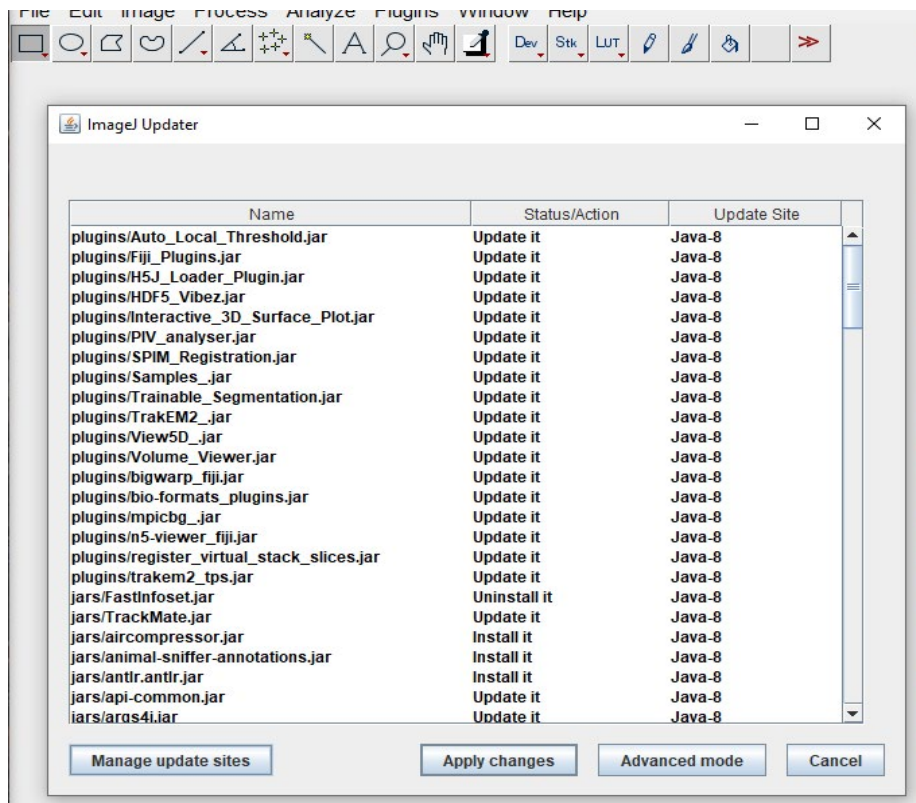


Add MoBIE by following the following steps:

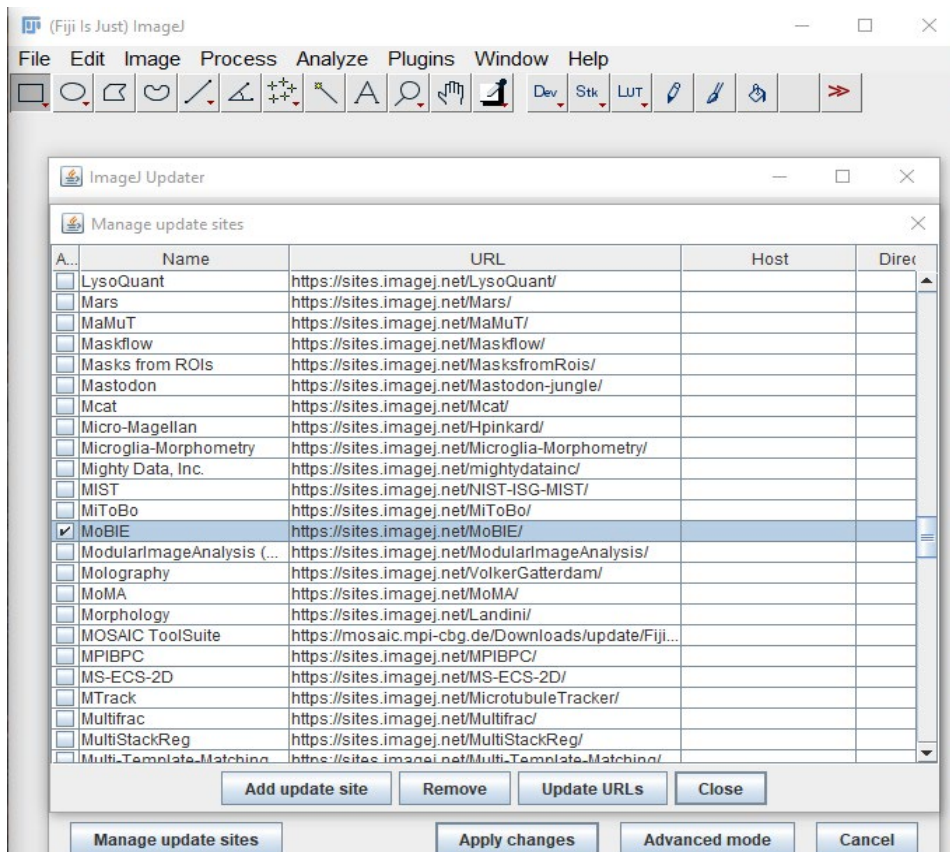
5. Click on **Help** → **Update**



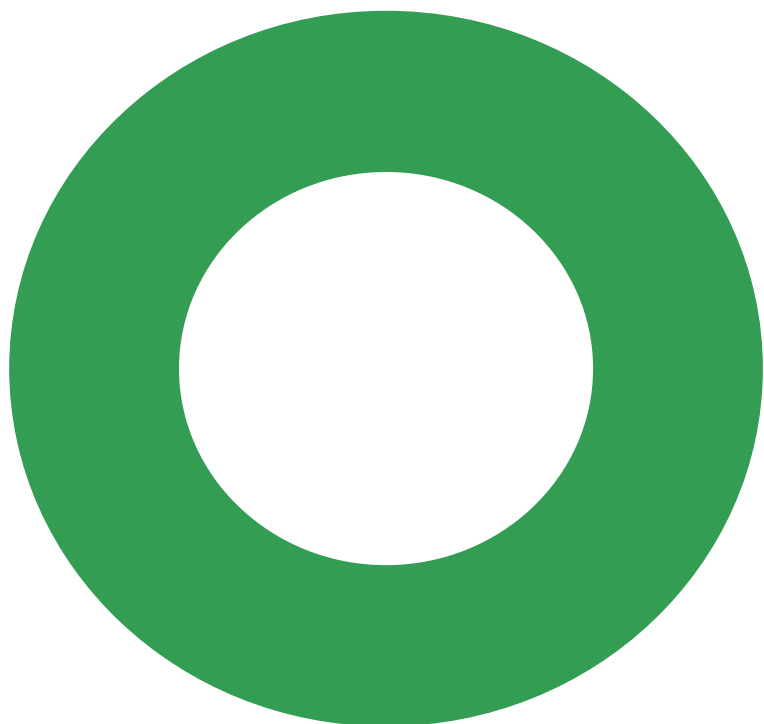
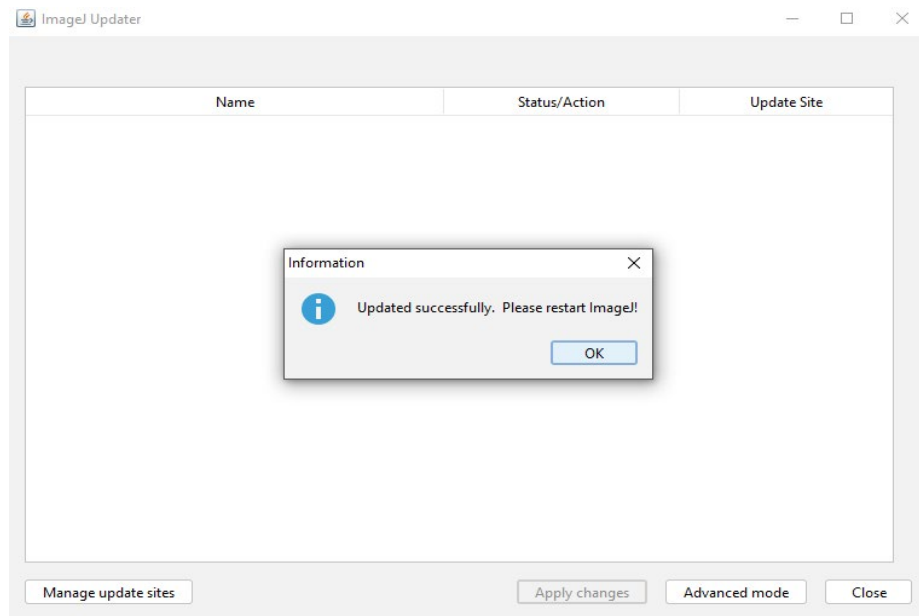
6. Click on **Manage update sites**. A new window will pop up.



7. Find MoBIE (the list of updates is in alphabetical order), select it and click **Close**.



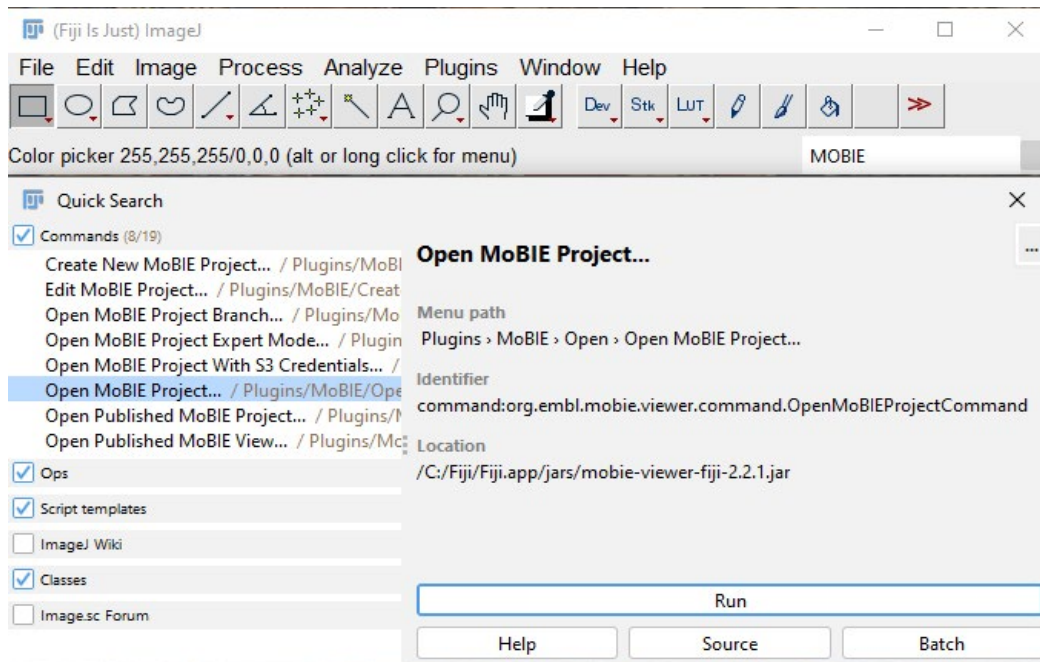
8. On the “ImageJ Updater” window, click **Apply changes**. Your Fiji will download and update all selected sites.
9. Restart Fiji (ImageJ).



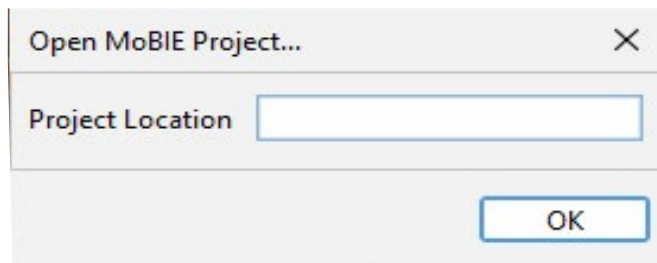
Opening data for visualisation

MoBIE is a cloud-hosted tool, which means you will need a stable internet connection in order to use it. Before following these steps, make sure you are connected.

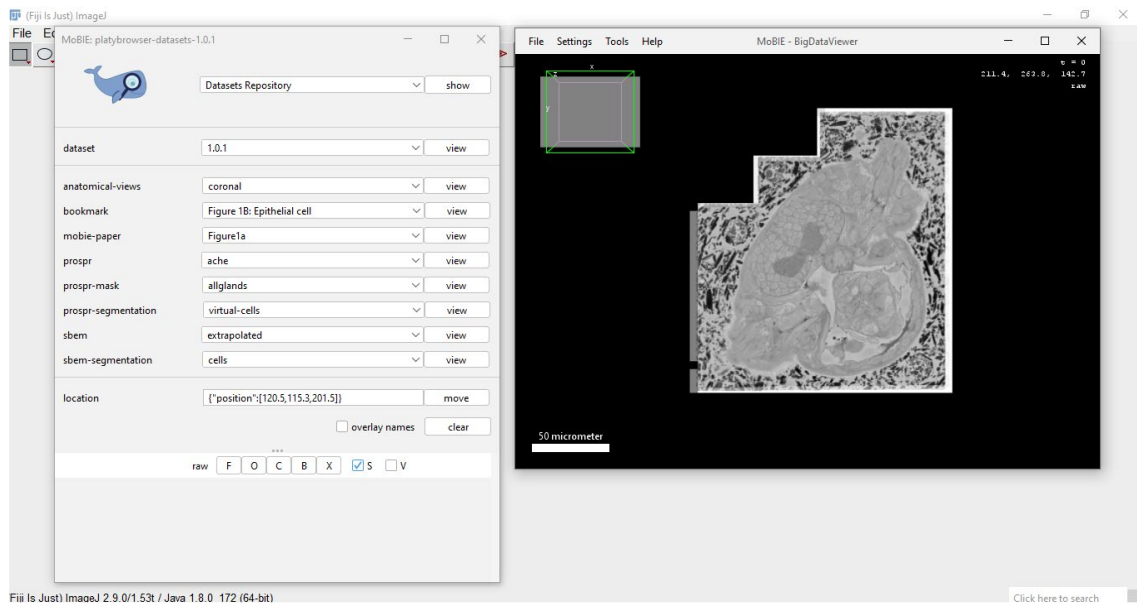
1. On the Fiji panel, type MoBIE in the search box on the right. A “Quick Search” window will appear.
2. Choose **Open MoBIE project** on the Commands tab and click **Run**.



3. An “Open MoBIE Project” window will appear. Feed the following link into the “Project Location” search bar:
<https://github.com/mobie/platybrowser-datasets>.
4. Click **OK**.



5. Multiple windows pop up. Focus on “MoBIE:platybrowser-datasets-1.0.1” and “MoBIE - BigDataViewer”



You can find useful information on how to navigate on the BigDataViewer window by clicking on the **Help** tab.

Navigation

Using the mouse:

Left-drag	Rotate (pan and tilt) around the point where the mouse was clicked.
Right-drag or Middle-drag	Move in the xy-plane.
Scroll	Move along the z-axis.
Meta Scroll or Ctrl Shift Scroll	Zoom in and out.

Using the keyboard:

X / Y / Z	Select rotation axis.
← / →	Rotate clockwise / counter-clockwise around the choosen rotation axis.
↑ / ↓	Zoom in / out.
, / .	Move forward / backward along the z-axis.
Shift X	Rotate to the zy-plane of the current source. (Look along the x-axis of the current source.)
Shift Y or Shift A	Rotate to the xz-plane of the current source. (Look along the y-axis of the current source.)
Shift Z	Rotate to the xy-plane of the current source. (Look along the z-axis of the current source.)
[or n	Move to previous timepoint.
] or m	Move to next timepoint.

Hold **Shift** to rotate and browse 10x faster.
Hold **Ctrl** to rotate and browse 10x slower.

Finding cells and structures in the PlatyBrowser

The PlatyBrowser dataset window contains useful information for easy navigation of data. For example, use a specific location from the “bookmark” for the visualiser to take you to specific cells in the organism.

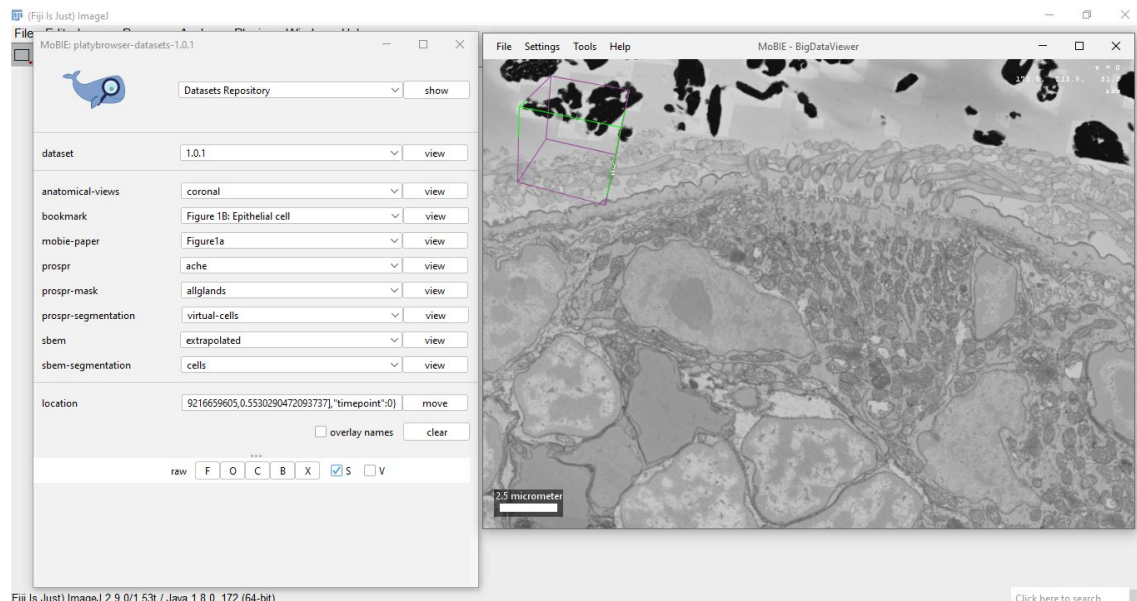
In this particular case, we will explore a predetermined region where a multiciliated cell resides and contains a rich population of mitochondria.

1. Copy the coordinate information below and feed it into the location bar on the MoBIE: platybrowser window.

```
{ "normalizedAffine": [-0.03412397604987898, 0.0030321151132691074, 0.009845289100542269, 4.884586500918973, -0.0070447070370438574, -0.03172397300444243, -0.014646870674711356, 9.17852774516154, 0.007516351661251353, -0.01596762335914084, 0.030969479216659605, 0.5530290472093737], "timepoint": 0 }
```

2. Click **move**. Your Fiji screen should look like the screen shown in the image below. On the MoBIE - BigDataViewer window you will be able to see the bookmarked region, which in our case is a multiciliated cell.

You can explore the region by zooming in and out (Ctrl+Shift+Scroll or using the ↑ ↓ keys on your keyboard), or moving from left to right (right-click your mouse and drag the picture).



Here are coordinates which can be used to locate:

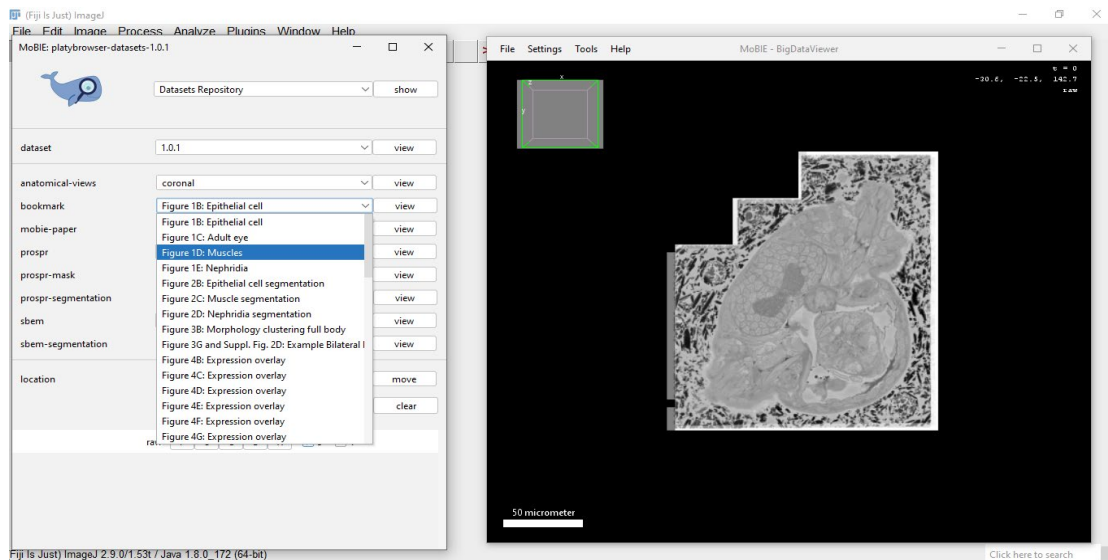
- Mitochondrion

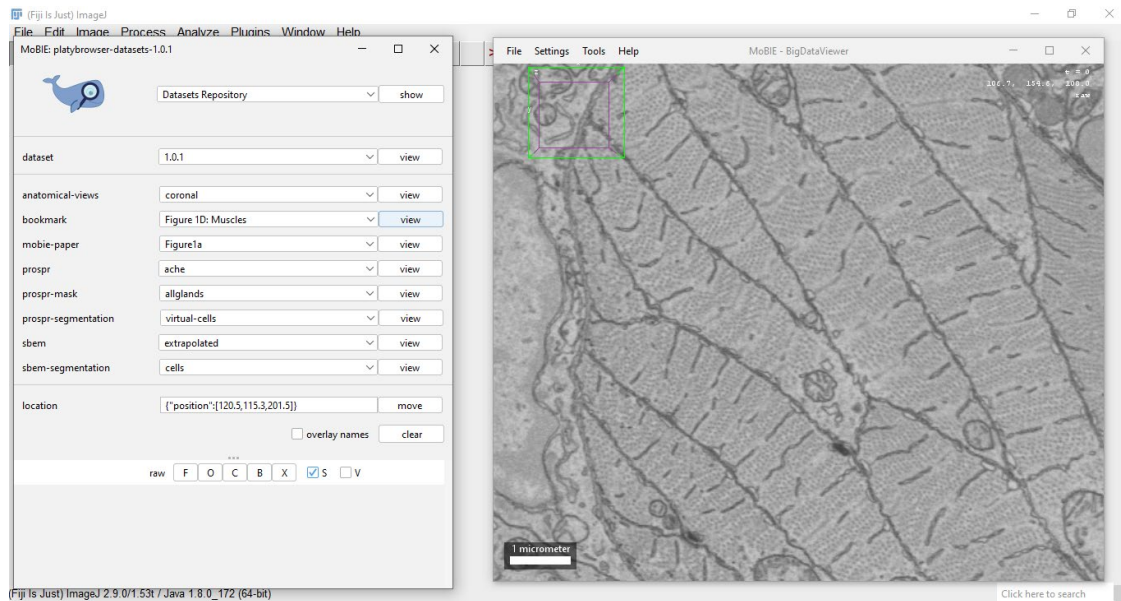
```
{"normalizedAffine":[0.09006388844614853,-0.10002608164247305,
-4.667503493061111E-50,1.7764018816859748,0.10002608164247305,
0.09006388844614853,-1.2159262309193589E-49,-25.988671222311197,
1.2159262309193589E-49,4.667503493061111E-50,0.13459836927239138,
-29.70988208130259],"timepoint":0}
```

- Golgi apparatus

```
{"normalizedAffine":[0.09006388844614853,-0.10002608164247305,
-4.667503493061111E-50,1.362512992797086,0.10002608164247305,
0.09006388844614853,-1.2159262309193589E-49,-25.72061566675564,
1.2159262309193589E-49,4.667503493061111E-50,0.13459836927239138,
-29.463701525746846],"timepoint":0}
```

You can also use the project's own bookmarks to explore the atlas, as shown in this case by looking at some muscle cells. Simply choose your bookmark of interest from the list and click **view**.





You are welcome to find your own areas of interest by browsing the atlas, and create your own bookmarks to revisit them in the future. The MoBIE team have created great resources on this and other topics, and you can find them here: <https://mobie.github.io/>. Their [MoBIE core functionality video](#) and their Views and locations [tutorial page](#) are particularly useful for this purpose.

Furthermore, browse through other projects with interesting data that you can also use to extract impactful images for your lessons.

Examples:

- Arabidopsis project:
<https://github.com/mobie/arabidopsis-root-lm-project>
- COVID project:
<https://github.com/mobie/covid-if-project>

1. [Whole-body integration of gene expression and single-cell morphology](#), Vergara, Hernando M. et al., Cell, Volume 184, Issue 18, 4819 - 4837.e22
2. <https://www.biorxiv.org/content/10.1101/2022.05.27.493763v2>
3. <https://www.embl.org/news/science/platybrowser/>





Science Education and Public Engagement

EMBL

Meyerhofstraße 1
69117 Heidelberg
Germany

Tel: +49 6221 387 8805

Mail: sepe@embl.org

Website: embl.org/ells



Terms of use

The educational resource is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) License. To view a copy of this license, visit <https://www.creativecommons.org/licenses/by-nc-sa/4.0/>

October 2022