

Open Microanatomy Handbook

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This documentation is currently work in progress

Introduction to Open Microanatomy

What is Open Microanatomy

Open Microanatomy is a project built on top of QuPath which contains three components: **Open Microanatomy Server**, **Open Microanatomy Cloud** and **QuPath Edu Extension**.

QuPath Edu Extension is an extension for **QuPath**, which allows QuPath projects (called *Lessons* in QuPath Edu) to be synced between multiple users via an **Open Microanatomy Server**. The **Open Microanatomy Server** handles all the heavy lifting required to authenticate users, upload new slides, manage data and so on. *QuPath Edu* is also compatible with other data sources, such as **Omero**.

Open Microanatomy also includes **Open Microanatomy Cloud**, which is a web application that communicates with a **Open Microanatomy Server** and can be used for **viewing** projects.

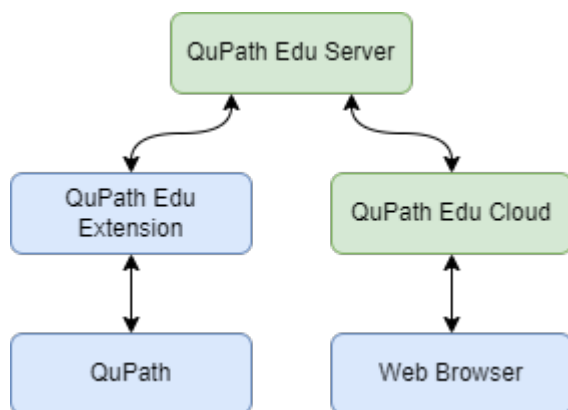


Figure 1. Visual representation of different Open Microanatomy components and how they communicate with each other. Blue components are downloaded by the end-user and the green components are setup by the system administrator

Hierarchy

A **Open Microanatomy Server** is “compartmentalized” as shown in **Figure 2**. Each server can host one or multiple *Organizations*. Each organization has its own *Workspaces*, which hold *Classes*, which contain the *Lessons*. See **Table 1** for how to think about these.

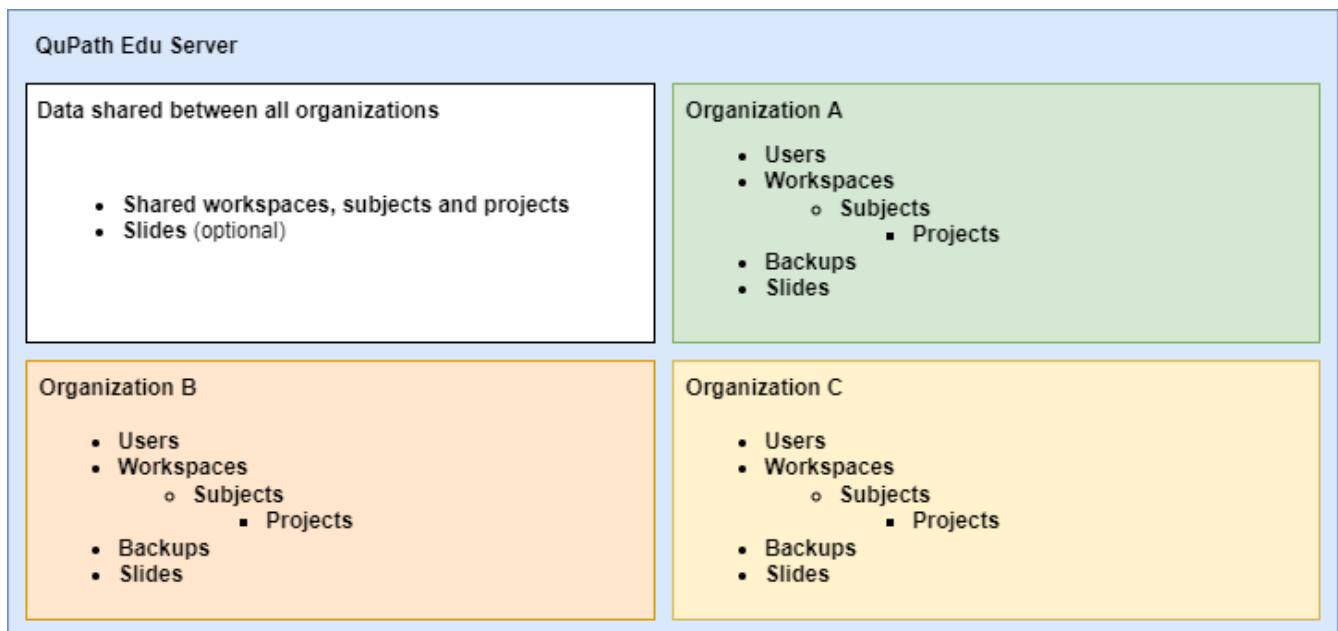


Figure 2. A demonstration of the Open Microanatomy hierarchy, with a server with three different organizations.

Table 1. Translations for different Open Microanatomy components

Name	Translation
Organization	Represents a university, school, department, or such – depending on your needs
Workspace	A course, such as <i>Histology</i> or <i>Pathology</i> .
Class	A class such as <i>Basic Histology</i> or <i>Advanced Histology</i> .
Lesson	A lesson within that class, such as <i>Epithelium</i> or <i>Connective tissue</i> .

Getting started

Feature comparison

☑ = supported ☐ = not supported (and currently no plans to implement) ☐☐ = work in progress

Feature	Browser / Mobile	Desktop app
View slides	☐	☐
Slide tours	☐☐☐	☐
Creating content	☐	☐
Administrative tasks	☐	☐
Authentication	☐☐☐	☐

Prerequisites

QuPath & QuPath Edu Extension

- A 64-bit Windows, macOS or Linux machine, with at least 250 MB of disk space

Open Microanatomy Cloud

- None

Open Microanatomy Server

- See [Open Microanatomy Server](#) chapter.

Installing QuPath Edu Extension

1. Install [QuPath](#) by following the instructions on the QuPath website
2. Download the [QuPath Edu extension](#)
3. Install the extension by drag and dropping the downloaded `.jar` file to the QuPath viewer

See [here](#) for more detailed instructions on how to install QuPath extensions

QuPath Edu Extension

Connecting & authenticating

First time setup

When starting QuPath Edu for the first time, you'll see the *First-time setup* dialog. You must either select a *public host* or enter your **QuPath Edu Servers** address to continue. If you are unsure what your institutions address is, try contacting your IT-services. Public hosts are QuPath Edu Servers which can be freely viewed by anyone. Currently the only public host is the demo server provided by the University of Oulu.

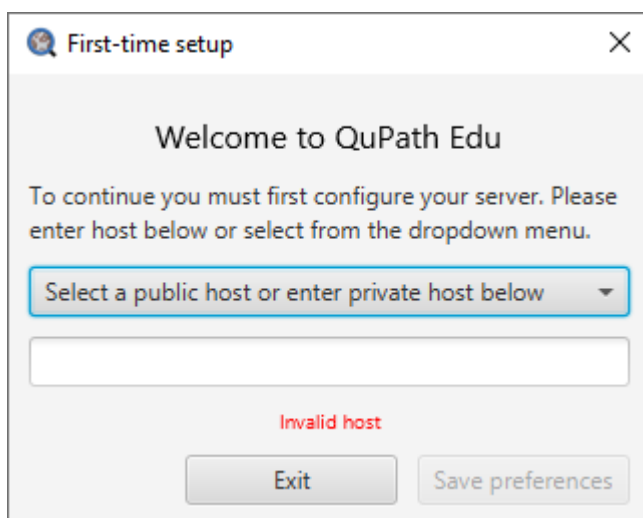


Figure 3. First-time setup dialog

You can change your host later by clicking the **Change host ...** link on the **Login dialog** (see [Figure 4](#)) or from the QuPath settings **Edit > Preferences > Edu**

Logging in

You can continue either **Continue as a guest** (*only read permissions*) or authenticate using **Credentials** (*regular email & password combination*) or a **Microsoft account**.

NOTE

Logging in using Credentials and/or Microsoft Authentication may not be available on your organization depending on your *Open Microanatomy Server* setup.

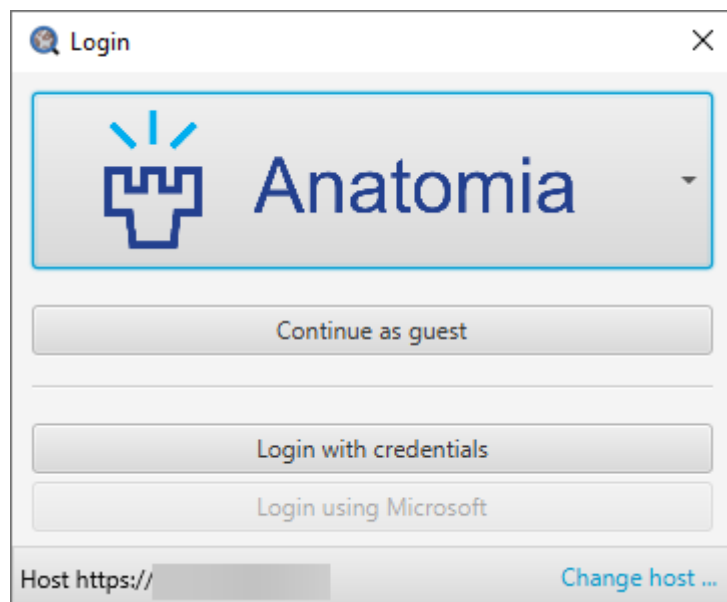


Figure 4. Login dialog. Change host by pressing the [**Change host ...**] on the bottom-right hand corner.

Password recovery

If you forgot your password, you can recover your password by pressing [**Login with credentials**] and then [**Forgot password**] from the bottom right-hand corner.

Creating content

Going further, it's assumed the reader is already familiar with QuPath. If you have never used QuPath before, it's advised to read the [QuPath documentation](#) first.

Before making changes anywhere, confirm that you have **Editing mode enabled** by pressing [**Turn editing on**] on the QuPath toolbar (see [Figure 5](#) below). If any button is disabled, try checking first that **a)** edit mode is enabled, **b)** you're logged in **b)**, you have the required permissions to make changes (see [Users & Roles](#)).

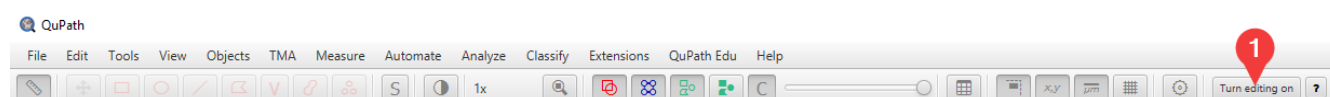


Figure 5. QuPath Toolbar. Notice how the annotation tools are disabled because editing mode is not turned on.

Creating workspaces, courses and lessons

Begin by opening the **Select lesson** (see [Figure 7](#) below) interface by pressing either [**Open lesson**]

or [**Create lesson**] buttons in the main QuPath interface on the left sidebar (see [Figure 6](#) below).

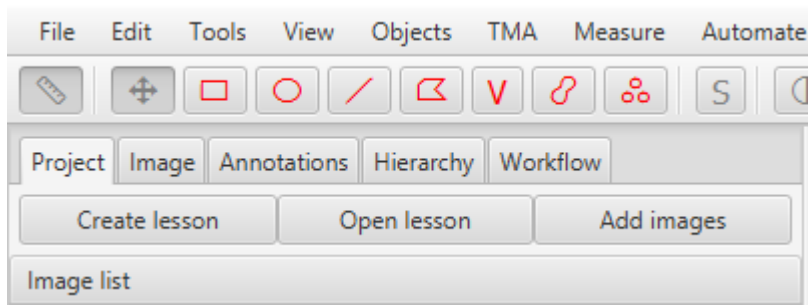


Figure 6. Buttons to open and create lesson, and add images

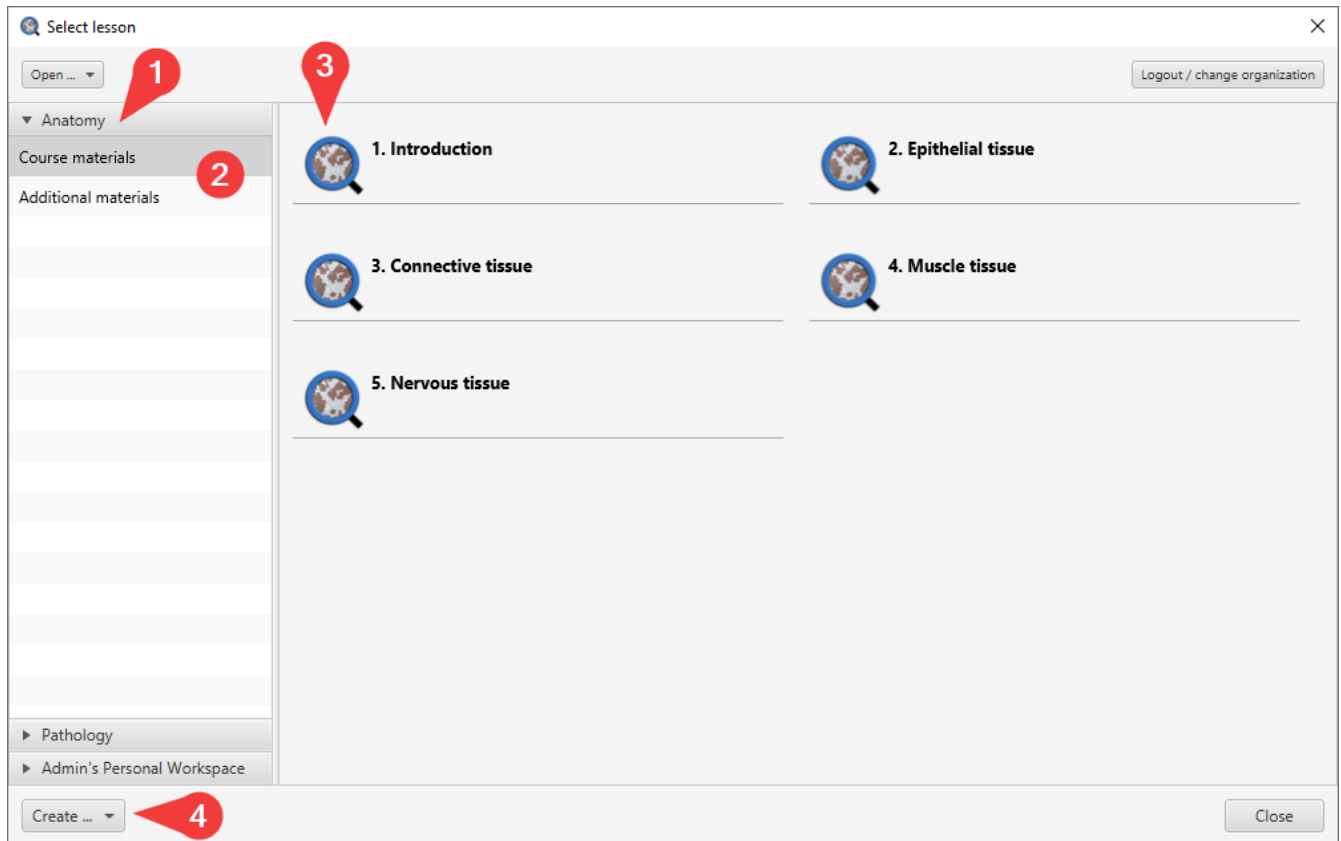


Figure 7. 1: A workspace named *Anatomy*. 2: Two courses named *Course materials* and *Additional materials*. 3: Five lessons belonging to the *Course materials* course. 4: Create a workspace, course or a lesson.

Create new workspaces by pressing [**Create ...**] and selecting either **Workspace**, **Course** or **Lesson**. **Course** and **Lesson** are disabled until you select a **Workspace**.

Delete or rename any **Workspace**, **Lesson** or **Class** by right-clicking on it. You can also **hide** Classes or set a **description**. Hiding a Class will hide that Class from guests and users without write permissions. Deleting a Workspace will delete all Lessons and Classes belonging to that Workspace and similarly deleting a Lesson will delete all Classes belonging to that Lesson.

WARNING

Deleting a workspace, lesson or class is currently not reversible. See [Backups](#) for more details.

Adding slides to a lesson

To add a new slide click on [**Add images**] (next to [**Open lesson**], see [Figure 6](#) above) to open the **Slide manager** interface. From here, select any slide you wish to add and click on [**Add selected**]. This will open the **QuPath Image Import** interface. These settings are important if you're planning on doing any analysis on the slides later. The default options and setting the **Image type** to **Brightfield (H-DAB)** is usually enough for teaching purposes. Clicking on [**Import**] will add the slide to the lesson.

Making changes to slides

Adding annotations, modifying slide description or such work identically as in QuPath, just make sure you have **enabled editing mode** (see [Figure 5](#)). Read the [QuPath documentation](#) for detailed information on annotating and such.

Any changes will be saved when either **a)** clicking on **File > Save** or **File > Save as**, **b)** changing slides, **c)** closing the lesson.

Modify Lesson Information

Edit the **Lesson Information** by either **a)** double-click anywhere on the **Lesson Information** tab **b)** **File > Project... > Edit lesson information**.

Lesson Information supports **rich text**, which includes custom fonts, colors, tables, images, videos, hyperlinks and much more.

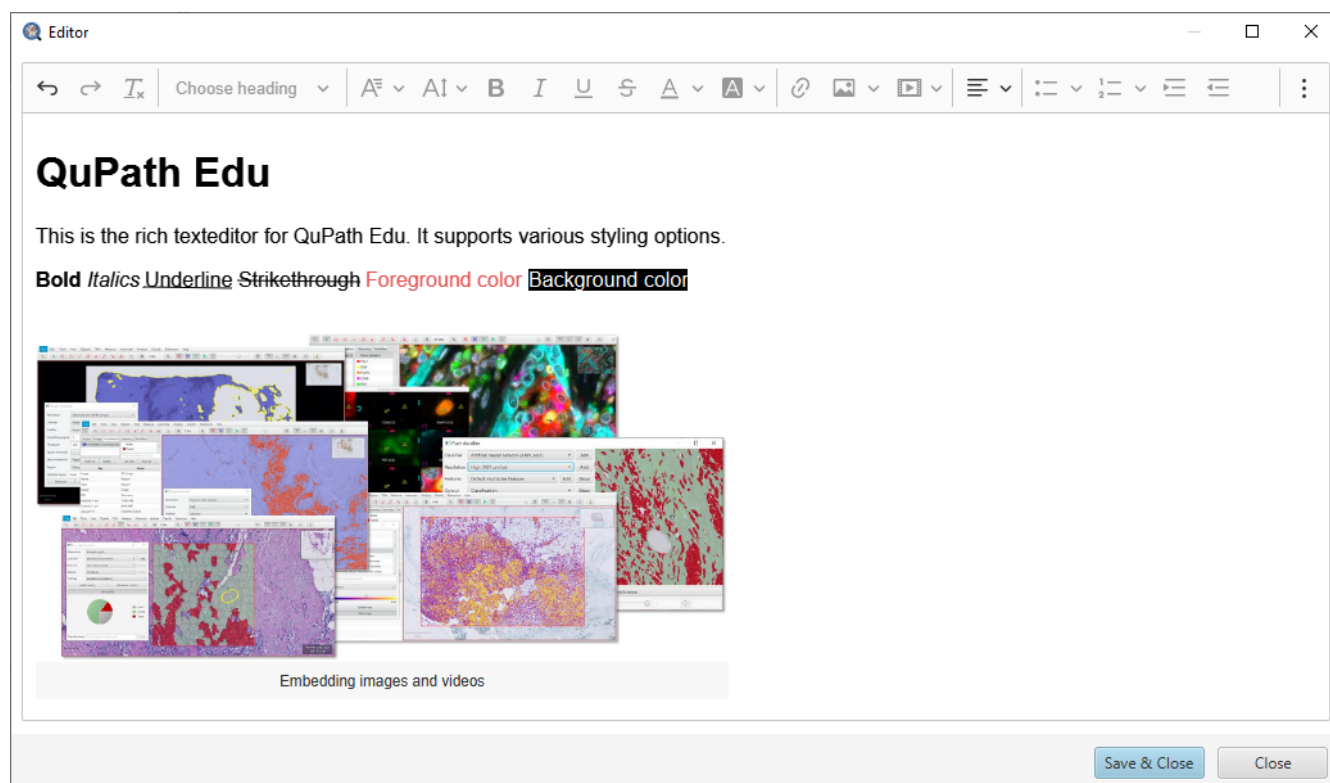


Figure 8. Rich text editor.

Creating slide tours

Slide tours are a feature introduced by QuPath Edu, it allows teachers to create short guided tours of slides, going through the key points of a slide.

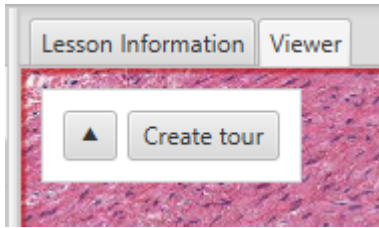


Figure 9. Create slide tour button on viewers top-left corner.

Slide tours consists of "**frames**", which the user views one-by-one. To create a **Slide tour**, press on **[Create tour]** tour on the Viewers top-left corner. Next click on **More ▾ > Create new frame**, and pan & zoom on the point of interest, make any annotations you wish. Set a description for this frame by pressing **More ▾ > Edit text**. Save changes by clicking on **More ▾ > Save changes**. Create as many frames you wish by clicking **More ▾ > Create new frame** and again making any annotations, panning & zooming, setting a description and saving the changes with **More ▾ > Save changes**. Preview your slide tour by clicking on **[Previous]** and **[Next]**.

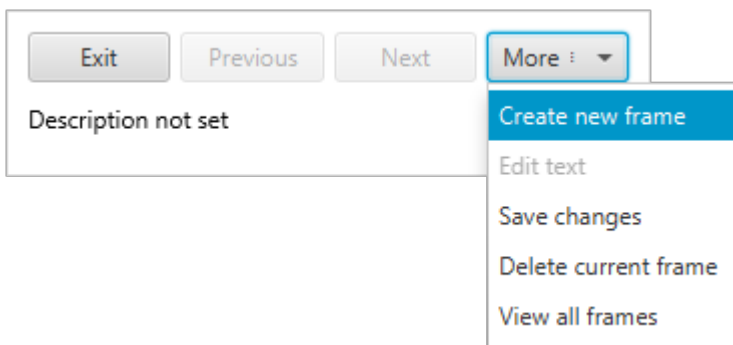


Figure 10. Slide tour editing interface

Administrative tasks

Most administrative tools are available by selecting **QuPath Edu > ...** from the QuPath top bar. Some administrative tasks requires access to the server and are detailed in the [Open Microanatomy Server](#) chapter.

Users & Roles

Manage users by opening the **User management** interface using **QuPath Edu > Manage users**.

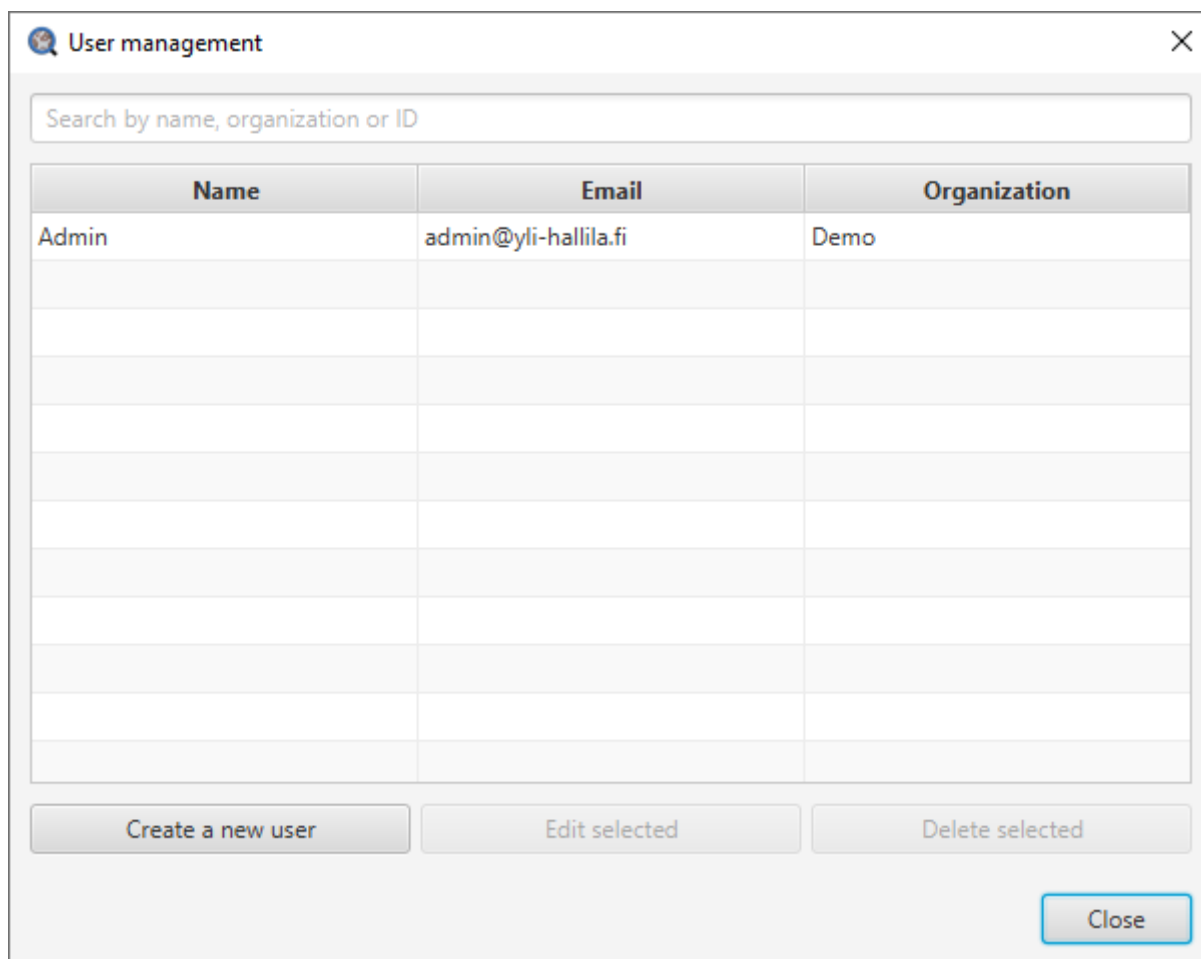


Figure 11. User management interface

Users with the **Administrative tasks** role are able to view & modify all users regardless of organization. Users with only the **Manage users** roles can only view & modify users that belong to the users organization.

Only users with the **Administrative tasks** role are able to migrate users to a different organization.

Passwords are required to have at least 3 characters, no other requirements.

Table 2. Explanation for different roles

Role	Explanation
Manage slides	Upload new slides and delete / modify slides that are owned by the users organization.
Manage users	Create new users and edit existing users on the users organization.
Moderator tasks	Create new workspaces, courses and lessons on the users organization.
Administrative tasks	All permissions, regardless of organization.

Slides

Manage slides by opening the **Slide management** interface using **QuPath Edu > Manage slides**.

WARNING

Currently there's no way to restore a deleted workspace / class or a lesson without administrative tools. A whole database backup is performed every 24 hours, which can be used to restore any deleted workspace / class or lesson.

NOTE

In QuPath Edu Server version 1.0 a bug exists, which allows users with write permissions to preview all backups regardless of organization. Restoring backups is still limited to users with proper write permissions to a specific workspace.

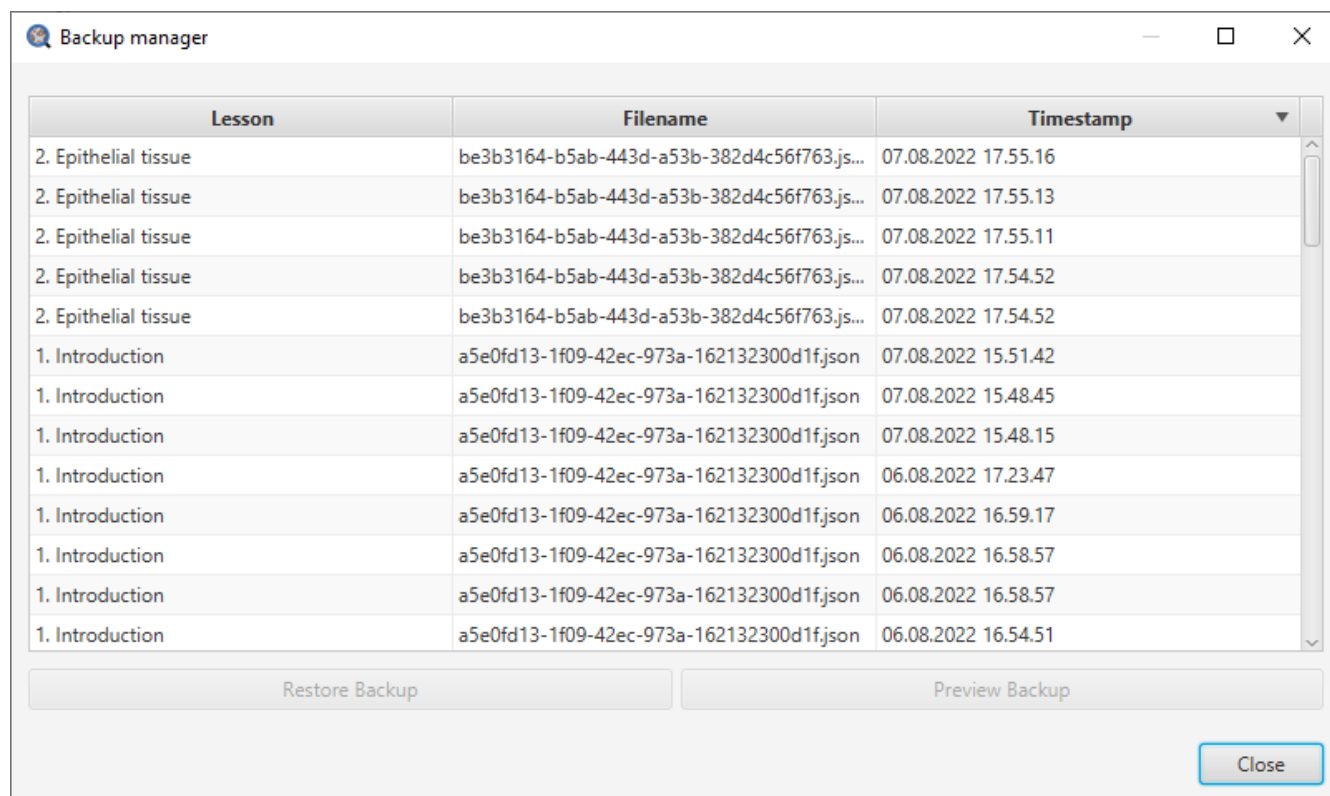


Figure 13. Backup management interface.

Organizations

Manage organizations by opening the **Organization management** interface using **QuPath Edu › Manage organizations**.

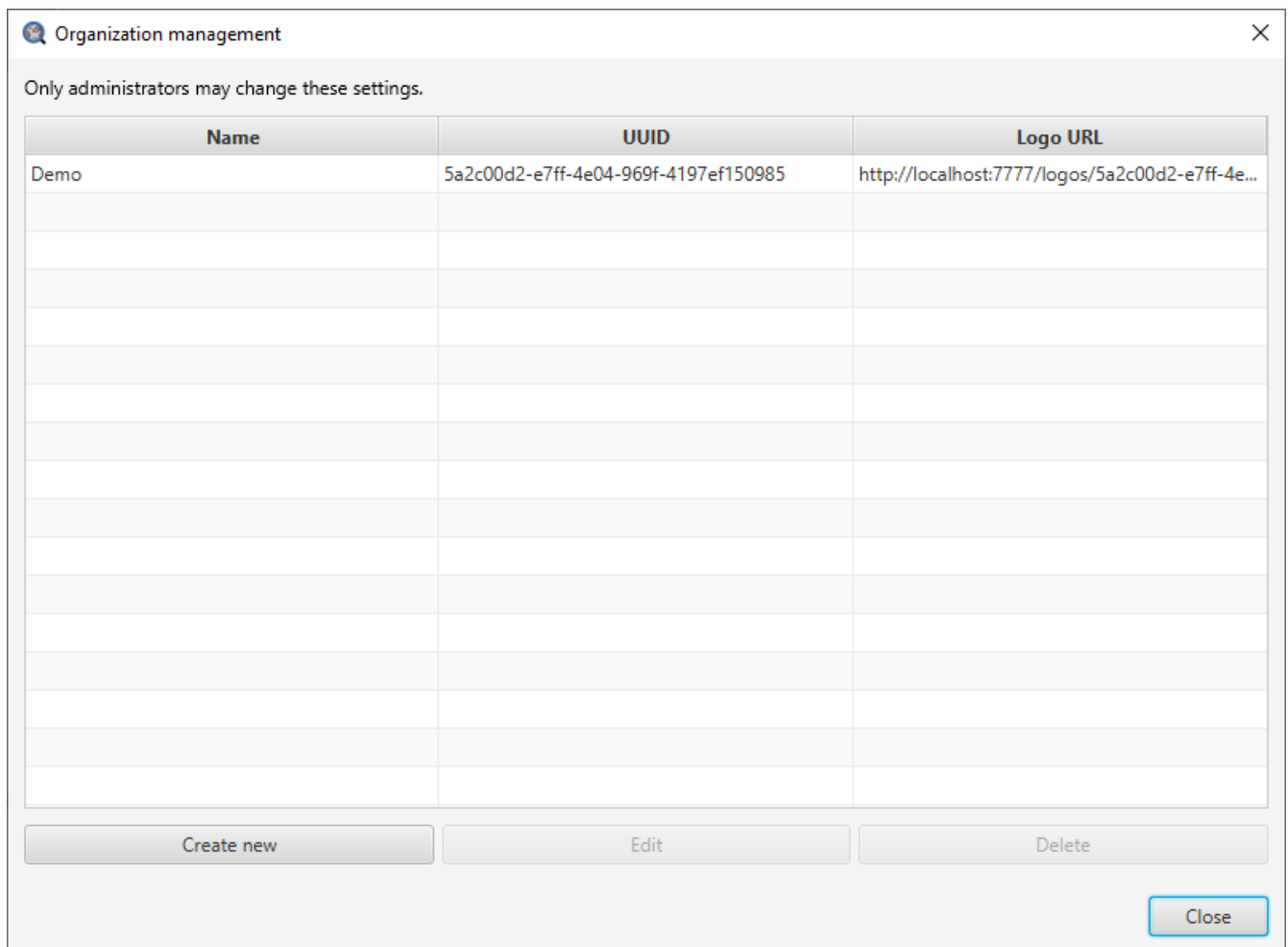


Figure 14. Organization management interface. Each organization has an UUID (Universal Unique Identifier) which distinguishes it from others.

Making any changes to an organization requires the *Administrative tasks* role.

Deleting an organization will delete **permanently all data** associated with that project, including **workspaces, lessons, courses, users, and slides**.

Clicking **[Edit]** allows you to **rename** and **upload a logo** for that organization, see [Figure 13](#).

Organization logo requirements

- PNG filetype
- Size of 400x80 px or greater
- Aspect ratio of 5:1

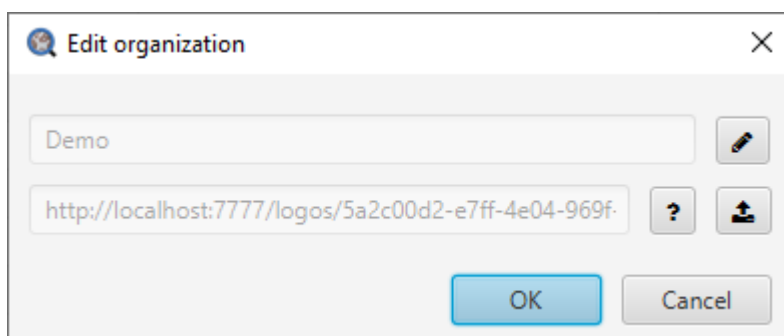


Figure 15. Edit organization dialog.

Permissions

Manage permissions by opening the **Permission management** interface using **QuPath Edu › Manage permissions**.

By default, when creating a new workspace, it is automatically assigned the **Write** access for **yourself** and **Read** access to **no-one**. You can restrict access to either **a)** only yourself, **b)** specific organizations, **c)** specific users, **d)** combination of users and organizations.

Simply use **[+]**, **[<]**, **[>]**, **[>>]**, **[<<]** and **[?]** to add/remove permissions. Double-arrows moves **all items** and single-arrows move **only the selected item**. Clicking **[?]** will give you an analysis of who has read/write permissions in plain English.

Remember to press **[Save changes]** (bottom right-hand corner); currently QuPath Edu gives **no warning** if forgetting to save any changes.

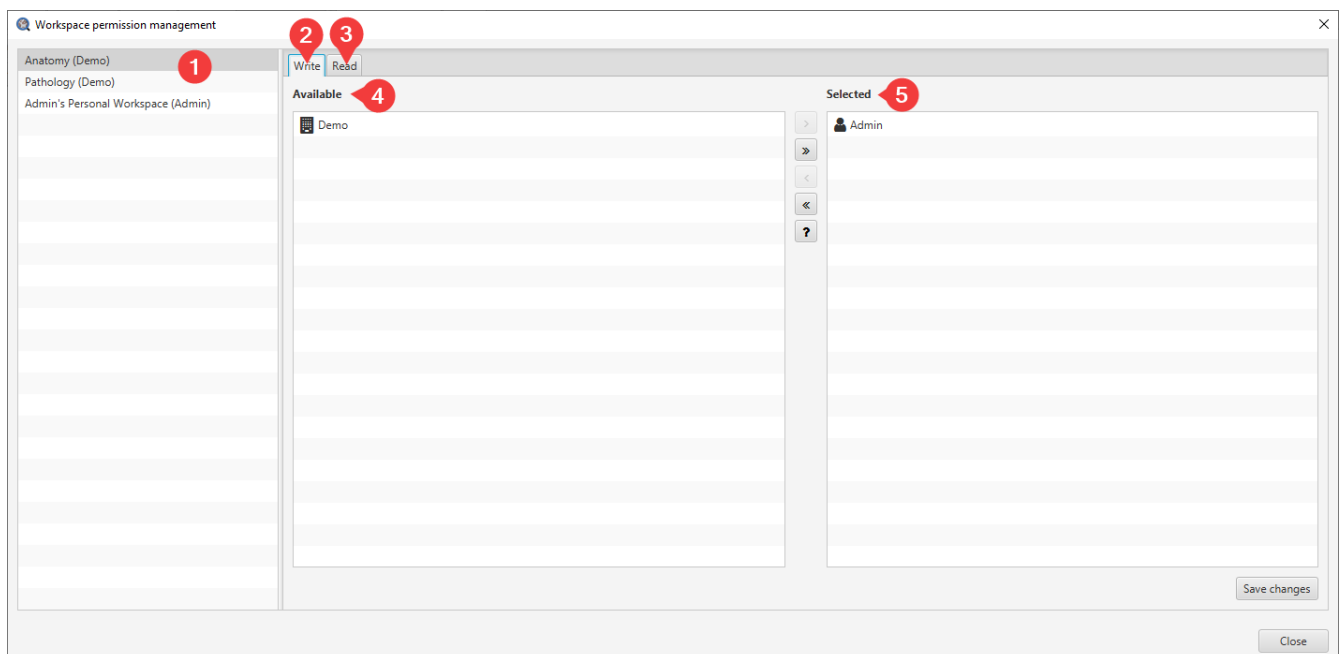


Figure 16. Permission management interface. **1:** List of all workspaces, the organization is specified in parentheses. **2 & 3:** Read & write permissions separated in different tabs. **4 & 5:** Left pane indicates any users/organizations available and right pane indicates users/organizations with active permissions.

Open Microanatomy Cloud

Documentation in progress.

Source code and more details are available at openmicroanatomy/web.

Open Microanatomy Server

Prerequisites

- Java 14 or newer

Installation & Running

Open Microanatomy Server consists of two components: the **server** itself and of a **tiler** which converts slides into smaller chunks called **tiles**. You must be running both the **server** *and* **tiler** for Open Microanatomy to function normally: without the tiler you *cannot* upload new slides.

It's advised to create a separate user, such as `openmicroanatomy` and to use software such as `screen` to create separate sessions for both instances. Both the tiler and server must be running on the same server.

Support for a Docker containers is under work.

Installation (Linux)

These instructions assume you're familiar with Linux already and skips multiple crucial steps such as creating a new user.

1. Download the latest `open-microanatomy-server.jar` from [GitHub](#).
2. Save it to e.g. `/home/openmicroanatomy/server/open-microanatomy-server.jar`
3. Extract OpenSlide Binaries
 - *these are currently only available from the [QuPath repository](#) — download the `.jar` file specific to your operating system and **extract** it to where you saved `qupath-edu-server.jar`.*

Running the server

1. Start the server with `java -jar <jar> [-port <port>]`
2. During your initial start-up, you will create your first administrator account.

Running the tiler

1. Start the tiler with `java -jar <jar> --tiler`
2. Tiler validates that everything is working as expected and will wait for new slides.

Configuration

Configuration is available at `application.conf` which will be generated during the initial start-up. The `application.conf` contains comments for configuration instructions.

To **generate a new configuration** simply delete the old one and restart the server. To **reload the configuration** you must restart the server.

The **most important configuration step** is setting the `server.host` parameter to your host and

port — this should point to your reverse proxy address (see [SSL](#) chapter). **Your server *will not* function properly if you do not set the host parameter.**

For storing the tiles there are two options. **Flatfile** storage uses the Open Microanatomy Server to store any tiles. For **Cloud storage** currently **CSC Allas** is only supported, with initial support for **Amazon S3** existing. If you're interested in support for Amazon S3, please create a GitHub issue regarding this.

SSL

Open Microanatomy Server does **not** include support for SSL and it is up to the end-user to set up a **reverse proxy** using software such as nginx or Apache to provide a secure connection.

Below is a example nginx reverse proxy configuration using [Certbot](#).

```
server {
    server_name open.microanatomy.server;

    access_log /var/log/nginx/reverse-access.log;
    error_log /var/log/nginx/reverse-error.log;

    include /etc/nginx/conf/proxy.conf;

    location / {
        proxy_pass http://127.0.0.1:7777;
    }

    listen [::]:443 ssl;
    listen 443 ssl;
    ssl_certificate /etc/letsencrypt/live/open.microanatomy.server/fullchain.pem;
    ssl_certificate_key /etc/letsencrypt/live/open.microanatomy.server/privkey.pem;
    include /etc/letsencrypt/options-ssl-nginx.conf;
    ssl_dhparam /etc/letsencrypt/ssl-dhparams.pem;
}

server {
    if ($host = open.microanatomy.server) {
        return 301 https://$host$request_uri;
    }

    listen 80;
    listen [::]:80;

    server_name open.microanatomy.server;
    return 404;
}
```

HTTP API

Open Microanatomy Server includes a **REST API** — documentation is available [here](#).