

# What about the FA in FAIR?

## Image repositories for findable and accessible imaging data

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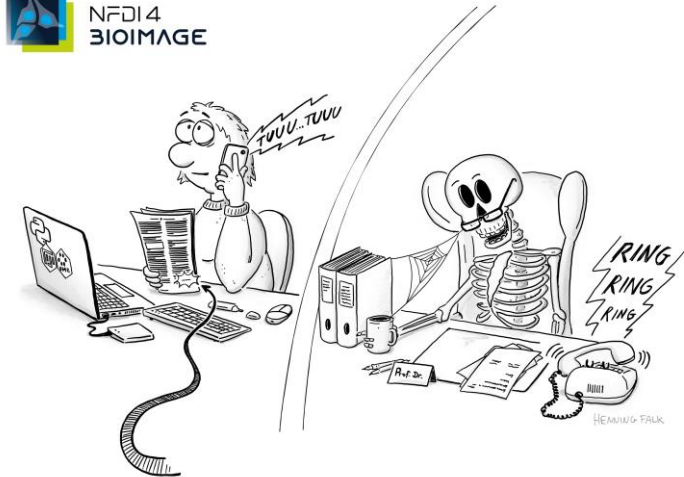
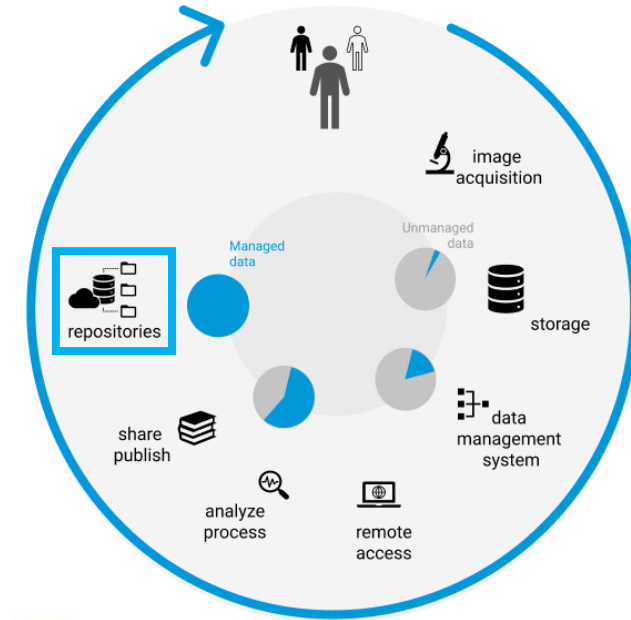


**Have you worked with data  
repositories before?**

# What are data repositories?

Digital storage space for data (and metadata) with the goal of

- preserving the data
  - making data findable
  - making data accessible
- Paper publication and data publication to a suitable repository should go hand in hand
- DOI of the data publication can be put into the data availability statement of the paper

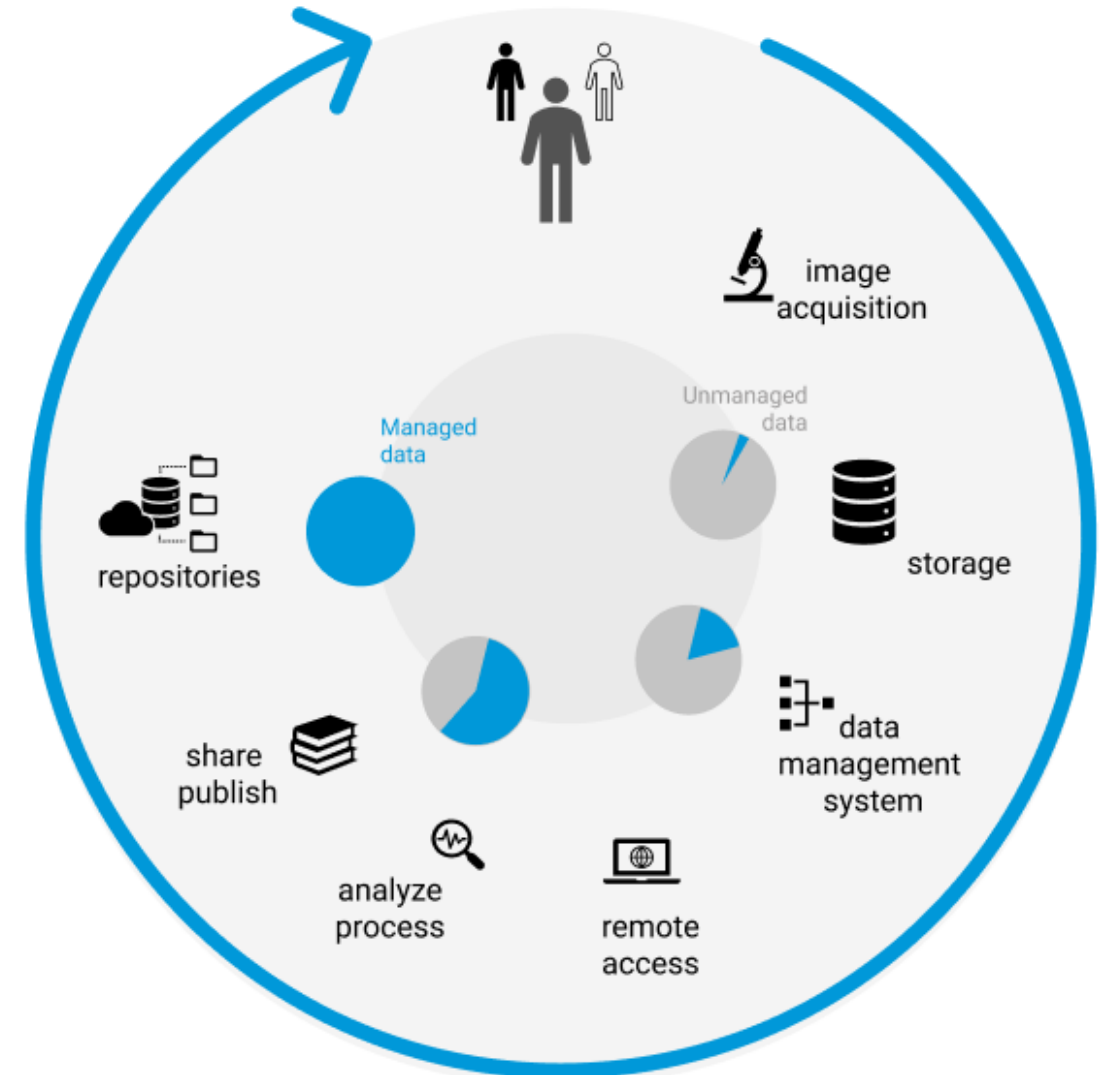


# Why using data repositories?

Depositing data on a repository will

- increase trust in your (published) findings
- help understand your results
- help reproduce your results
- save resources
- enable reuse of data

➤ makes your data FAIR!



# How to find a suitable data repository?

Repositories have to comply with some general criteria (from Practical Guide to the International Alignment of Research Data Management), such as

- persistent identifiers for data
- metadata
- access and licenses regulations
- data preservation

You can use these repository registries:

- re3data.org - Registry of Research Data Repositories

<https://www.re3data.org/>

- FAIRsharing.org - Standards, Databases, Policies

<https://fairsharing.org/>

- OpenAIRE - Explore

<https://explore.openaire.eu/>

re3data.org

FAIRsharing.org  
standards, databases, policies

OpenAIRE | EXPLORE



**If you worked with data  
repositories before, which data  
repository was it?**

# Which repository fits to my (bioimage) data?

You have to decide, do you want to use a

- generic repository, e.g. Zenodo
- discipline-specific or domain-specific repository, e.g. Electron Microscopy Public Image Archive (EMPIAR)
- archive-type data repository, e.g. BioImage Archive (BIA)
- added-value databases, e.g. Image Data Resource (IDR)



➤ Community-developed checklists for publishing images and image analyses, Schmied et al. (2023), Nat Methods



## Type:

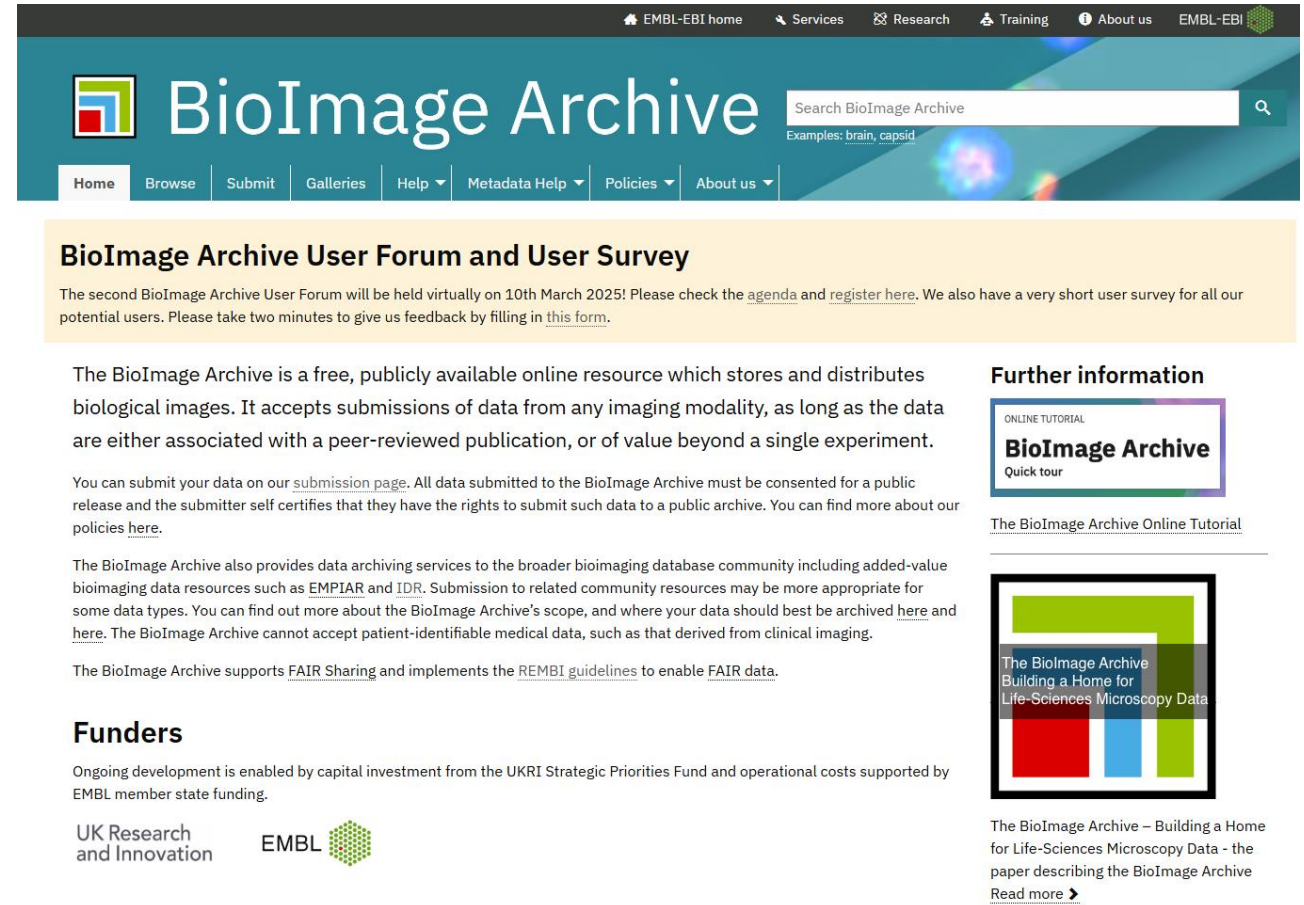
- archive image data repository

## Location:

- implemented at the European Molecular Biology Laboratory – European Bioinformatics Institute (EMBL-EBI) at Hinxton, UK

## Data uploaded:

- as of January 2025 600 TB was deposited
- in over 800 studies



The screenshot shows the BioImage Archive website. The header includes navigation links: EMBL-EBI home, Services, Research, Training, About us, and EMBL-EBI. The main banner features the BioImage Archive logo and a search bar with the text "Search BioImage Archive" and examples: "brain, capsid". Below the banner is a navigation menu with links: Home, Browse, Submit, Galleries, Help, Metadata Help, Policies, and About us. The main content area has a yellow banner for the "BioImage Archive User Forum and User Survey" with a deadline of 10th March 2025. Below this, there are sections for "Further information" and "Funders". The "Further information" section includes links to an online tutorial and a quick tour. The "Funders" section lists UK Research and Innovation and EMBL. The bottom right corner features a box titled "The BioImage Archive Building a Home for Life-Sciences Microscopy Data" with a "Read more" link.

**BioImage Archive User Forum and User Survey**

The second BioImage Archive User Forum will be held virtually on 10th March 2025! Please check the [agenda](#) and [register here](#). We also have a very short user survey for all our potential users. Please take two minutes to give us feedback by filling in [this form](#).

The BioImage Archive is a free, publicly available online resource which stores and distributes biological images. It accepts submissions of data from any imaging modality, as long as the data are either associated with a peer-reviewed publication, or of value beyond a single experiment.

You can submit your data on our [submission page](#). All data submitted to the BioImage Archive must be consented for a public release and the submitter self certifies that they have the rights to submit such data to a public archive. You can find more about our policies [here](#).

The BioImage Archive also provides data archiving services to the broader bioimaging database community including added-value bioimaging data resources such as [EMPIAR](#) and [IDR](#). Submission to related community resources may be more appropriate for some data types. You can find out more about the BioImage Archive's scope, and where your data should best be archived [here](#) and [here](#). The BioImage Archive cannot accept patient-identifiable medical data, such as that derived from clinical imaging.

The BioImage Archive supports [FAIR Sharing](#) and implements the [REMBI guidelines](#) to enable [FAIR data](#).

**Funders**

Ongoing development is enabled by capital investment from the UKRI Strategic Priorities Fund and operational costs supported by EMBL member state funding.

UK Research and Innovation EMBL

**Further information**

ONLINE TUTORIAL  
**BioImage Archive**  
Quick tour

The BioImage Archive Online Tutorial

The BioImage Archive Building a Home for Life-Sciences Microscopy Data

The BioImage Archive – Building a Home for Life-Sciences Microscopy Data - the paper describing the BioImage Archive  
[Read more](#)

<https://www.ebi.ac.uk/bioimage-archive/>



## Image preview:

- working on alpha version of image preview using OME-Zarr

## Type of data:

- BIA accepts bioimaging data in general

## Metadata requirements:

- minimal mandatory metadata requirements

## Example of a data publication



<https://www.ebi.ac.uk/biostudies/bioimages/studies/S-BIAD1241>  
<https://alpha.bioimagearchive.org/bioimage-archive/study/S-BIAD1241/>

## Type:

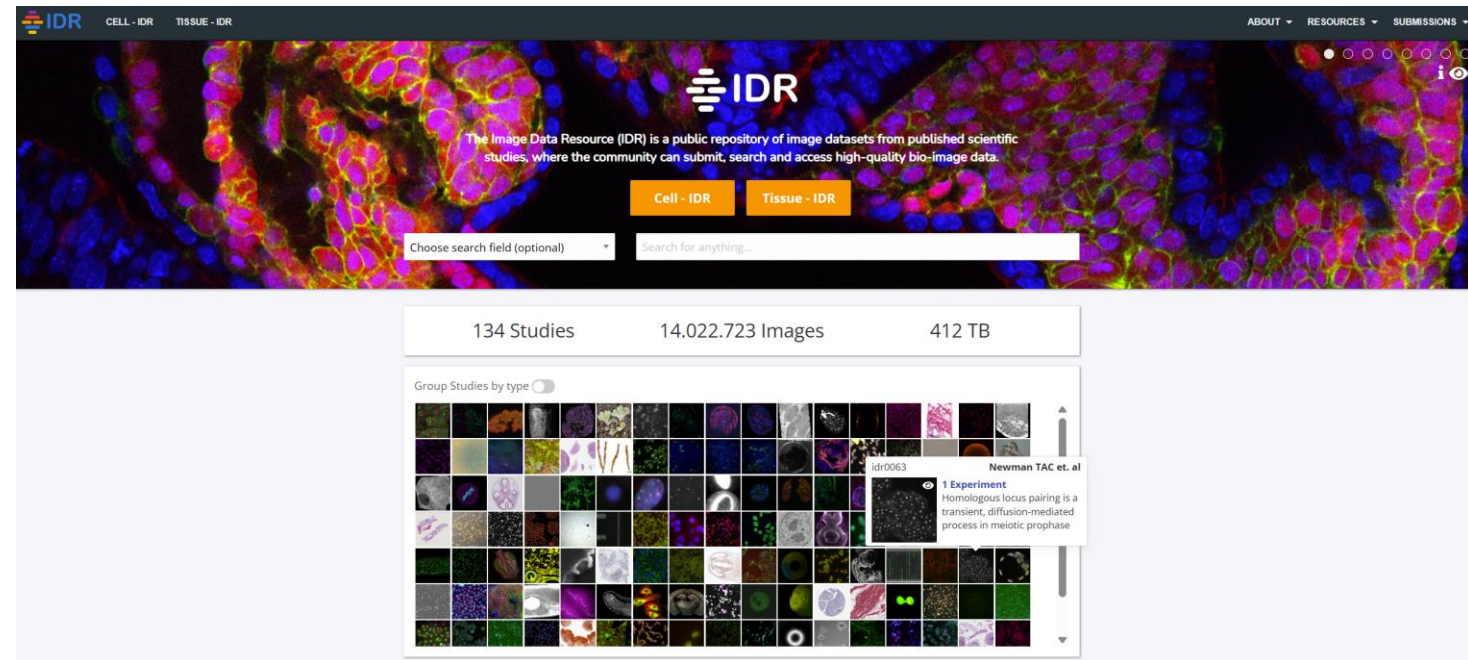
- added-value database

## Location:

- developed as a collaboration of the EMBL-EBI at Hinxton, UK, and the Open Microscopy Environment consortium (OME) at University of Dundee

## Data uploaded:

- as of January 2025 411 TB was deposited
- in over 130 studies



<https://idr.openmicroscopy.org/>

## Image preview:

- image preview possible with BIO-FORMATS plugin (as in OMERO)

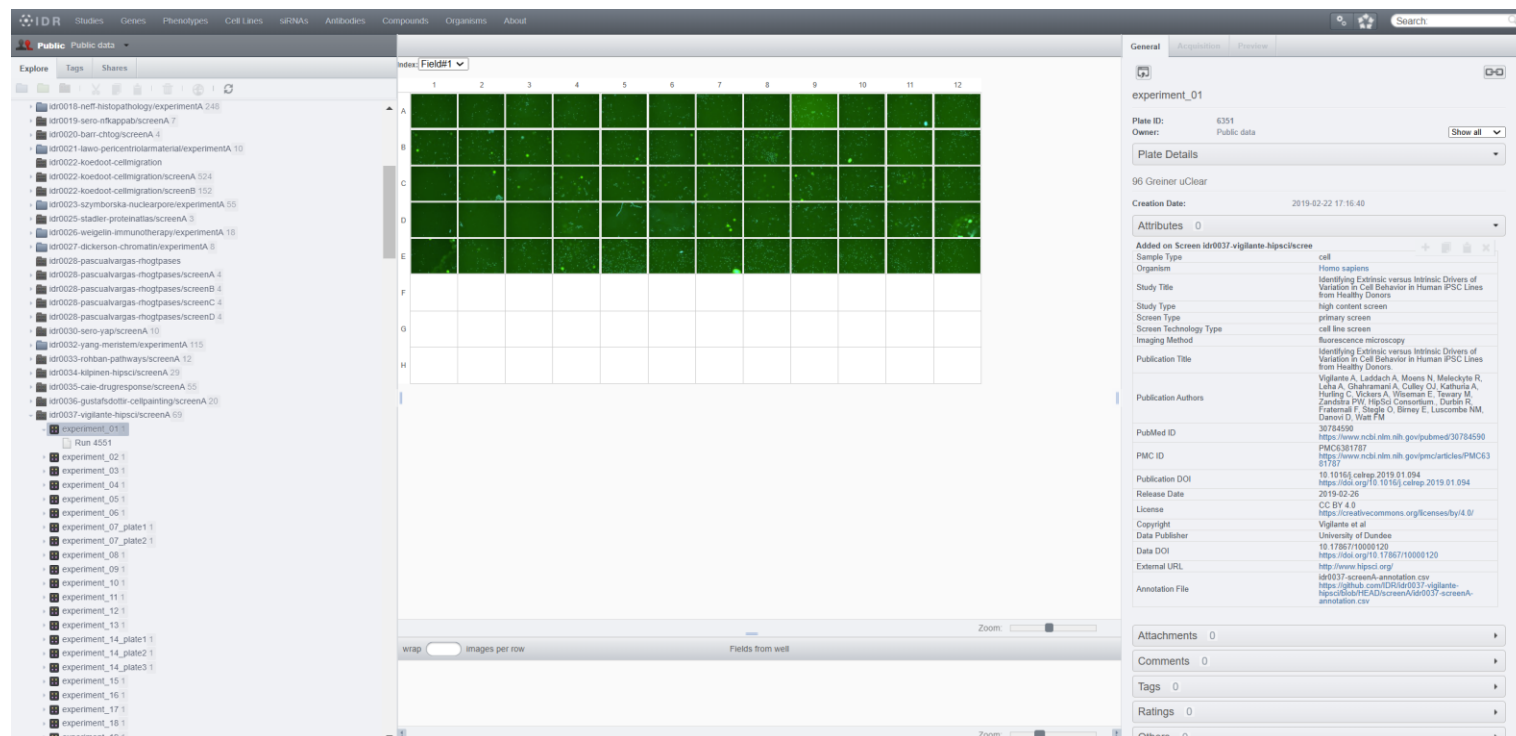
## Type of data:

- curated datasets that will be valuable to broad scientific audience, cell- and tissue-centric

## Metadata requirements:

- moderate mandatory metadata requirements

## Example of a data publication

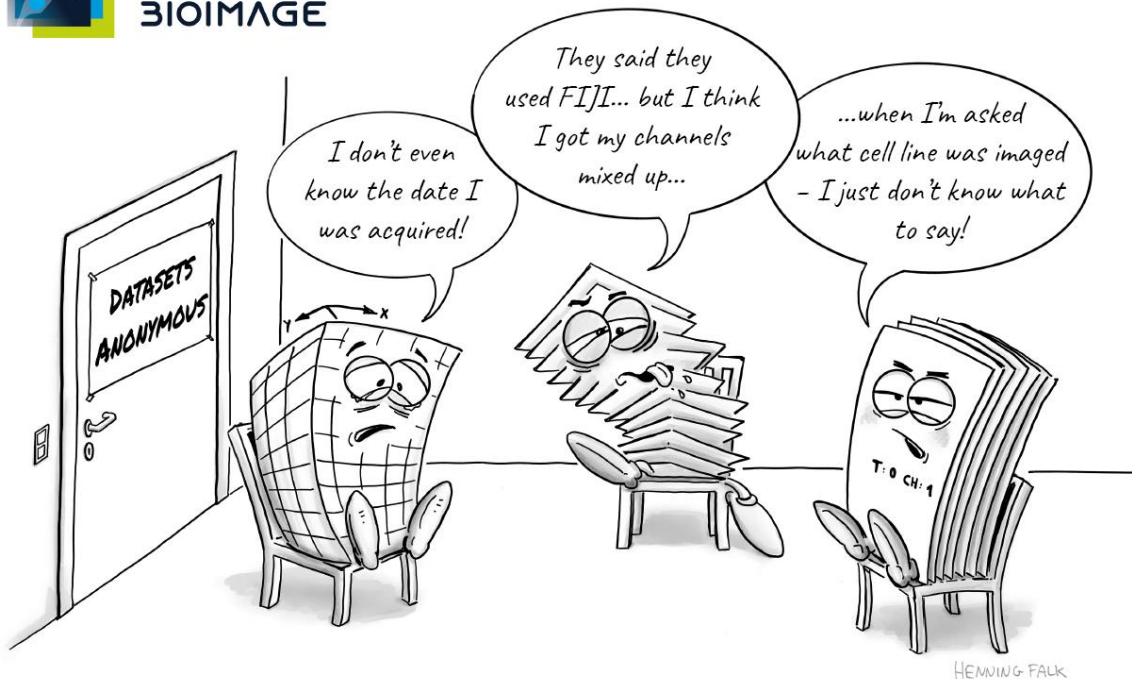


<https://idr.openmicroscopy.org/webclient/?show=screen-2051>



**What do you know about  
metadata standards for  
bioimaging?**

# Metadata – data about data



**DATA ANNOTATION MATTERS.**

Two types of metadata:

- technical metadata – stored with the image
- biological metadata – needs to be annotated

Adequate data management tool like OMERO will give access to both:

- automatic read-out of technical metadata (via BIO-FORMATS plugin)
- using key-value pairs for biological metadata annotation by hand or via scripts

➤ Bonus: depositing data to a repository will be less effort



Metadata annotation depends on the discipline or data repository

- IDR has same layout as OMERO
- BIA metadata schema is based on REMBI

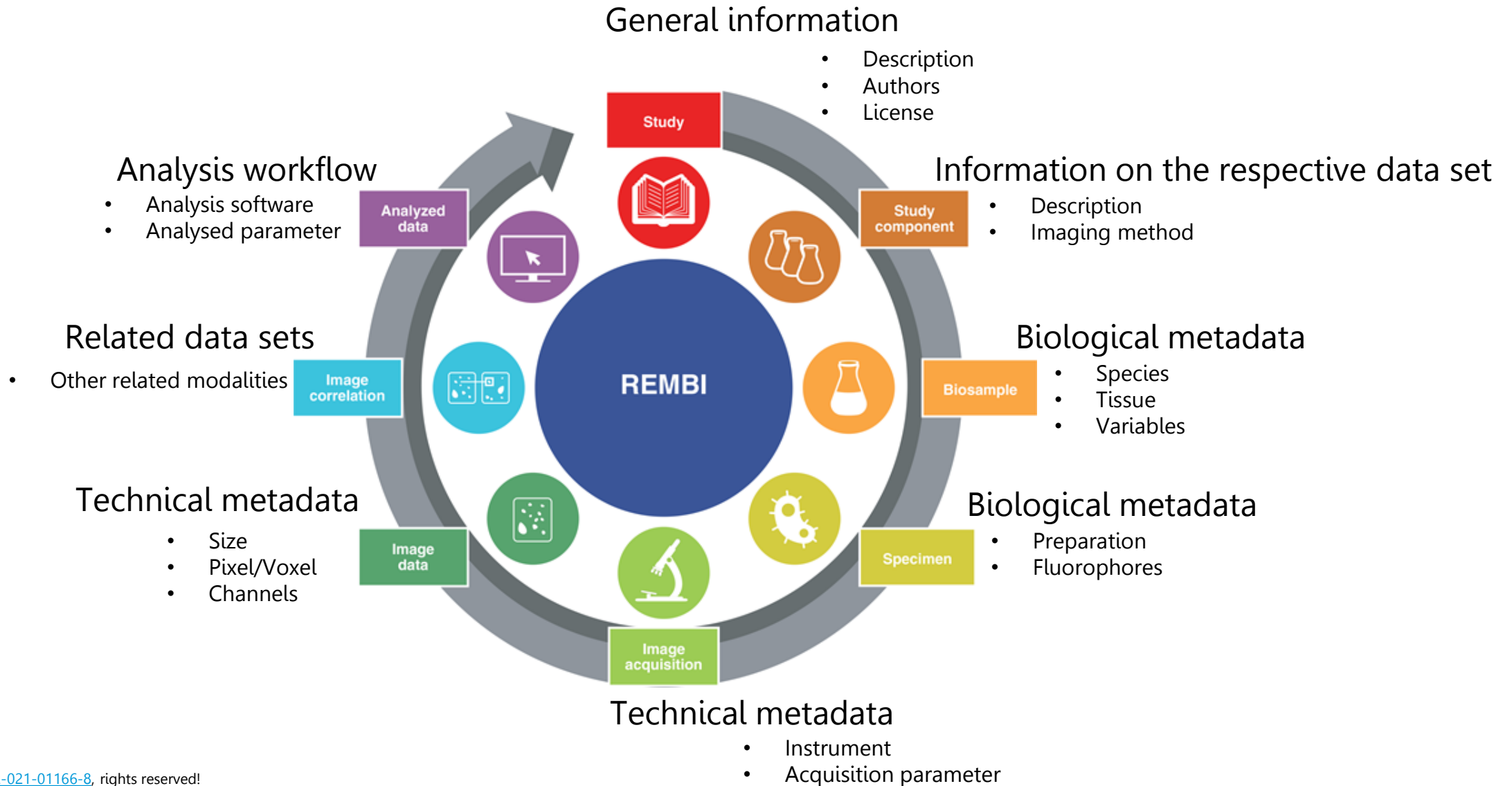
## Recommended Metadata for Biological Images (REMBI)

- is a widely used collection of metadata
- provides examples to look up
- recommends ontology databases

➤ REMBI is used as a metadata guideline for biological images, but not set in stone!

Module	Attribute	Comments	Data entry method	Relevant existing standards and ontologies
<b>Study</b> <i>(contains 1 or more)</i>	Study type	Type of the overall study, which may include	text, ontology	EDAM-BIOIMAGING, FBbi, EFO, IDR
	Study description	Study description, e.g., title of published paper	text	
	General dataset info	Authors, publications, licenses etc	misc.	Dublin Core, DataCite Metadata,
<b>Study component</b> <i>(contains Image data)</i>	Imaging method	Technique used to acquire image data	ontology	EDAM-BIOIMAGING, FBbi, OME
	Study component description	Description specific to this image dataset	text	IDR
<b>Biosample</b>	Identity	Internal unique ID		
	Biological entity	What is being imaged	text and/or ontology entry (multiple possible)	EFO
	Organism	Species (multiple possible)	taxonomy	NCBI Taxonomy
	Intrinsic variable	Intrinsic (e.g. genetic) alteration if applicable	text and/or ontology entry (multiple possible)	EFO
	Extrinsic variable	External biosample treatment (e.g. reagent) if applicable	text and/or ontology entry (multiple possible) or associated file	EFO, IDR
	Experimental variables	What is intentionally varied (e.g. time) between multiple entries in this study component	text and/or ontology entry (multiple possible)	EFO
<b>Specimen</b> <i>(linked to Biosample)</i>	Experimental status	Test/ control		OME
	Location within Biosample	Plate/dish coordinate or tissue location	text, file, ontology, or widget for specific method types	EDAM-BIOIMAGING, FBbi
	Preparation method	Sample preparation protocol		
	Signal/contrast mechanism	How is the signal generated by this sample	text, ontology	EDAM-BIOIMAGING, FBbi
	Channel - content	Specific specimen staining (e.g. IEM, DAB)	text	EFO
	Channel - biological entity	What molecule is stained	text, ontology entries	
<b>Image acquisition</b> <i>(linked to Specimen)</i>	Instrument attributes	Details about instruments used	text, file, ontology, or widget for specific instrument types	EDAM-BIOIMAGING, FBbi, OME, 4DN-BINA-OME
	Image acquisition parameters	Image acquisition details	text, file, ontology, or widget for specific acquisition method types	EDAM-BIOIMAGING, OME, 4DN-BINA-OME
<b>Image data</b> <i>(result of Image acquisition, or processing of Image data)</i>	Type	Primary image/processed image/segmentation	pull-down	EDAM-BIOIMAGING
	Format & compression	File type	extract from data if possible	EDAM-BIOIMAGING, OME
	Dimension extents	Volume in pixels: x, y, z, tilts	extract from data if possible	OME
	Size description	Physical size of image volume in x,y,z & units (pull-down), OR magnification	extract from data if possible	OME
	Pixel/voxel size description	Physical size of pixels in x, y, z & units (pull-down)	extract from data if possible	OME
	Channel information	How are individual channels represented in the image	extract from data if possible	OME
	Image processing method	Image registration, other processing applied to this dataset	text, file, ontology, or widget for specific method types	EDAM-BIOIMAGING, FBbi
	Contrast inversion to TEM	Y/N: N if stained features result in brighter (whiter) signal; Y if it looks like a TEM image	pull-down	
	QC info	QC score for uploaded image quality if applicable	text or controlled vocabulary	
<b>Image Correlation</b> <i>(linked to 1 or more Image data)</i>	Spatial and temporal alignment	Method used to correlate images from different modalities (e.g. manual overlay, alignment algorithm etc)	text, ontology	EDAM-BIOIMAGING
	Fiducials used	Features from correlated datasets used for colocalization	text	
	Transformation matrix/ other	Correlation transformations	text, or related project files (e.g. .h5 Amira files)	
	Related images and relationships	Correlated dataset or images	link	
<b>Analysed data</b>	Analysis result type	Numerical analyses, segmentation (non-image), categorical features/phenotypes	text, ontology	EDAM-BIOIMAGING, OME
	Data used for analysis	Specific feature set used for analysis (e.g. volume measurements, locations of features)	text or file(s)	
	Analysis method and details	Analysis method	text, file, ontology, or pointer to Methods section	EDAM-BIOIMAGING

# Modules of REMBI



# What annotation can look like in OMERO

OMERO Data History Help Figure Key-Value Tag Search Admin

CAI-Modul\_WSe\_24-25

Explore Tags Shares

All Members

- Day3\_Processed 2
- Grp1\_1\_Protein-localization 6
  - 2024-10-23\_Grp1\_IIF\_day1 1
    - 2024-10-23\_LSM780\_Grp1\_640Vimentin\_568Tom20\_488Phalloidin\_405DAPI\_01\_De
  - 2024-10-24\_Grp1\_IIF\_day2\_B 5
  - 2024-10-24\_Grp1\_IIF\_day2\_BC 5
  - 2024-10-25\_Grp1\_transient\_expression\_CLV2-GFP 4
  - 2024-10-25\_Grp1\_transient\_expression\_CLV2-GFP\_CRN-mCherry 4
  - 2024-10-25\_Grp1\_transient\_expression\_CRN-mCherry 5
- Grp1\_2\_Super-resolution 6
- Grp1\_3\_Unknown-sample 13
- Grp1\_4\_FRAP 3
- Grp1\_5\_FRET-APB 3
- Grp1\_6\_FRET-FLIM 2
- Grp1\_7\_TEM 2
- Grp1\_8\_SEM 2
- Grp2\_1\_Protein-localization 6
- Grp2\_2\_Super-resolution 6
- Grp2\_3\_Unknown-sample 7
- Grp2\_4\_FRAP 3
- Grp2\_5\_FRET-APB 3
- Grp2\_6\_FLIM 4
- Grp2\_7\_SEM 1
- Grp2\_8\_TEM 3
- Grp3\_1.1\_Protein-localization 6
- Grp3\_1.2\_STED 5
- Grp3\_1.3\_Airyscan 3
- Grp3\_2\_Unknown-sample 5
- Grp3\_3\_FRAP 3

Add filter

2024-10-23\_LSM780\_Grp1\_640Vimentin\_568Tom20\_488Phalloidin\_405DAPI\_01\_De

Study description

This study aimed to analyze protein localization in mammalian and plant cells using confocal fluorescence microscopy

Study type

Protein localization, Indirect Immunofluorescence, confocal laser scanning microscopy

Study type term accession number (Protein localization)

[http://purl.obolibrary.org/obo/GO\\_0008104](http://purl.obolibrary.org/obo/GO_0008104)

Study type term accession number source REF

Gene Ontology

Study type term accession number (Indirect Immunofluorescence)

[http://purl.obolibrary.org/obo/NCIT\\_C176332](http://purl.obolibrary.org/obo/NCIT_C176332)

Study type term accession number source REF

NCI Thesaurus OBO Edition

Study type term accession number (confocal laser scanning microscopy)

[http://purl.obolibrary.org/obo/CHMO\\_0000089](http://purl.obolibrary.org/obo/CHMO_0000089)

Study type term accession number source REF

Chemical Methods Ontology

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CC BY Miriam Bäumers, Sebastian Hänsch

Imaging method

Confocal Laser Scanning Microscopy

Imaging method term accession number

[http://purl.obolibrary.org/obo/CHMO\\_0000089](http://purl.obolibrary.org/obo/CHMO_0000089)

Imaging method term accession number source REF

Chemical Methods Ontology

Study component description

This study aimed to analyze the varying protein localizations in human HeP2 cells, a cell line derived from a tumor specimen obtained from a patient with laryngeal carcinoma. Using indirect antibody staining and fluorescent dyes, cellular components were highlighted. These components were then visualized using confocal fluorescence microscopy, specifically with an LSM780 system. It additionally serves as a introduction to microscopy process and relevant programmes via an example picture

Organism

Homo sapiens

Organism term accession number

[http://purl.obolibrary.org/obo/NCBITaxon\\_9606](http://purl.obolibrary.org/obo/NCBITaxon_9606)

Organism term accession number source REF

NCBI organismal classification

Biological entity

HEP-2 cell

Biological entity term accession number

[http://purl.obolibrary.org/obo/BTO\\_0000976](http://purl.obolibrary.org/obo/BTO_0000976)

Biological entity term accession number source REF

The BRENDA Tissue Ontology

Preparation method

Indirect Immunofluorescence: Fixation with 4% para-Formaldehyde + 0.01% Triton in 1x PBS (10 min) Wash 3x with 1x PBS Permeabilization with 0.2 % Triton X-100 in 1x PBS (10 min) Wash 3x with 1x PBS Incubate with primary antibody mix (45 min, 100µl AB-mix per glass) Wash with 1x PBS (3x 5 min) Incubate with secondary (fluorescent) antibody mix and Phalloidins (45 min 100µl AB-mix per glass) ) Wash with 1x PBS (3x 5 min) Incubate with DAPI (10 min One sample with, one without) Wash with 1x PBS (3x 5 min) Mount on a slide with ProLong Diamond Polymerization of mounting medium at RT over night

Signal/contrast mechanism

fluorescent antibody staining, fluorescent dye

Channel 1 - content

StarRED

Channel 1 - biological entity

Vimentin

Channel 2 - content

Alexa568

Channel 2 - biological entity

Tom20

Channel 3 - content

Atto488

Channel 3 - biological entity

Phalloidin (Actin)

Channel 4 - content

DAPI

Channel 4 - biological entity

DNA



# What annotation can look like



<https://www.ebi.ac.uk/biostudies/bioimages/studies/S-BIAD1241>



<https://idr.openmicroscopy.org/webclient/?show=screen-2051>

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<https://nfdi4bioimage.de/about-us/data-stewardship-team/>

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All-hands Meeting NFDI4BIOIMAGE, 06.02.2025, Düsseldorf



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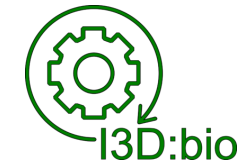
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<https://nfdi4bioimage.de/help-desk>

<https://nfdi4bioimage.de/about-us/data-stewardship-team/>

I3D:bio

<https://gerbi-gmb.de/i3dbio/>



## NFDI4BIOIMAGE partners

I3D:bio partners

GerBI-GMB community

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