

ARCify your research project

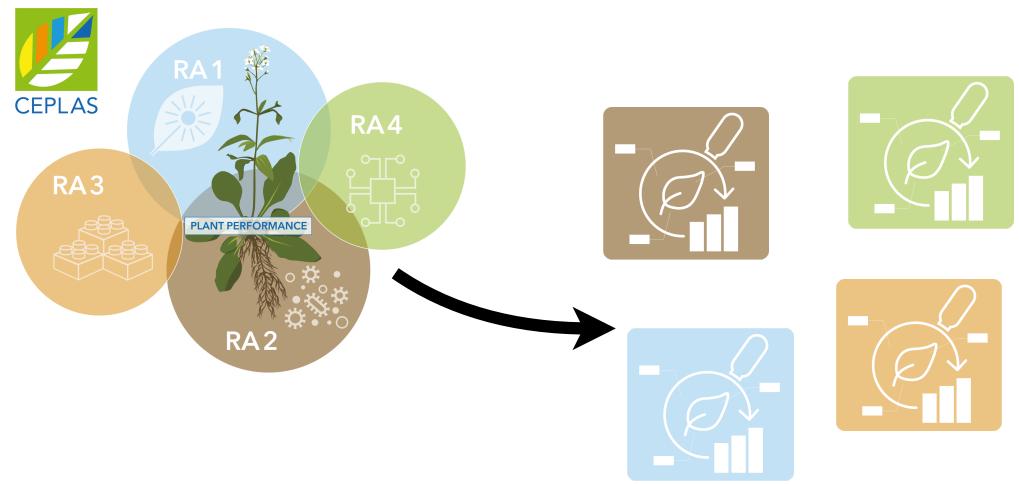
February 11th, 2025

Sabrina Zander, MibiNet

Dominik Brilhaus, CEPLAS

Goals

- First few steps into ARC ecosystem
- Move existing datasets into ARCs
- Share them via the DataHUB
- Annotate with metadata



House-keeping

- Use the pad to raise questions and feedback
- Copy / paste links (hands-on)



Training Materials

Slides are shared via [DataPLANT Training Material](#)

Resources – join the open source movement



DataPLANT (nfdi4plants)

DataPLANT Website: <https://nfdi4plants.org/>

Knowledge Base: <https://nfdi4plants.org/nfdi4plants.knowledgebase/>

DataHUB: <https://git.nfdi4plants.org>

GitHub: <https://github.com/nfdi4plants>

HelpDesk: <https://helpdesk.nfdi4plants.org>

You can help us by raising issues, bugs, ideas...

NEW! ARC website: <https://arc-rdm.org>

Continuous support

Data managers in Düsseldorf, Cologne, Jülich and close by (CEPLAS, MibiNet, TRR341) offer support.

- Join our [Slack](#) or [Matrix](#) for ad hoc support
- Monthly [user support meeting](#) (2nd Friday of the month)



trr_341



MibiNet

Introduce yourself

- Lab
- MibiNet / CEPLAS / TRR / ?
- Used code / programming language before
- Experience with Git / GitLab / GitHub?
- Have an ORCID
- My motivation / expectation
- My favorite lab assay

Let's draw a typical lab workflow



FAIR data stewardship

- Findable
- Accessible
- Interoperable
- Reusable

<https://doi.org/10.1038/sdata.2016.18>

[nature](#) > [scientific data](#) > [comment](#) > [article](#)

[Open Access](#) | [Published: 15 March 2016](#)

The FAIR Guiding Principles for scientific data management and stewardship

[Mark D. Wilkinson](#), [Michel Dumontier](#), [IJsbrand Jan Aalbersberg](#), [Gabrielle Appleton](#), [Myles Axton](#), [Arie Baak](#), [Niklas Blomberg](#), [Jan-Willem Boiten](#), [Luiz Bonino da Silva Santos](#), [Philip E. Bourne](#), [Jildau Bouwman](#), [Anthony J. Brookes](#), [Tim Clark](#), [Mercè Crosas](#), [Ingrid Dillo](#), [Olivier Dumon](#), [Scott Edmunds](#), [Chris T. Evelo](#), [Richard Finkers](#), [Alejandra Gonzalez-Beltran](#), [Alasdair J.G. Gray](#), [Paul Groth](#), [Carole Goble](#), [Jeffrey S. Grethe](#), [Jaap Heringa](#), [Peter A.C. 't Hoen](#), [Rob Hooft](#), [Tobias Kuhn](#), [Ruben Kok](#), [Joost Kok](#), [Scott J. Lusher](#), [Maryann E. Martone](#), [Albert Mons](#), [Abel L. Packer](#), [Bengt Persson](#), [Philippe Rocca-Serra](#), [Marco Roos](#), [Rene van Schaik](#), [Susanna-Assunta Sansone](#), [Erik Schultes](#), [Thierry Sengstag](#), [Ted Slater](#), [George Strawn](#), [Morris A. Swertz](#), [Mark Thompson](#), [Johan van der Lei](#), [Erik van Mulligen](#), [Jan Velterop](#), [Andra Waagmeester](#), [Peter Wittenburg](#), [Katherine Wolstencroft](#), [Jun Zhao](#) & [Barend Mons](#) 

— Show fewer authors

[Scientific Data](#) 3, Article number: 160018 (2016) | [Cite this article](#)

The FAIR principles

<p>Findable Accessible Interoperable Reusable</p>	<p>Easier collaboration & sharing</p> <pre>graph TD; A(()) --> B(()); A(()) --> C(()); A(()) --> D(()); B(()) --> E(()); C(()) --> E(()); D(()) --> E(());</pre>	<p>Increased findability and visibility</p>	<p>Reproducibility</p>
<p>Added-value to the research community</p> <p>nfdi NCBI EMBL-EBI</p>	<p>Compliance with funding policies</p> <pre>graph LR; A[Checkmark Document] --- B[DFG]; A --- C[EU Flag]</pre>	<p>Receive due credit</p> <pre>graph LR; A[Reuse] --- B[Citations]; A --- C[FAIR]</pre>	<p>Saves time & workload</p> <pre>graph LR; A[FAIR] --- B[Time wasted]</pre>

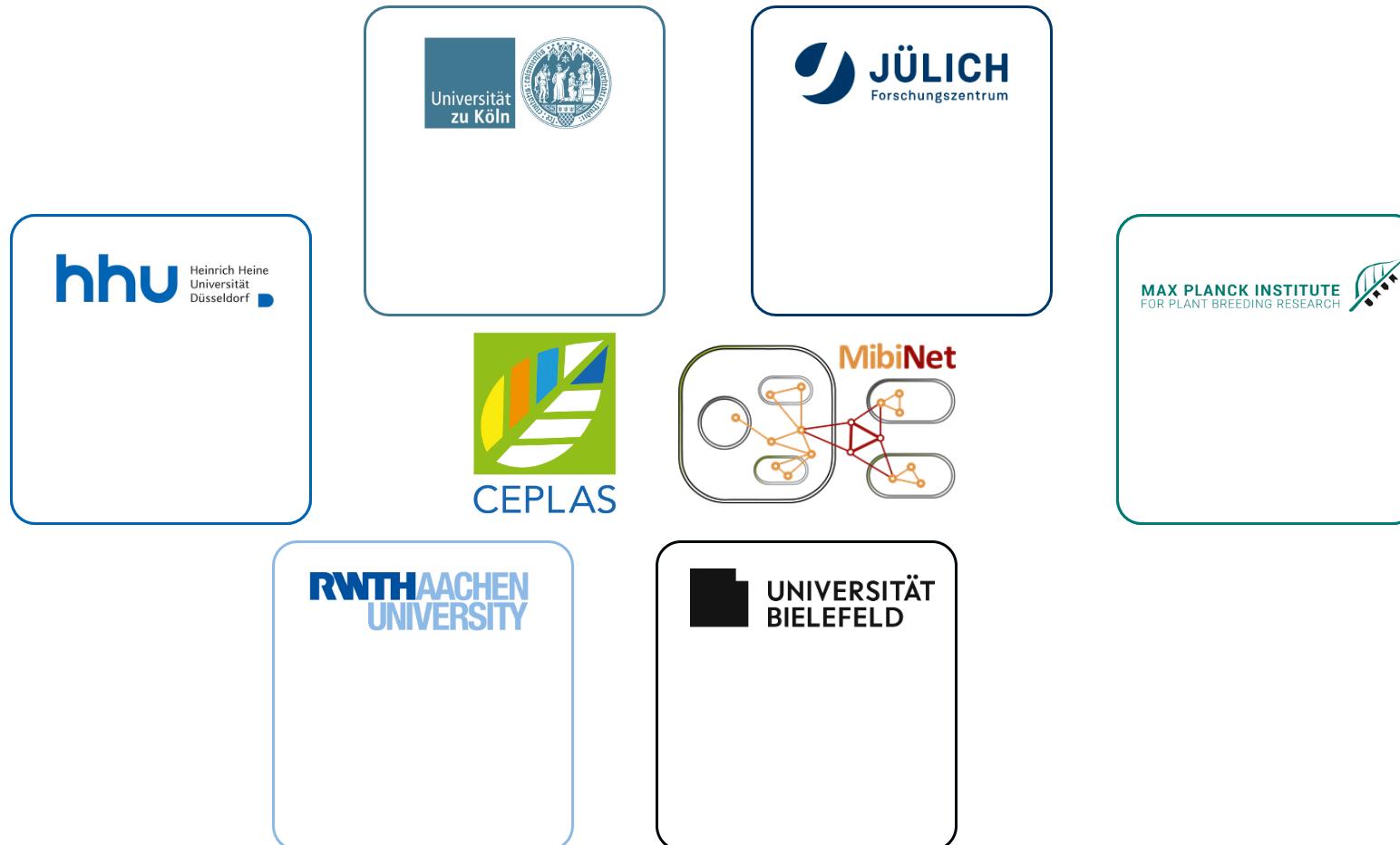
Is your data FAIR?

Findable | Accessible | Interoperable | Reusable

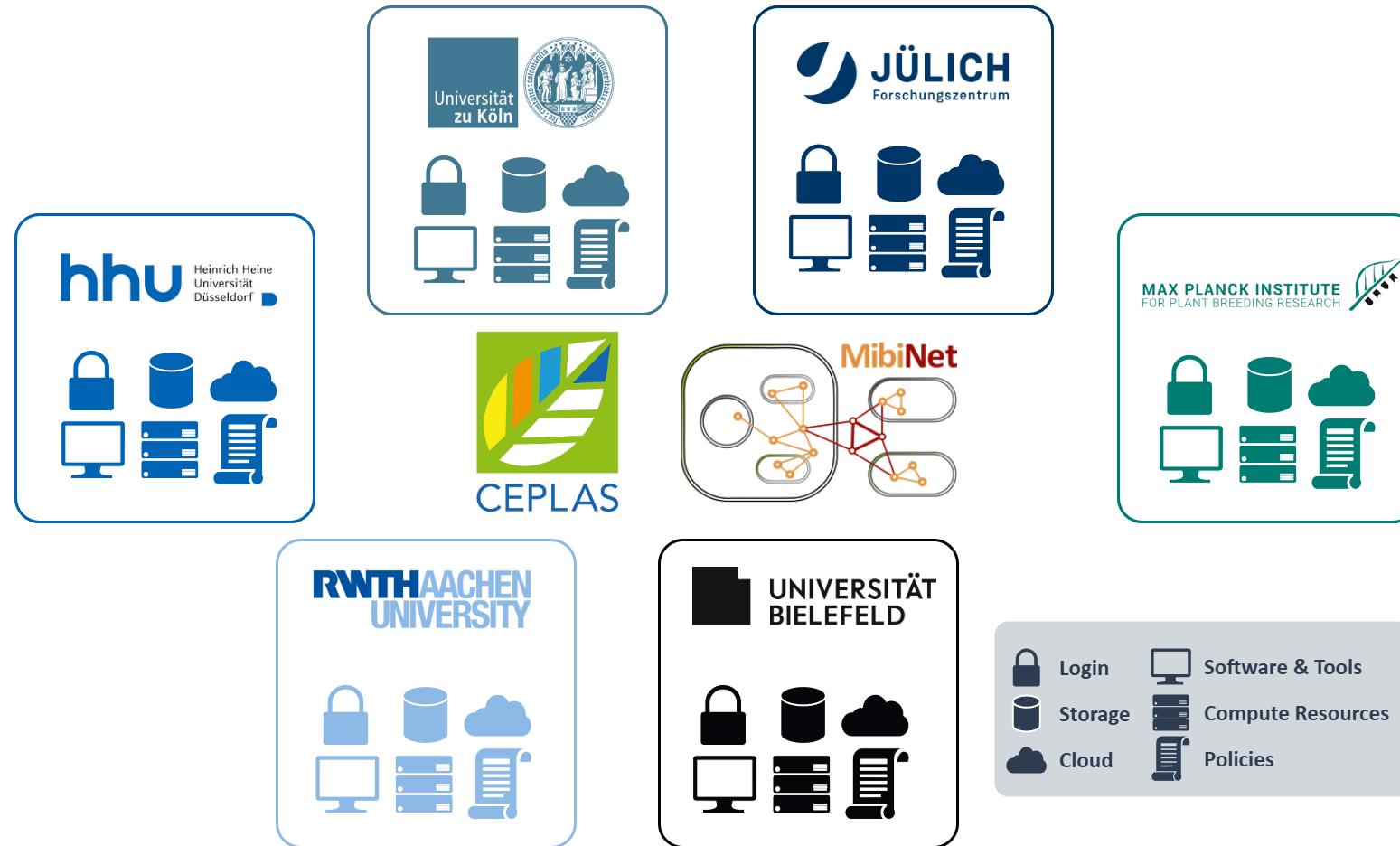
- Where do you store your data?
- How do you annotate your data?
- How do you share your data?
- What tools do you use to analyse your data?
- How do you reuse other people's data?



CEPLAS & MibiNet – Scattered across six locations

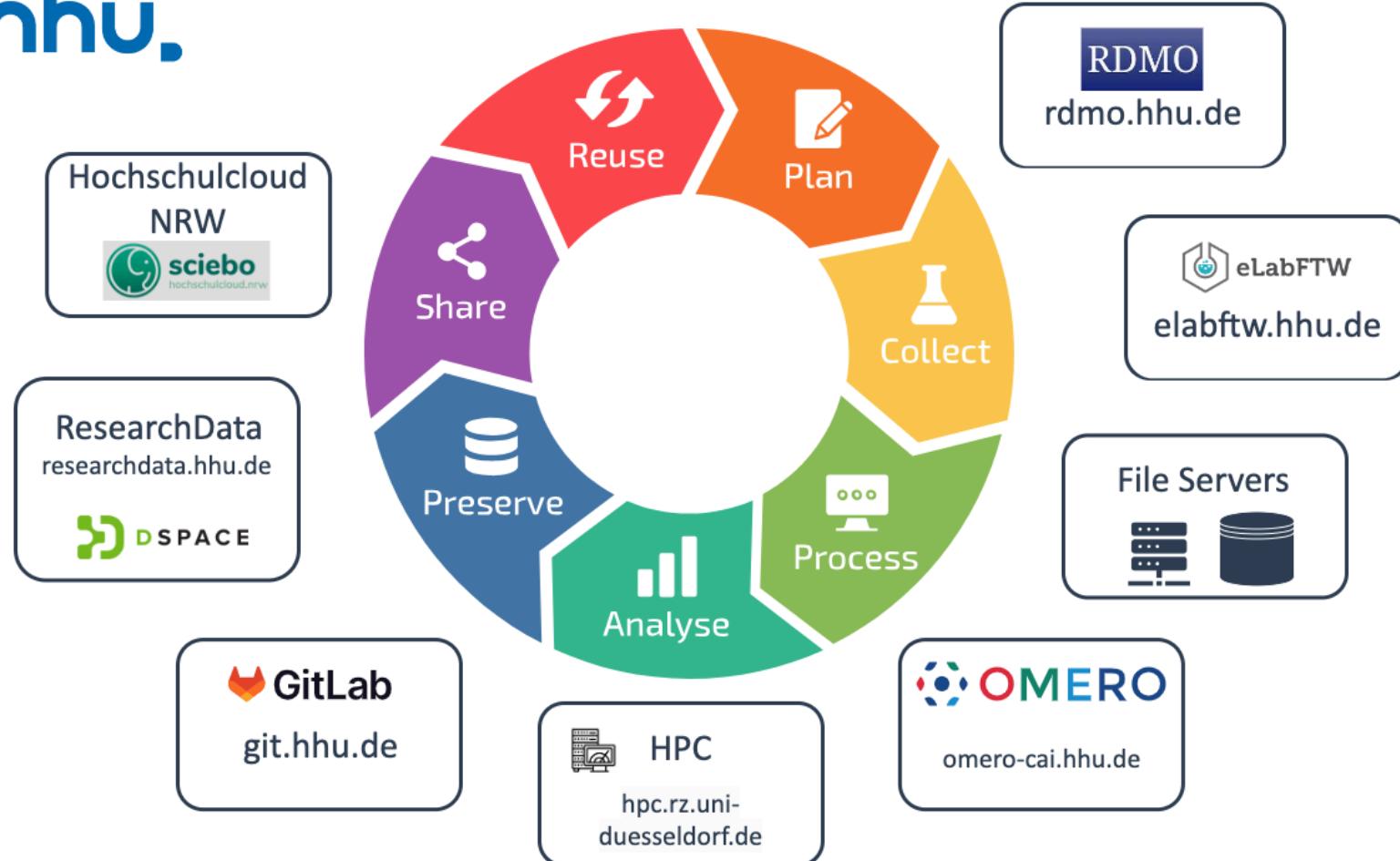


Data silos impede collaboration

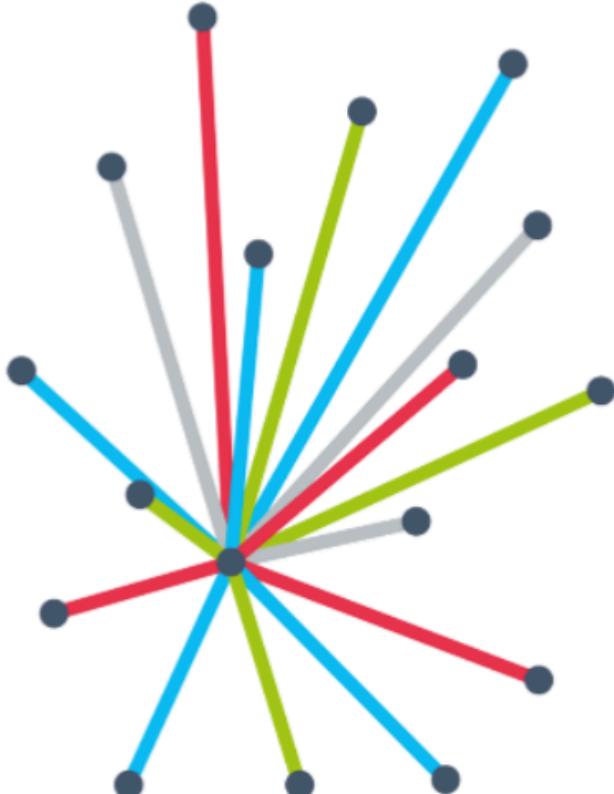


Missing interfaces impede collaboration

hhu.



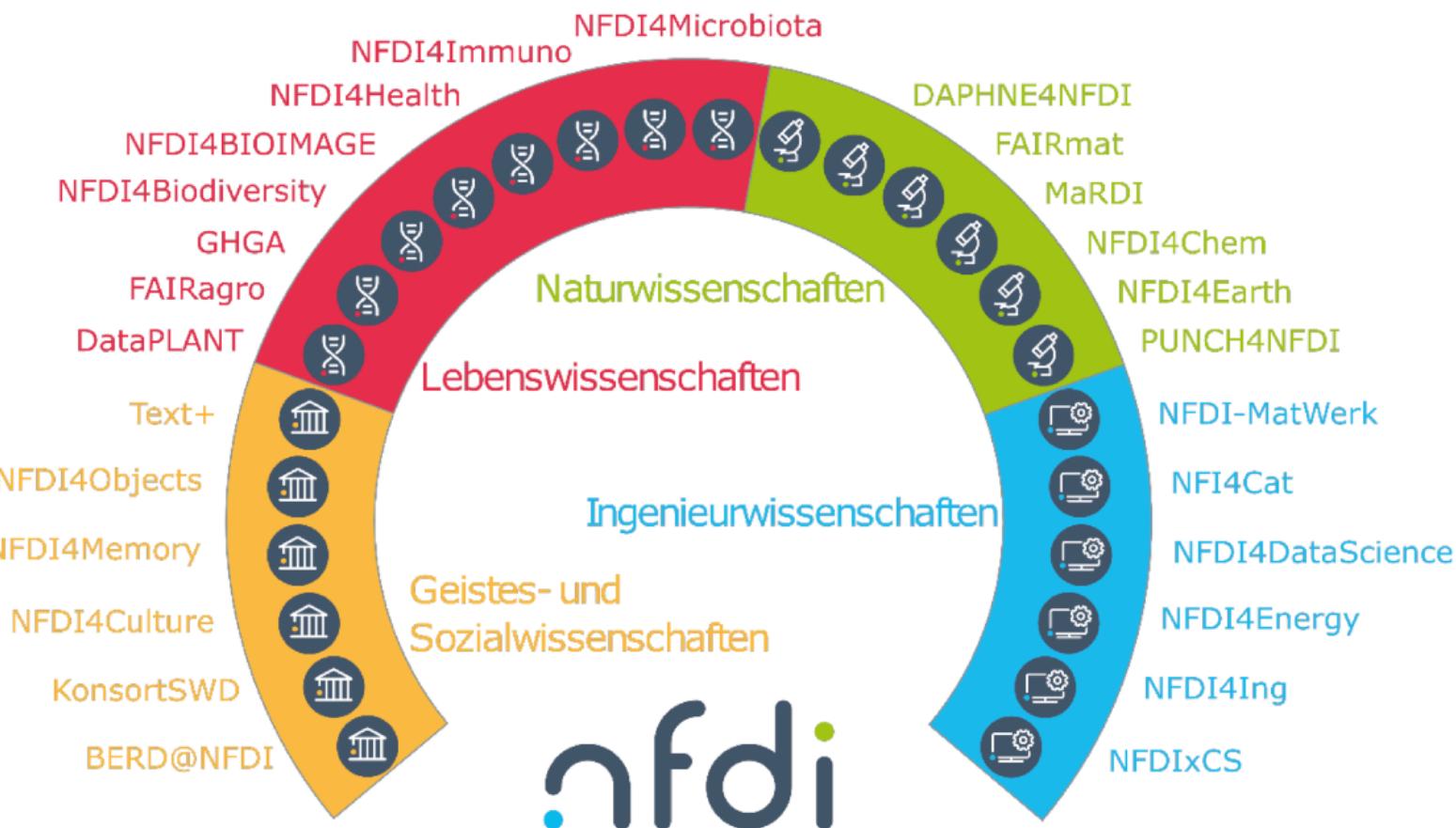
NFDI – Nationale Forschungsdaten Infrastruktur



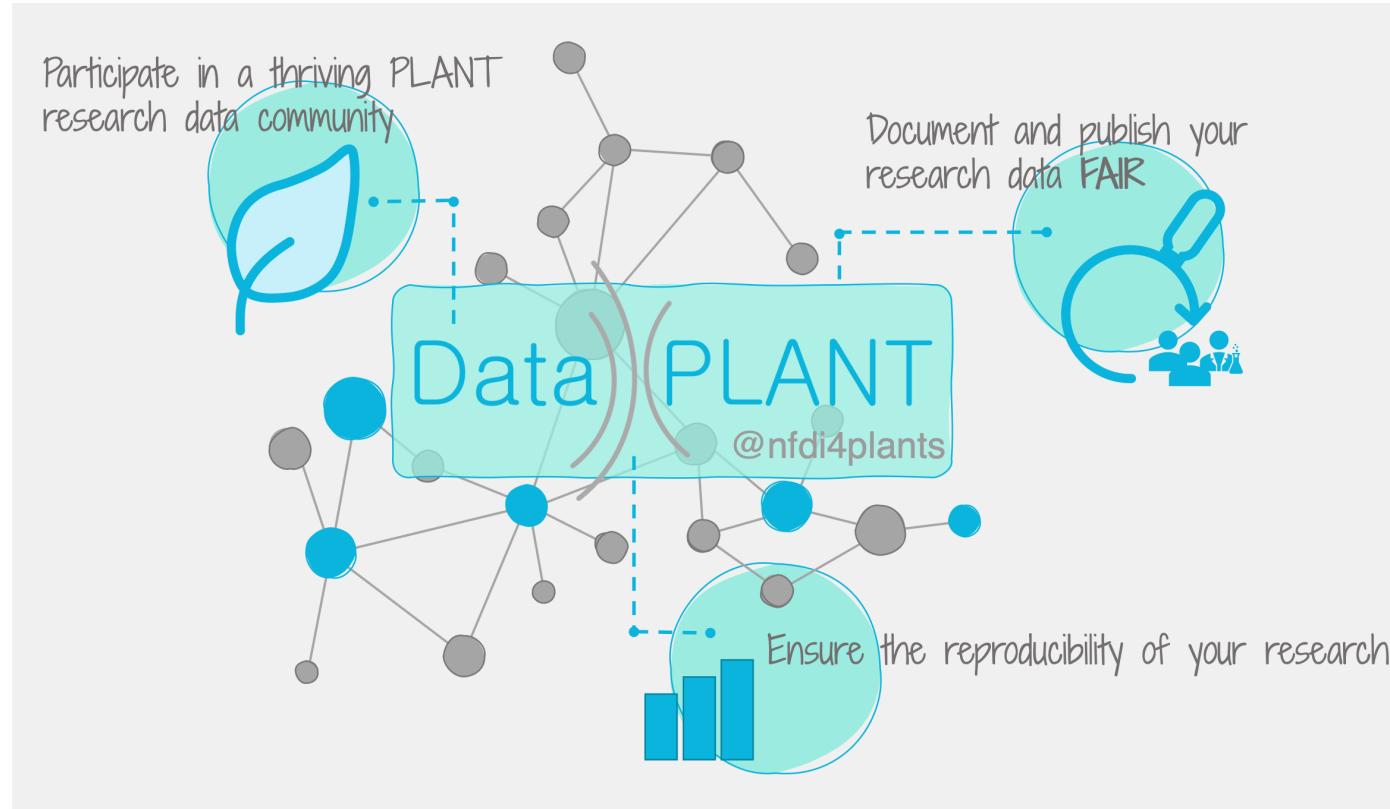
The aim of the national research data infrastructure (NFDI) is to systematically manage scientific and research data, provide long-term data storage, backup and accessibility, and network the data both nationally and internationally.

nfdi.de

NFDI – A community-targeted approach for RDM

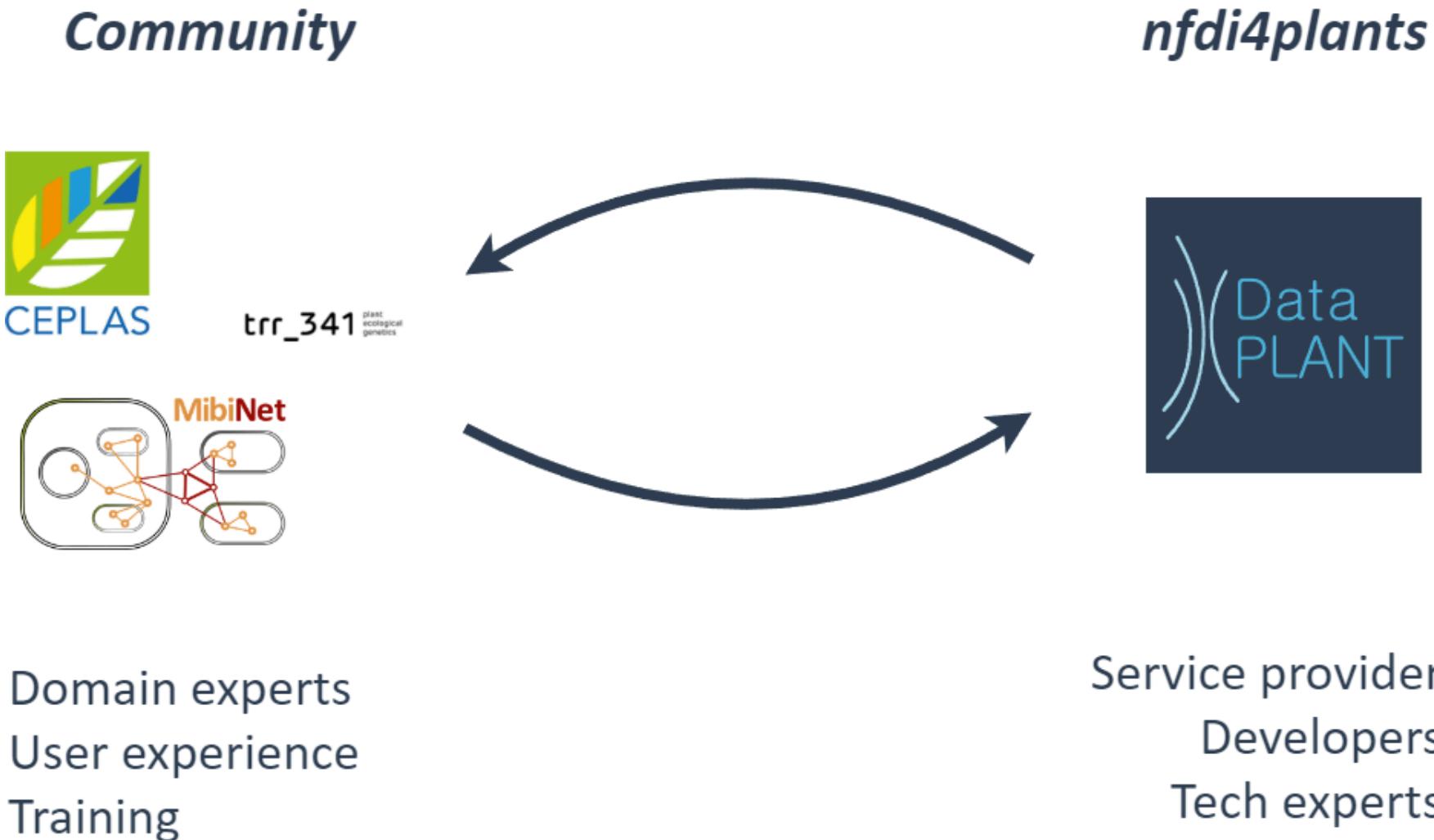


DataPLANT – NFDI4plants

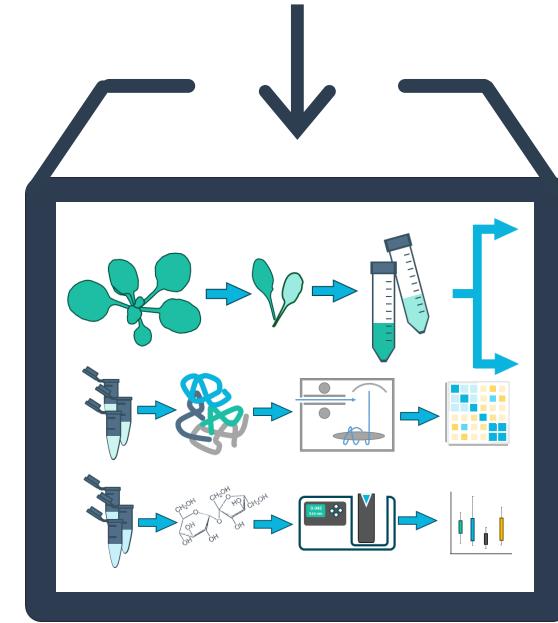
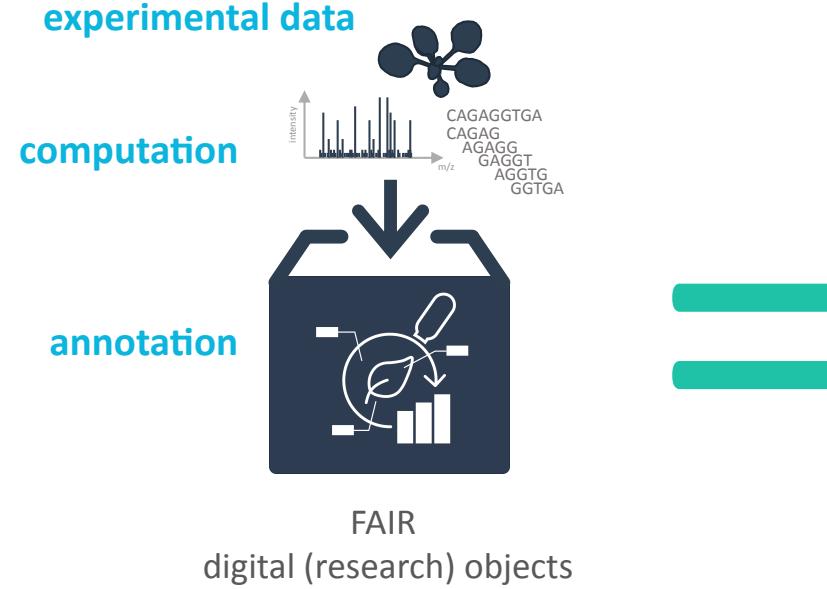


- <https://nfdi4plants.org>
- <https://arc-rdm.org>

Data Stewardship between DataPLANT and the community



Annotated Research Context (ARC)

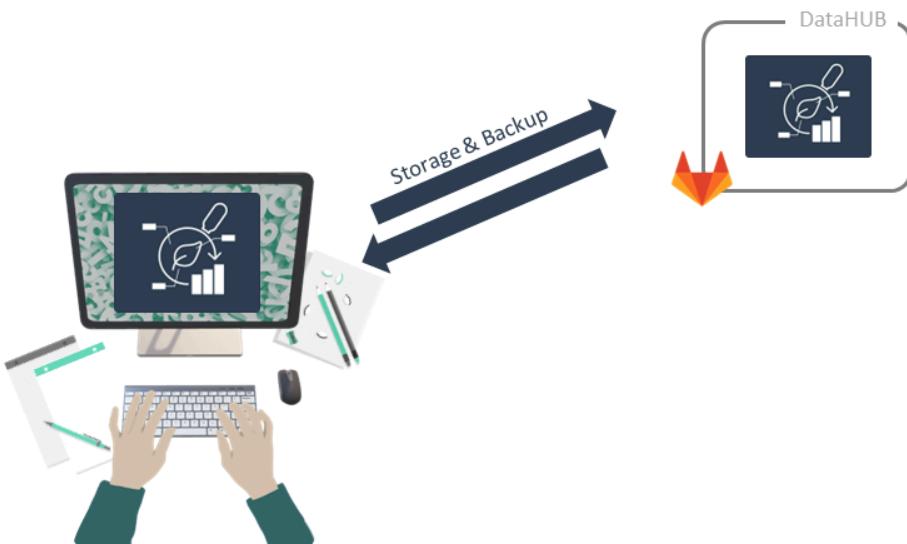


Your entire investigation in a single unified bag

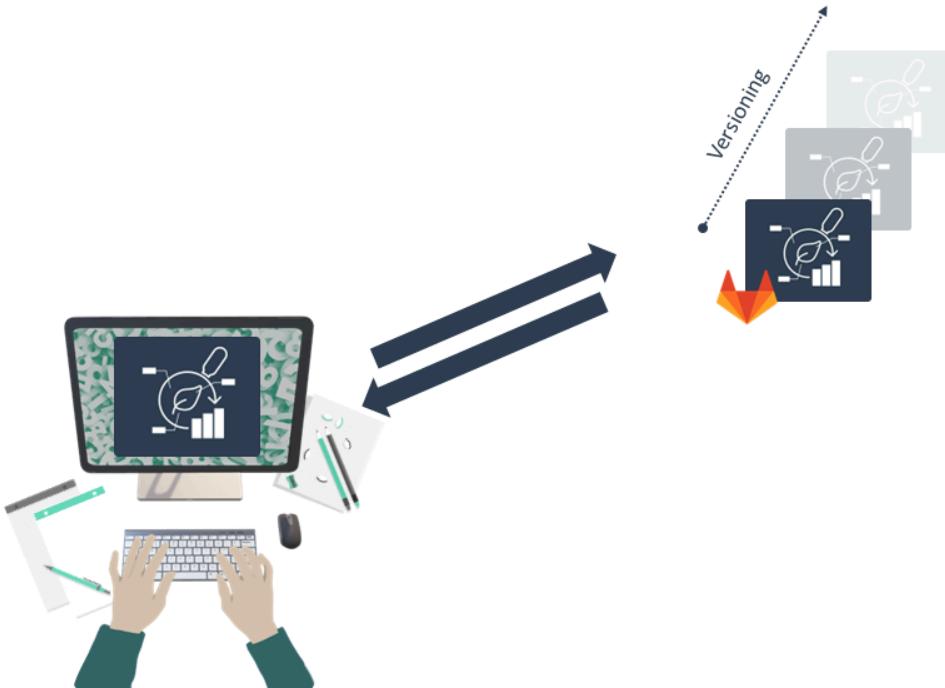
You can store your ARC in the DataHUB



You can store your ARC in the DataHUB



ARCs are versioned



You can invite collaborators



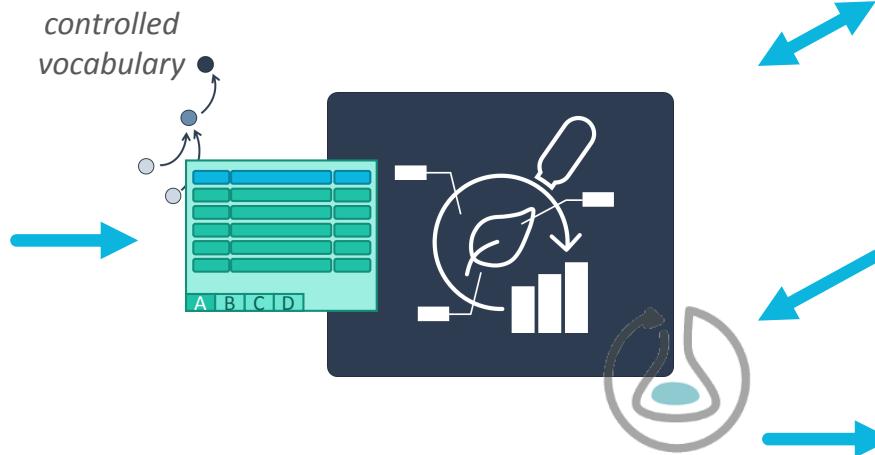
Collaborate and contribute



Reuse data in ARCs



ARC as single-entry point



specialized endpoints

ENA
European Nucleotide Archive

GEO
Gene Expression Omnibus

EBI: MetaboLights

PRIDE Archive
Proteomics Identifications Database

BioImage Archive

dataset search

Google
OpenAIRE

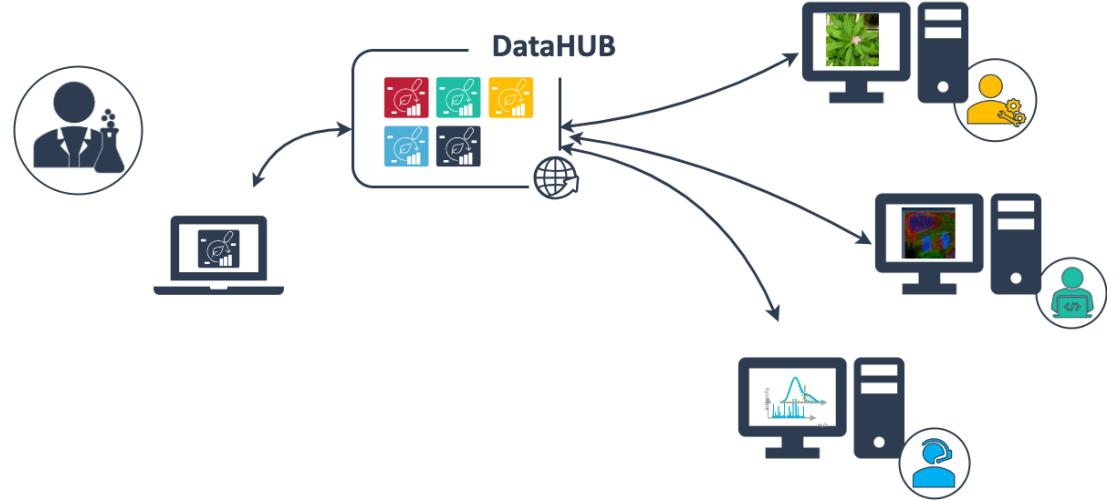
The
Dataverse®
Project

INVENIO

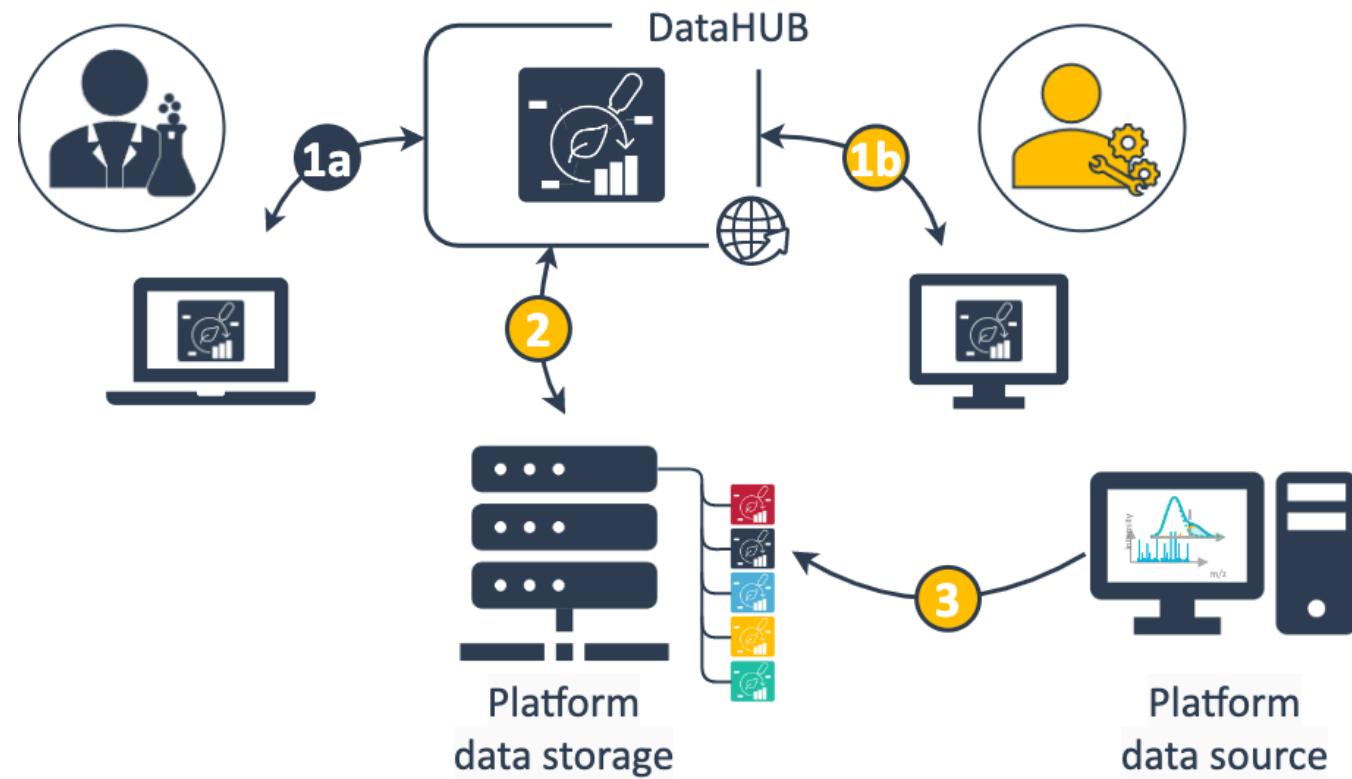
data publication

Enabling platforms

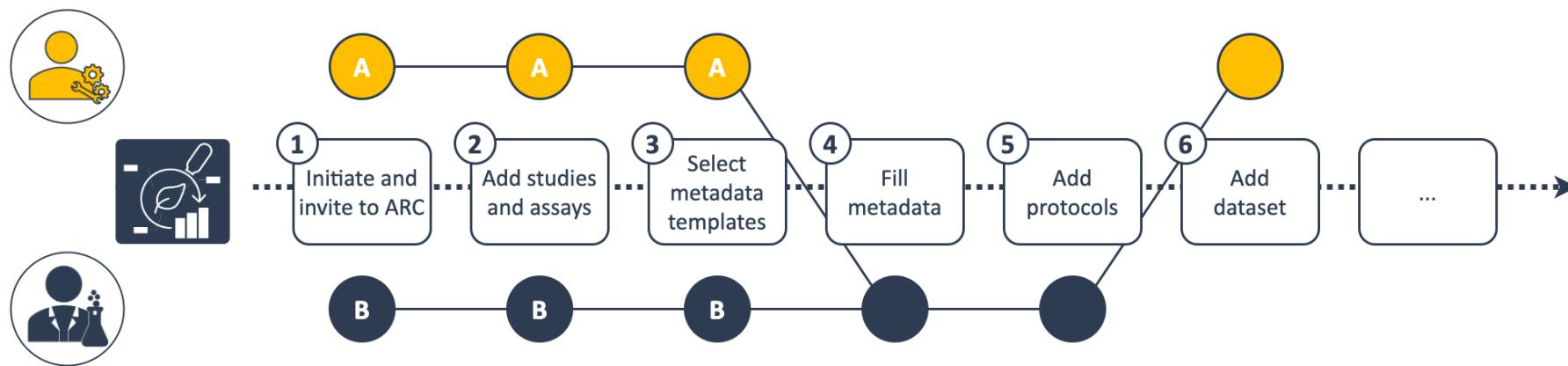
- Streamlined exchange of (meta)data
- Communication and project management



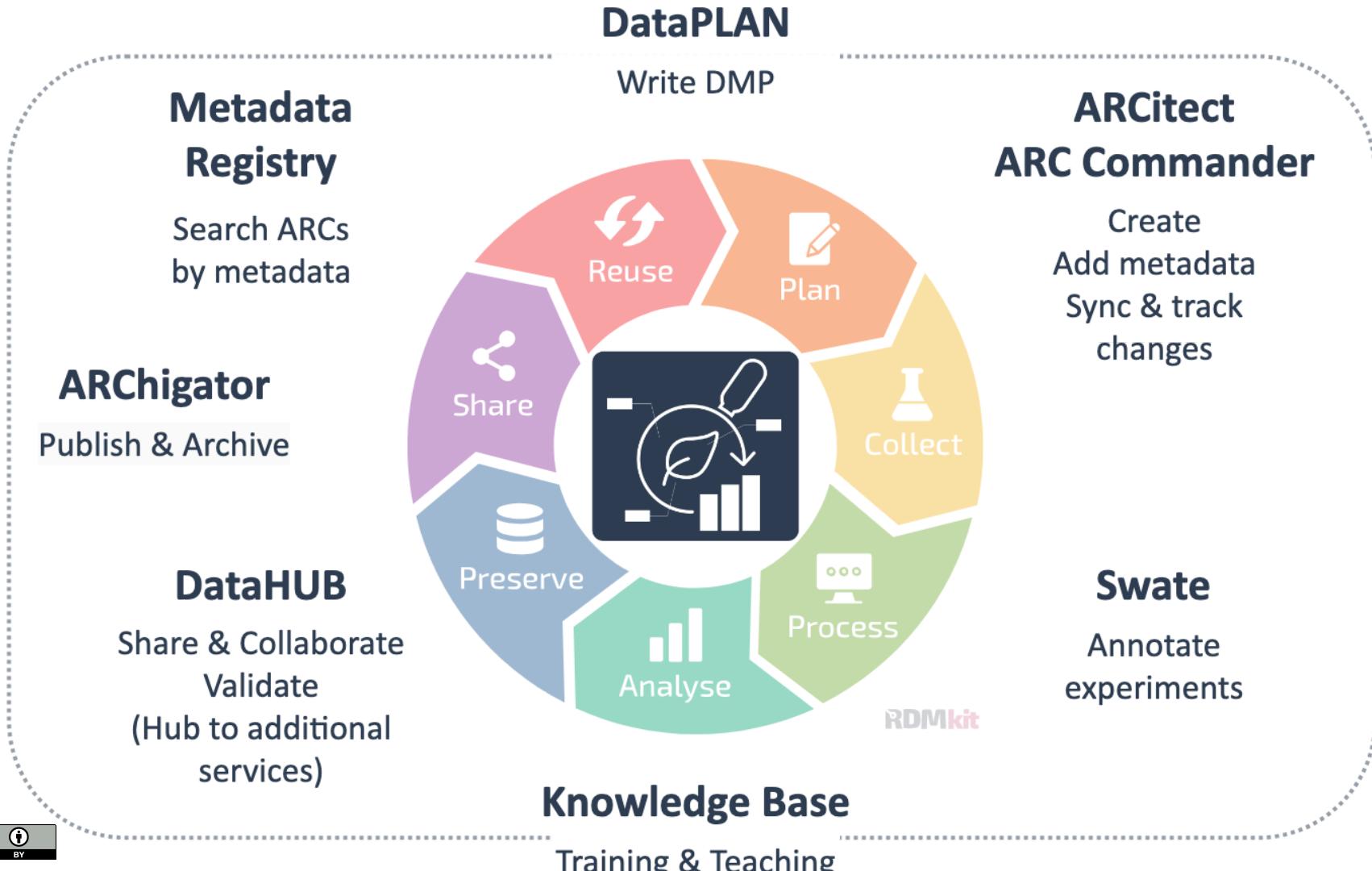
Streamlined data exchange



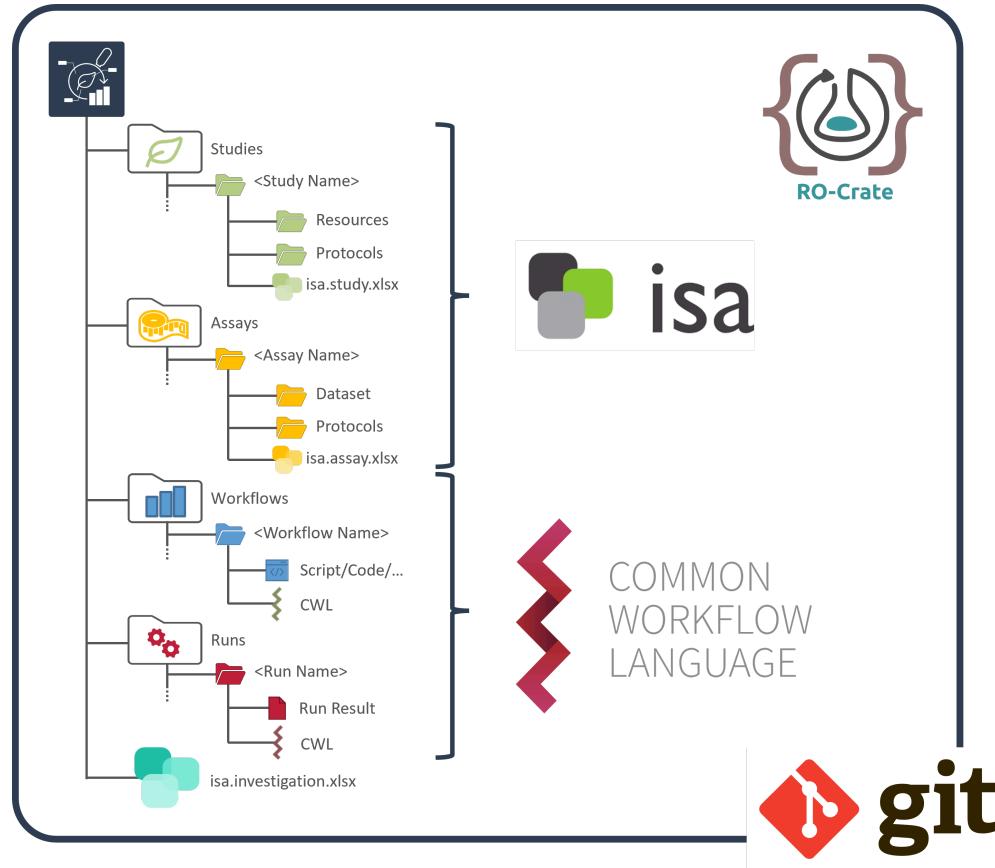
Meet your collaborators in an ARC



The ARC ecosystem



ARC builds on standards



RO-Crate

- standardized exchange
- <https://www.researchobject.org/ro-crate/>

ISA

- structured, machine-readable metadata
- <https://isa-tools.org/>

CWL

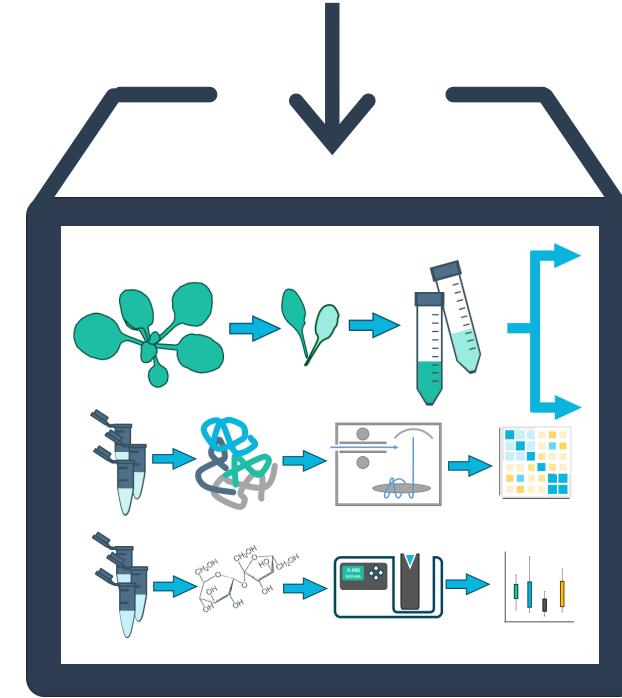
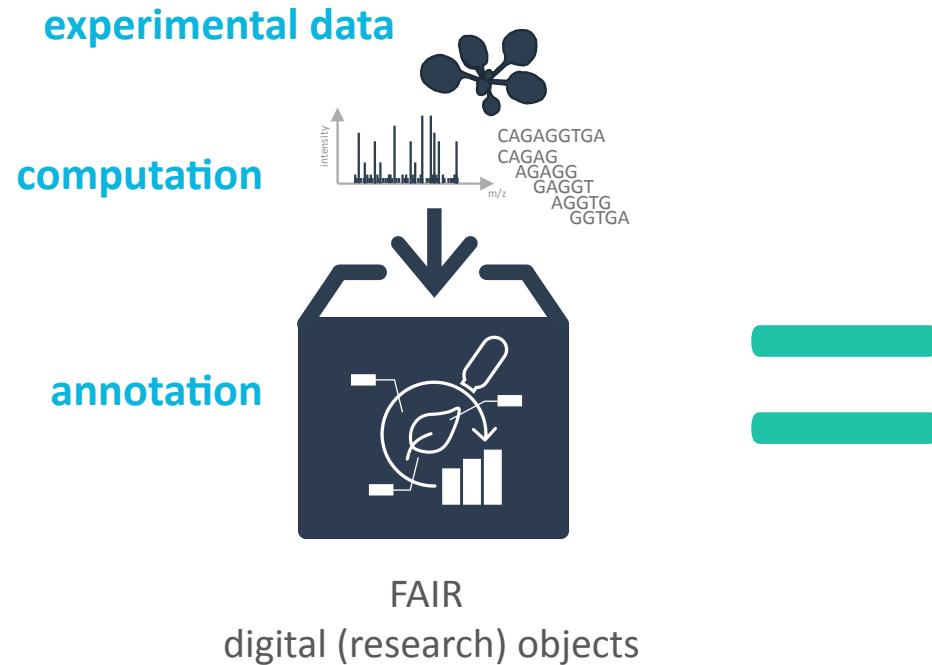
- reproducible, re-usable data analysis
- <https://www.commonwl.org/>

Git

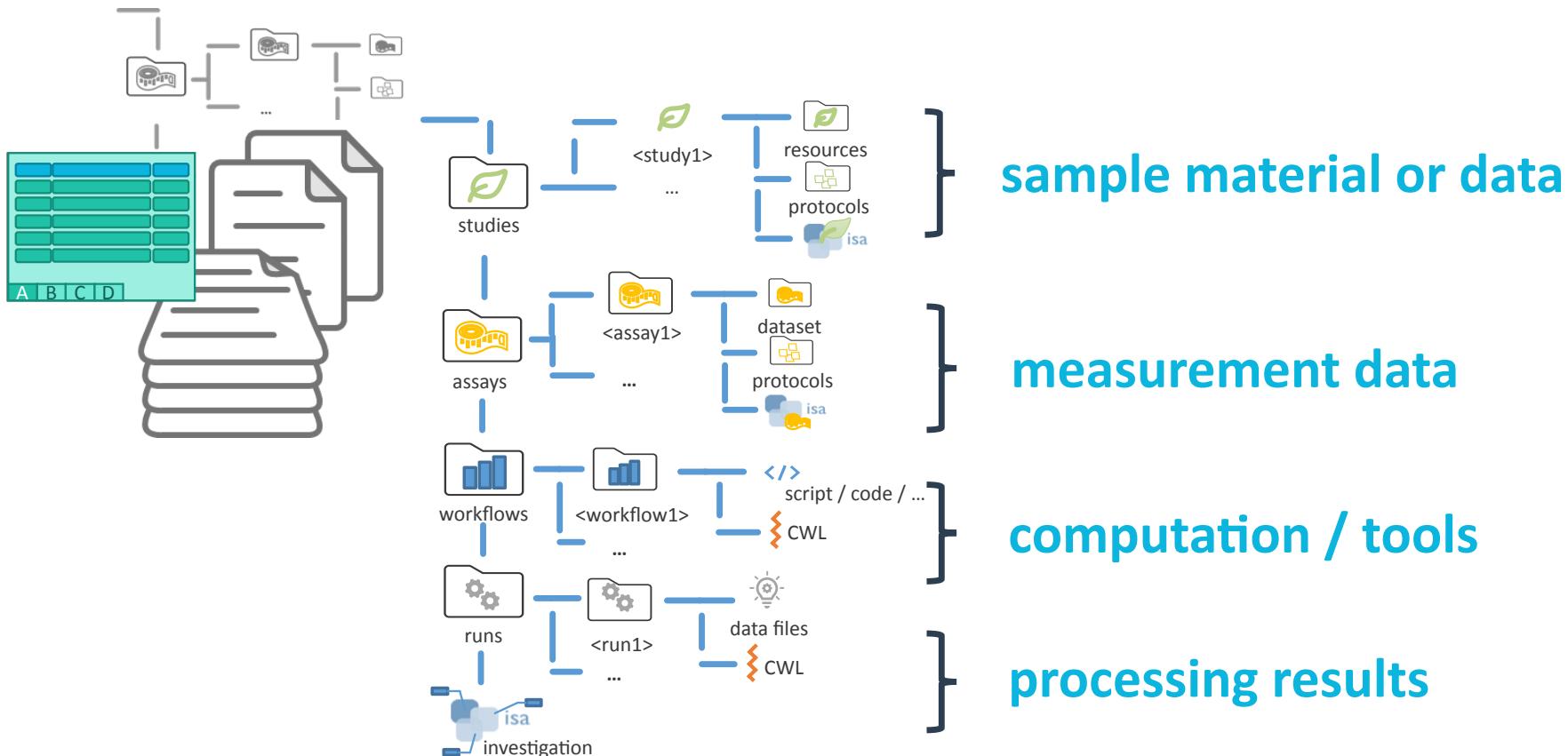
- version control
- <https://git-scm.com>

Hands-on part 1: Setup and ARCitect

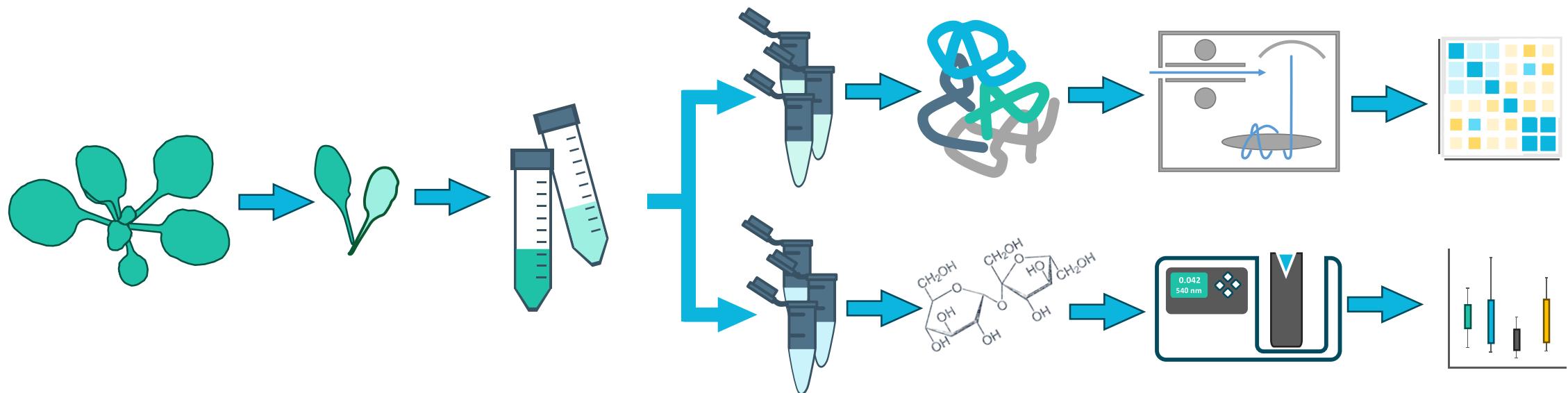
ARC: Annotated research context



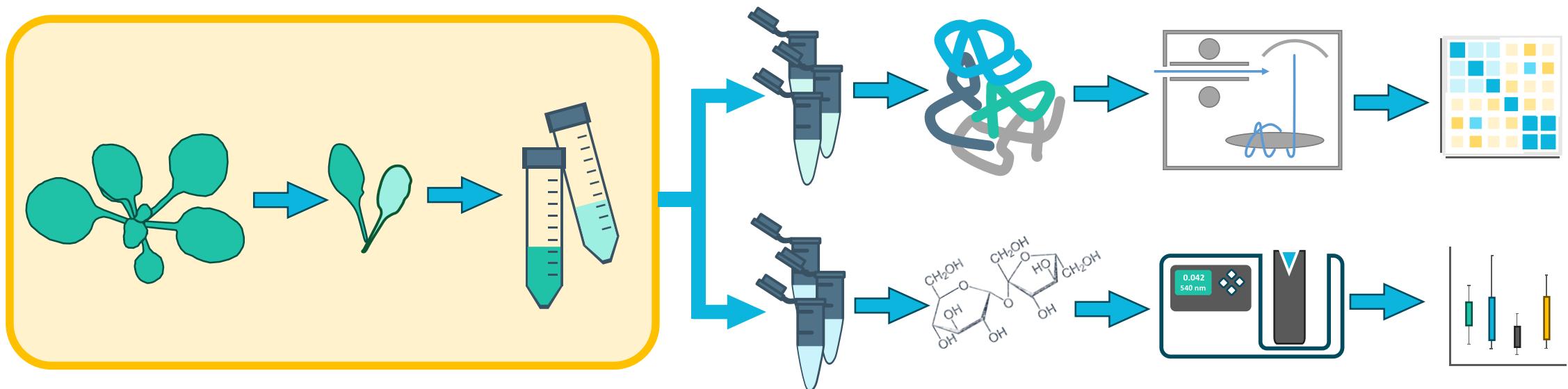
The ARC scaffold structure



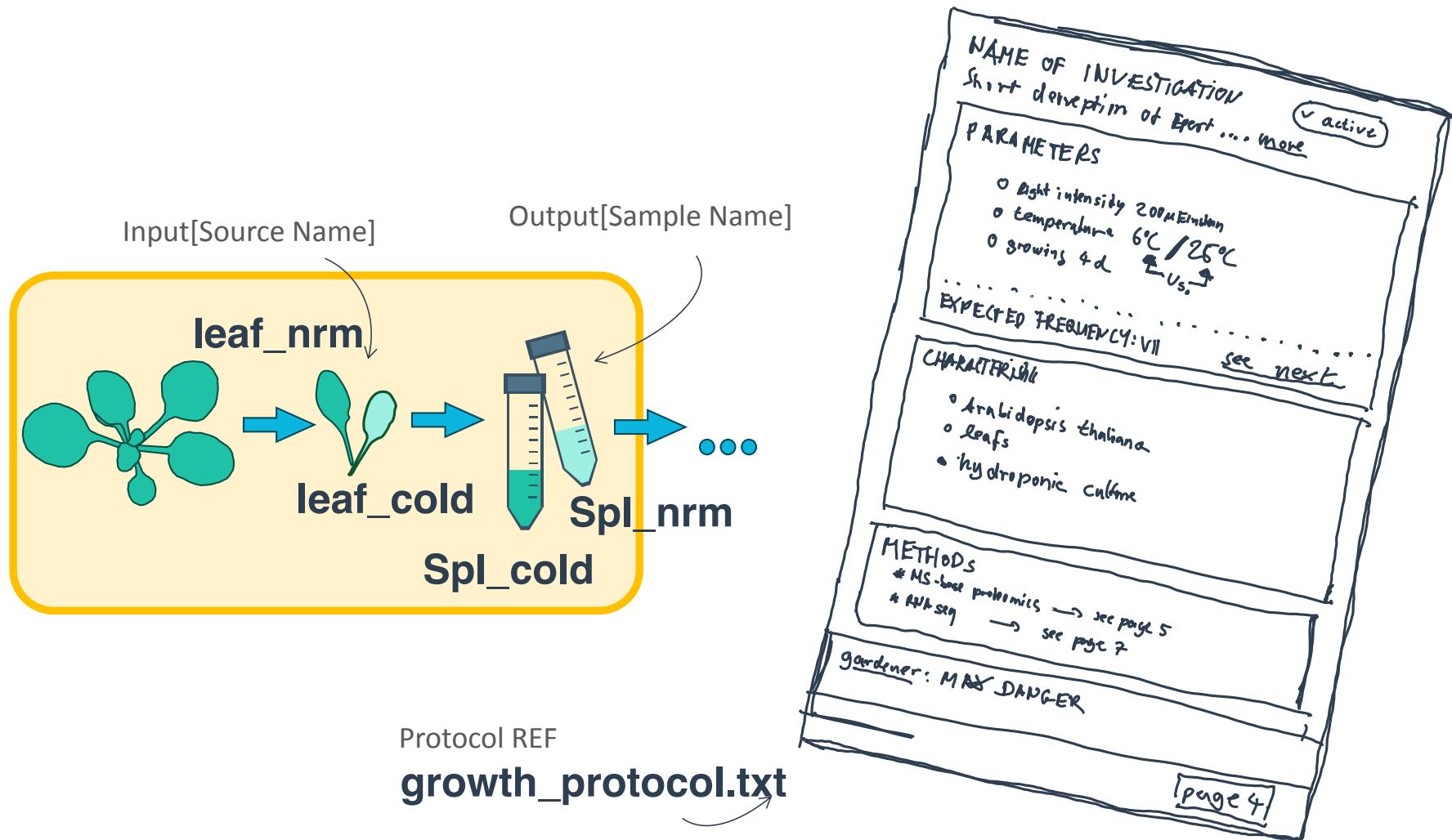
A small prototypic project



Divide and conquer for reproducibility



Identifying the 'study' part



A table-based organization schema

Input[Source Name]		Output[Sample Name]
leaf_nrm		spl_nrm
leaf_cold		spl_cold
A	B	C
D		

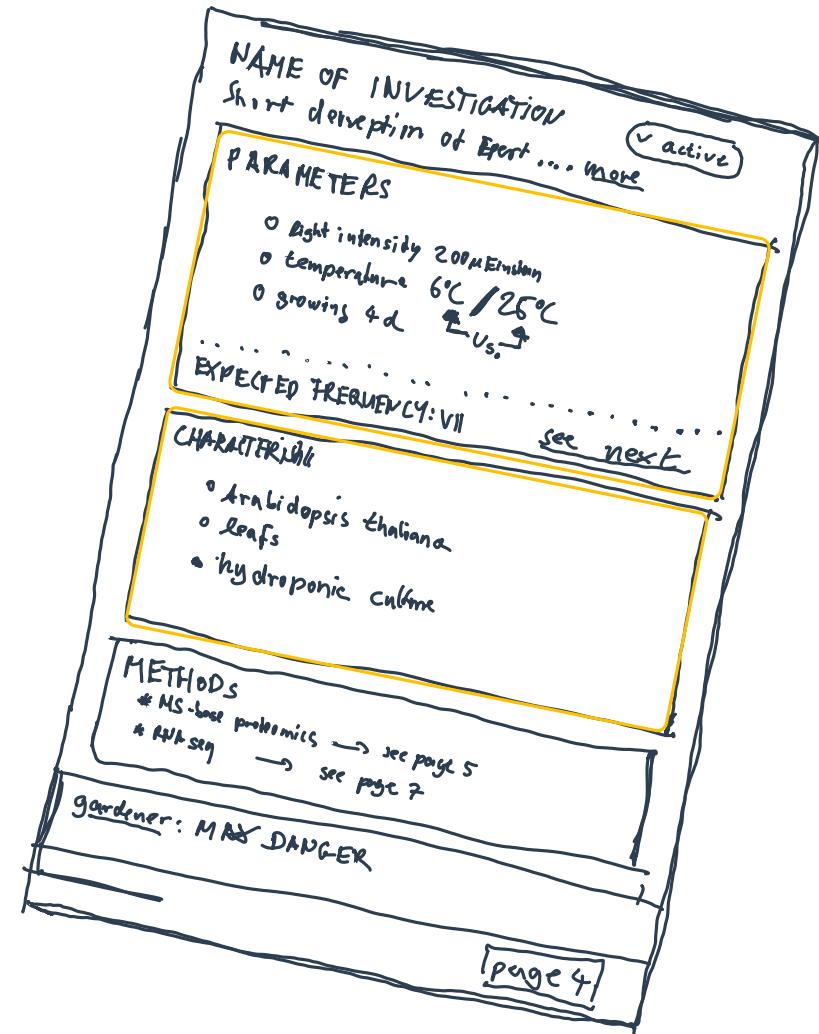
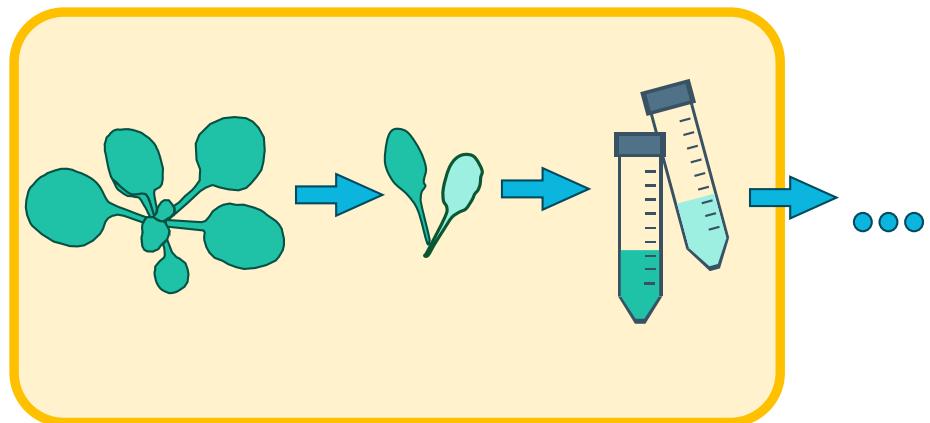
Referencing a protocol

This allows you to reference the free-text, human-readable protocol.

Input[Source Name]	Protocol REF	Output[Sample Name]
leaf_nrm	growth_protocol.txt	spl_nrm
leaf_cold	growth_protocol.txt	spl_cold
A	B	C

- 💡 It is recommended that the protocol is in an open format (.md|.txt|.docx|...)
- 💡 But everything is possible also an URI to an electronic lab notebook

Parameterizing the ‘study’



Finding the right metadata vocabulary

Parameters []

- Light intensity 200 µEinstein
- Temperature 6°C / 25°C
- Growing 4d

Characteristics []

- *Arabidopsis thaliana*
- Leaf
- Hydroponic culture
- Columbia

OLS: Finding the right metadata vocabulary

Temperature Dependence [Temperature:Dependence_Annotation](#)

http://purl.uniprot.org/core/Temperature_Dependence_Annotation

Indicates the optimum temperature for enzyme activity and/or the variation of enzyme activity with temperature variation; the thermostability/thermolability of the enzyme is also mentioned when it is known.

Ontology: [UNIPROT RDFS](#)

temperature [AFO:/result#AFR_0001584](#)

http://purl.allotrope.org/ontologies/result#AFR_0001584

A temperature (datum) is a quantity facet that quantifies some temperature. [Allotrope]

Ontology: [AFO](#)

temperature [FBcv:0000466](#)

http://purl.obolibrary.org/obo/FBcv_0000466

Mutation caused by exposure to a temperature that is higher or lower than 25 degrees Celsius.

Ontology: [FBCV](#)

temperature [PATO:0000146](#)

http://purl.obolibrary.org/obo/PATO_0000146

A physical quality of the thermal energy of a system.

Ontology: [PATO](#)

Also appears in: [NGBO](#) [HTN](#) [CAO](#) [ZP](#) [AGRO](#) [OMIABIS](#) [OBIB](#) [MONDO](#) [TXPO](#) [MCO](#) +

Welcome to the EMBL-EBI Ontology Lookup Service

temperature

Exact match Include obsolete terms Include imported terms

Examples: diabetes, GO:0098743

Looking for a particular ontology?

About OLS
The Ontology Lookup Service (OLS) is a repository for biomedical ontologies that aims to provide a single point of access to the latest ontology versions. You can browse the ontologies through the website as well as programmatically via the OLS API. OLS is developed and maintained by the Samples, Phenotypes and Ontologies Team (SPOT) at EMBL-EBI.

Related Tools
In addition to OLS the SPOT team also provides the Oxo and ZOOMA services. Oxo provides cross-ontology mappings between terms from different ontologies. ZOOMA is a service to assist in mapping data to ontologies in OLS.

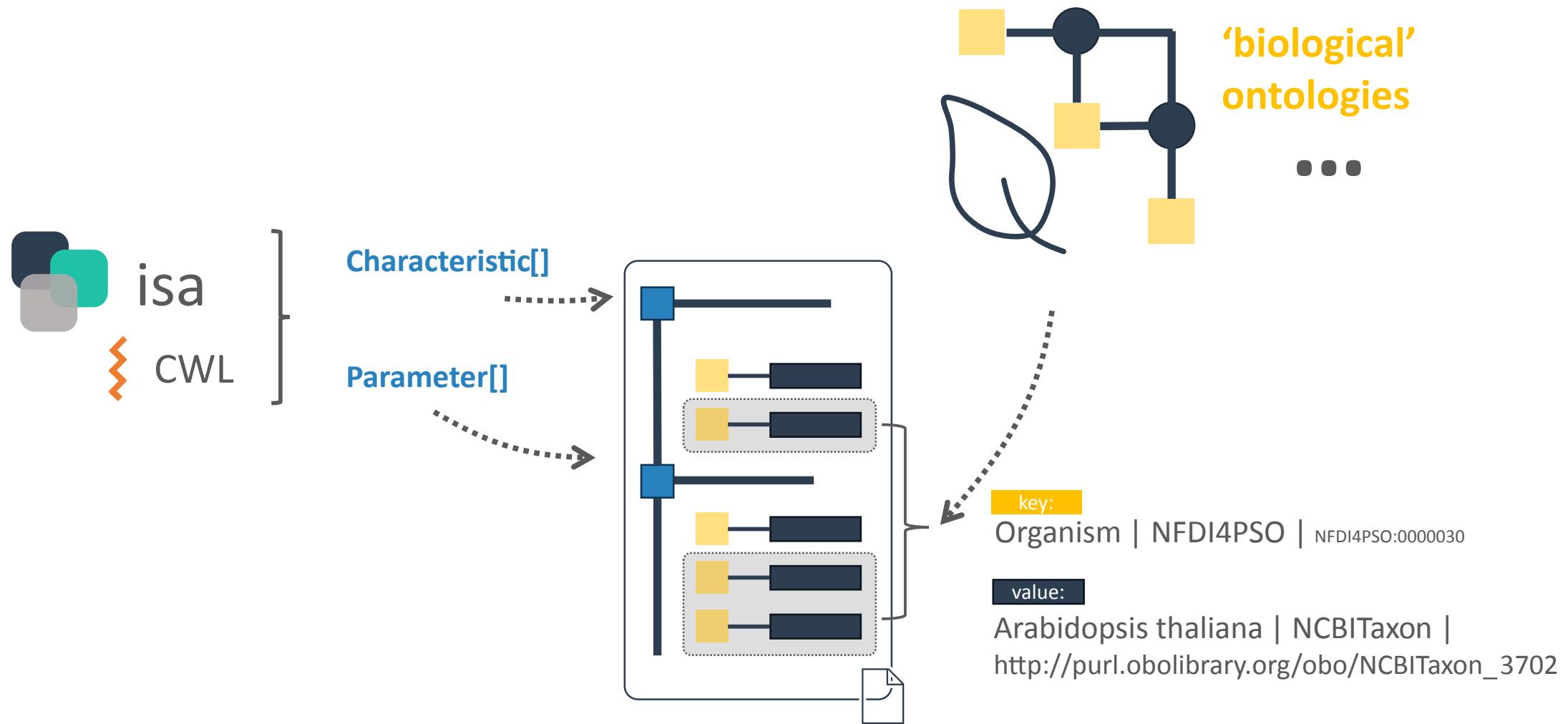
Report an Issue
For feedback, enquiries or suggestion about OLS or to request a new ontology please use our GitHub issue tracker. For announcements relating to OLS, such as new releases and new features sign up to the OLS announce mailing list.

FOLLOW US
 X

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Ontology Lookup Service (OLS): <https://www.ebi.ac.uk/ols4/>

Finding the metadata vocabulary and descriptors



Finding the metadata vocabulary and descriptors

Parameters []

- 
 -  Light intensity 200 µEinstein
- 
 -  Temperature 6°C / 25°C
- 
 -  Growing 4d

Characteristics []

- 
 -  Arabidopsis thaliana
- 
 -  Leaf
- 
 -  Hydroponic culture
- 
 -  Columbia

Finding the metadata vocabulary and descriptors

Parameters []

- █ Light intensity
 - █ 200 µEinstein
- █ Temperature
 - █ 6°C / 25°C
- █ Growth time
 - █ 4d

Characteristics []

- █ Organism
 - █ *Arabidopsis thaliana*
- █ Tissue
 - █ Leaf
- █ Growth medium
 - █ Hydroponic culture
- █ Ecotype
 - █ Columbia

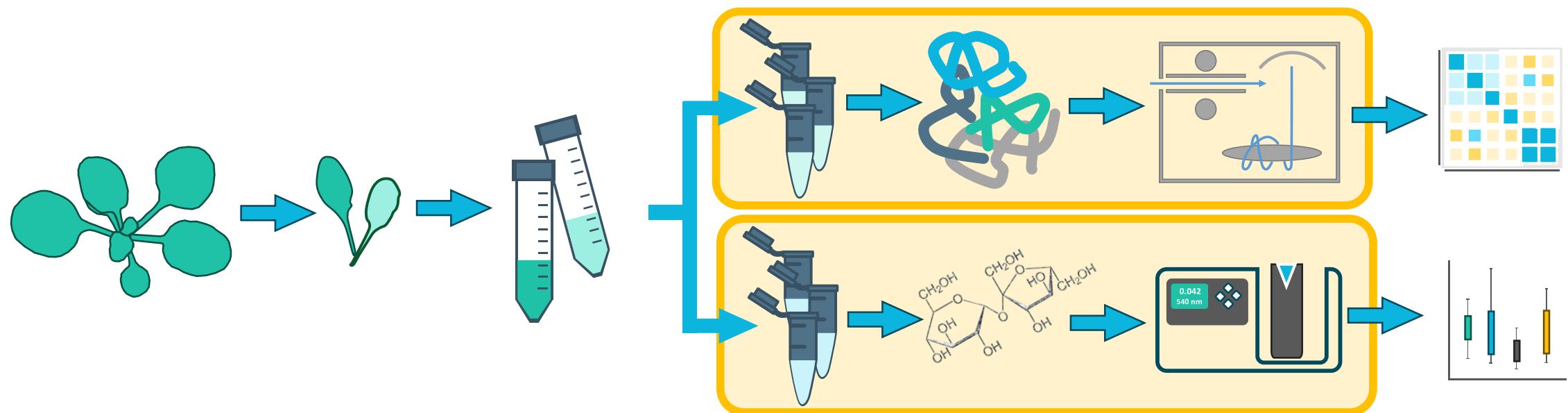
Hands-on part 1: Setup and ARCitect

Follow the [Start Here guide](#) in the DataPLANT knowledge base.

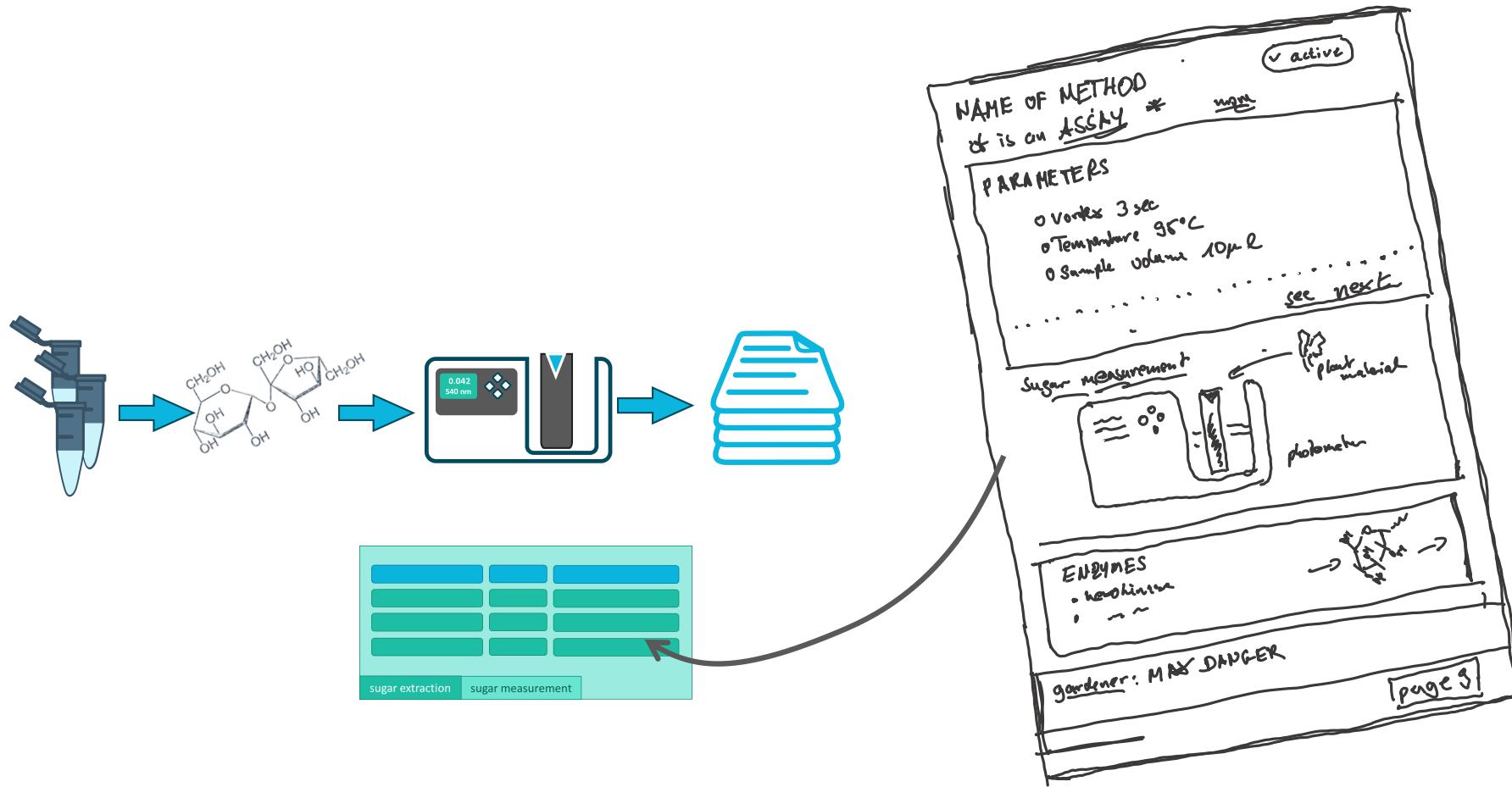
 Until step **Add a study**

Hands-on part 2: ARCitect (and Swate)

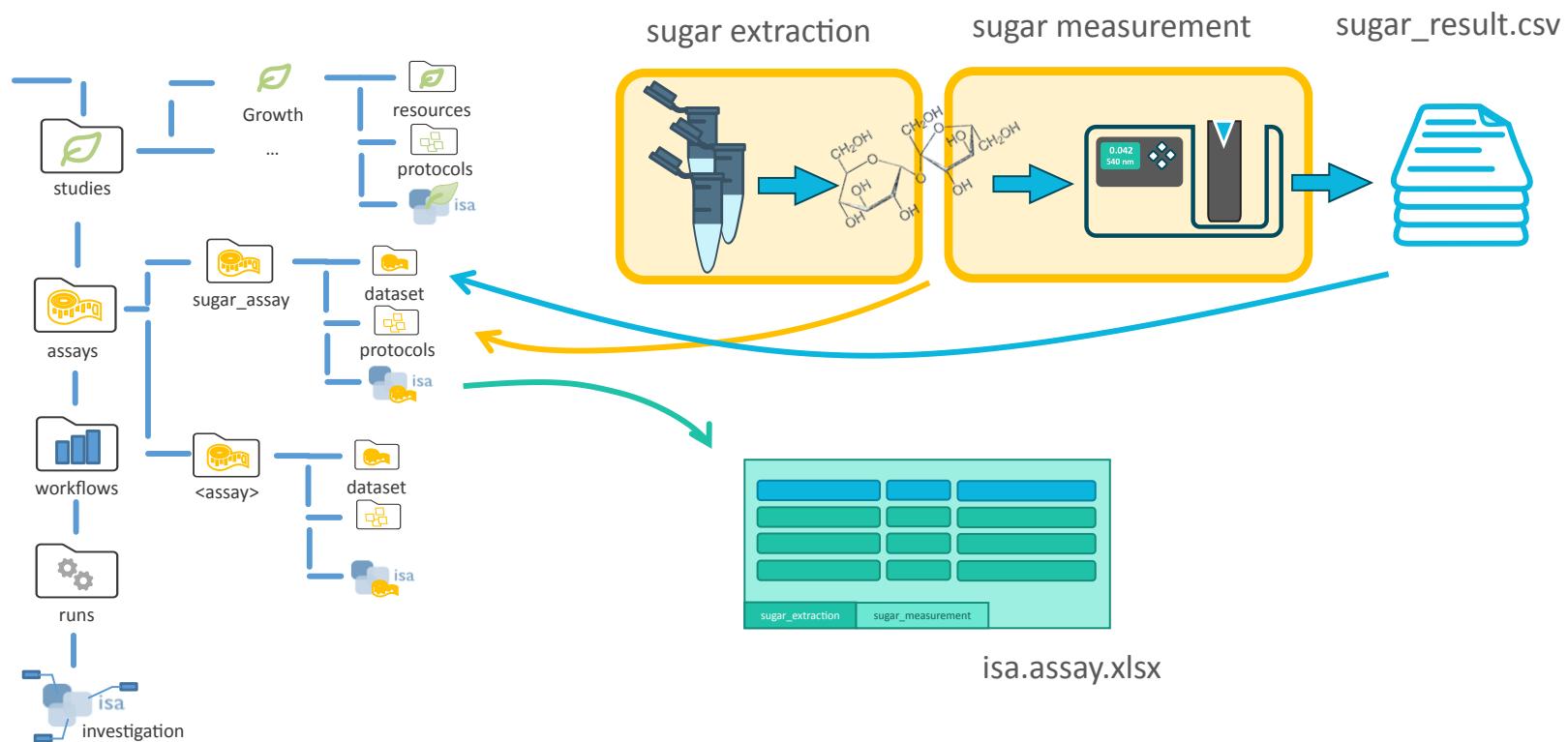
Identifying assays



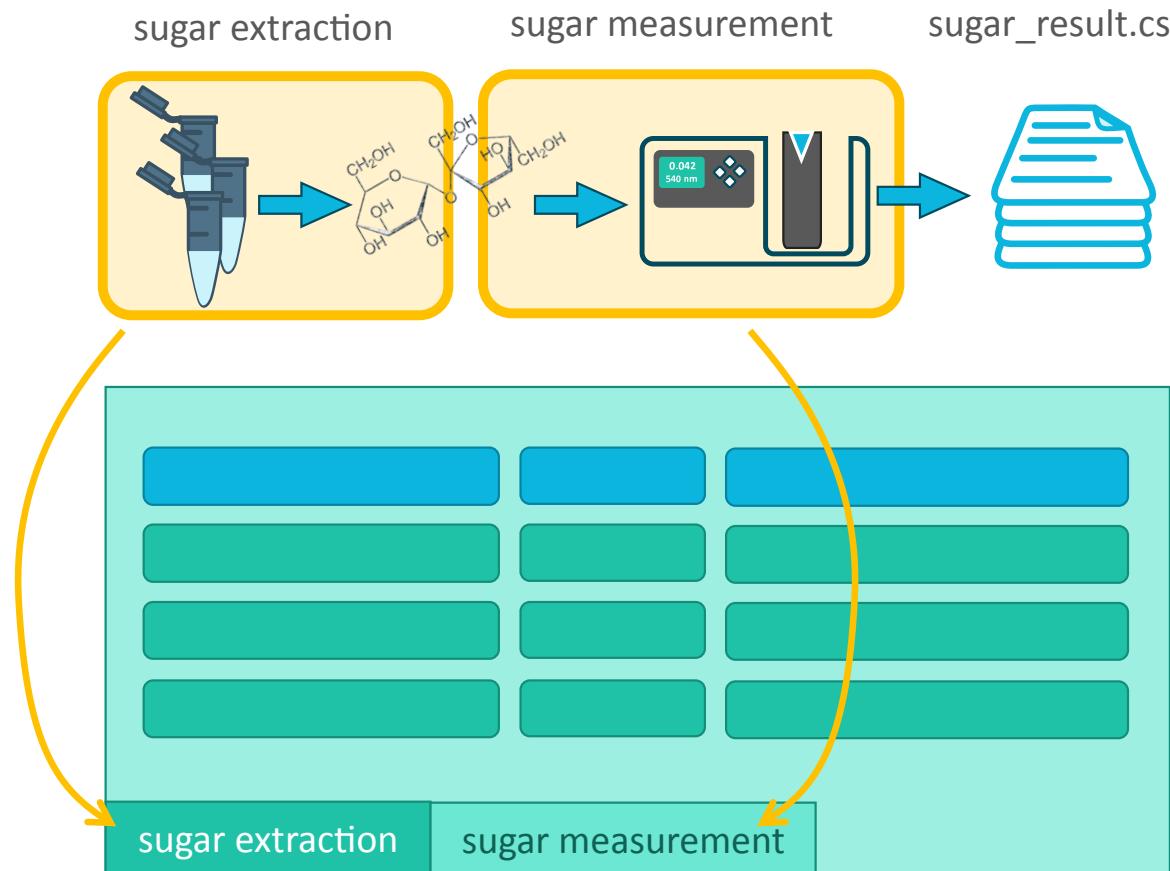
Assay for sugar measurement



Separating different assay elements



Isolating the lab processes in an assay



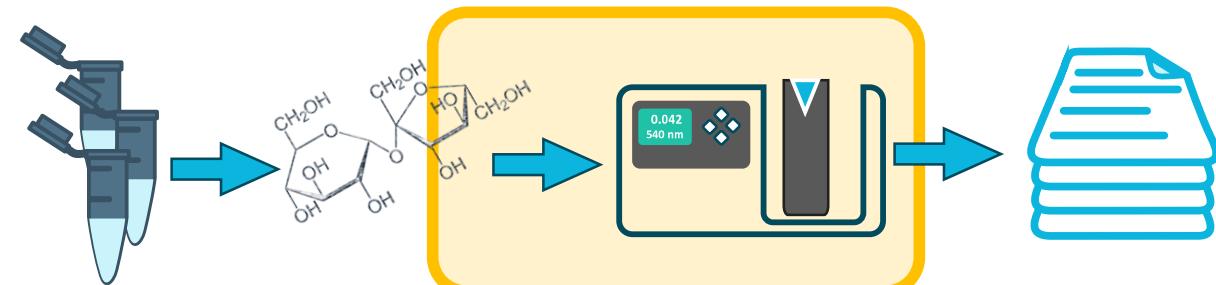
Parameteterization: sugar extraction

- Vortex Mixer
 - 3 seconds
- Temperature
 - 95 degree celsius



Parameteterization: sugar measurement

- technical replicate
 - 1,2,3,...
- sample volume
 - 10 microliter
- buffer volume
 - 190 microliter
- cycle count
 - 5



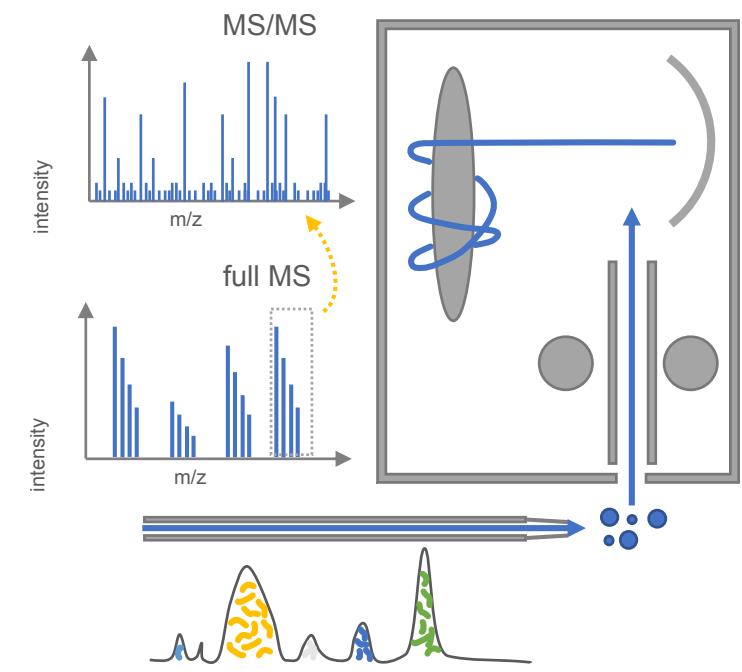
Save time using standard methods and SOPs

Parameter []

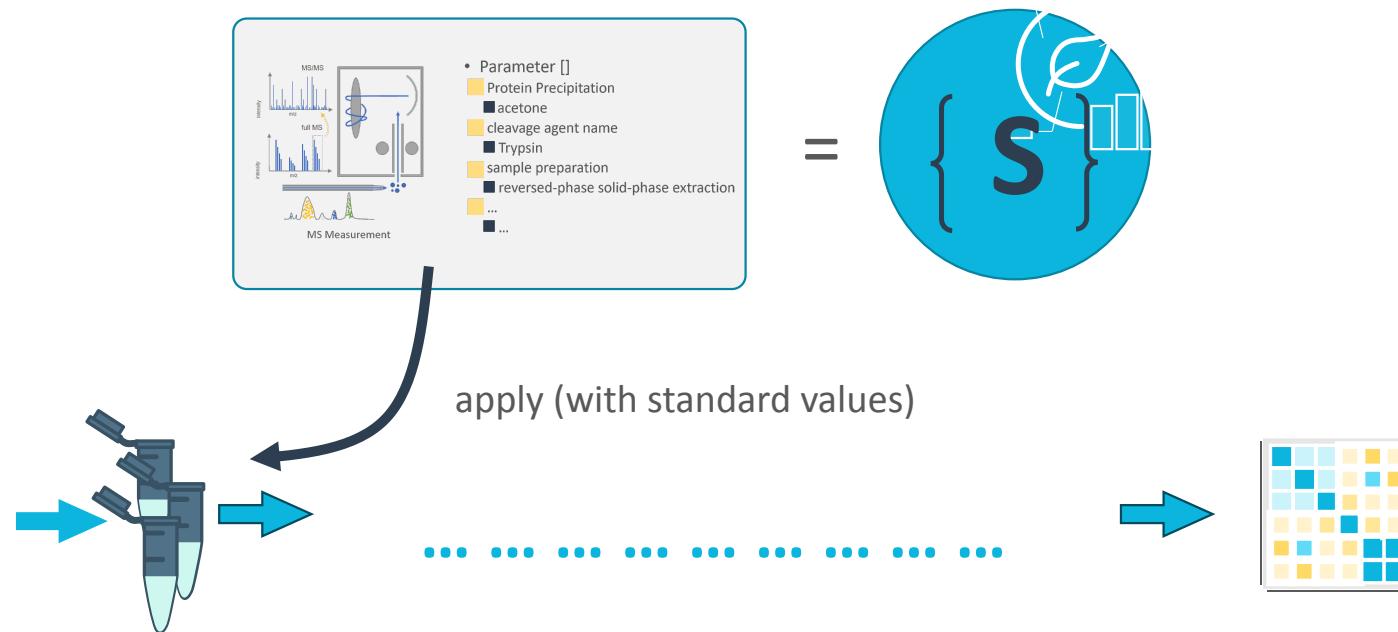
- █ Protein Precipitation
 - █ acetone
- █ cleavage agent name
 - █ Trypsin
- █ sample preparation
 - █ reversed-phase solid-phase extraction
- ...

Component []

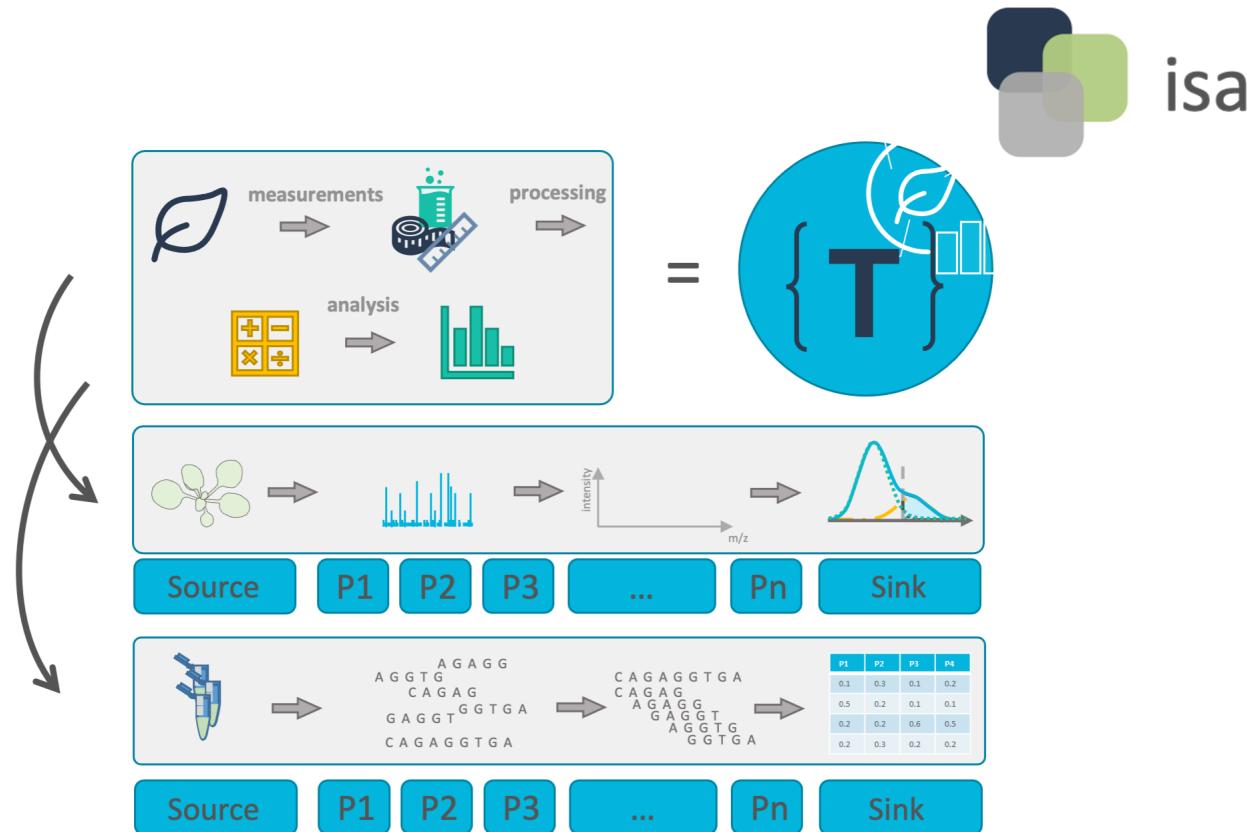
- █ chromatography instrument model
 - █ nanoElute2
- █ chromatography column model
 - █ PepSep C18 1.9 μ , 25cm x 75 μ m
- ...



Applying standard procedures to sample record



Realization of lab-specific metadata with templates



Facilities can define their most common workflows as templates

Hands-on part 2: ARCitect (and Swate)

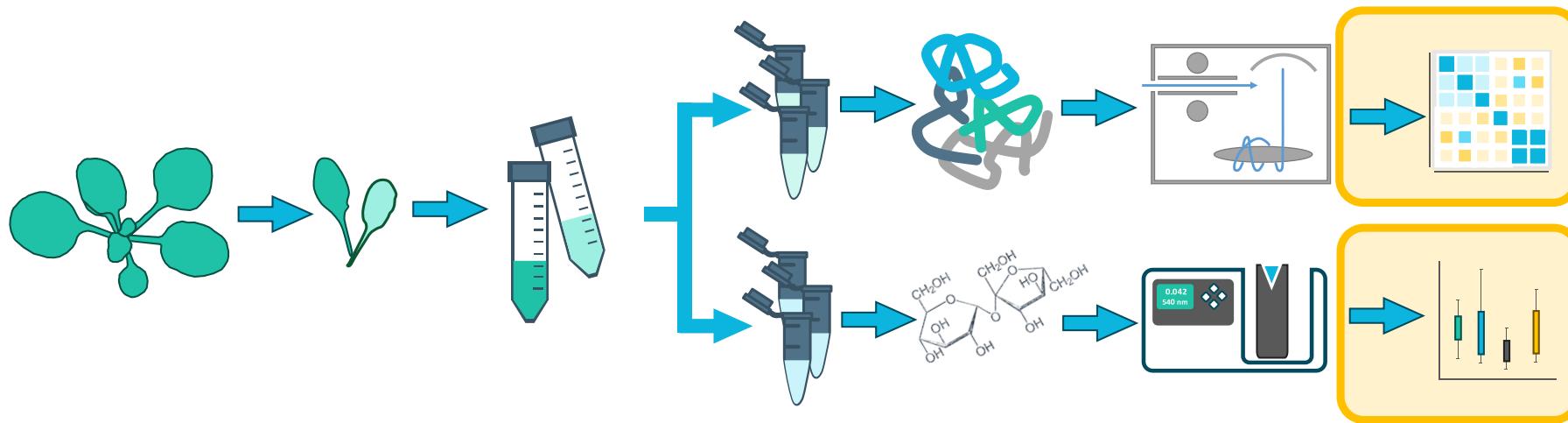
Continue the [Start Here](#) guide in the DataPLANT knowledge base.



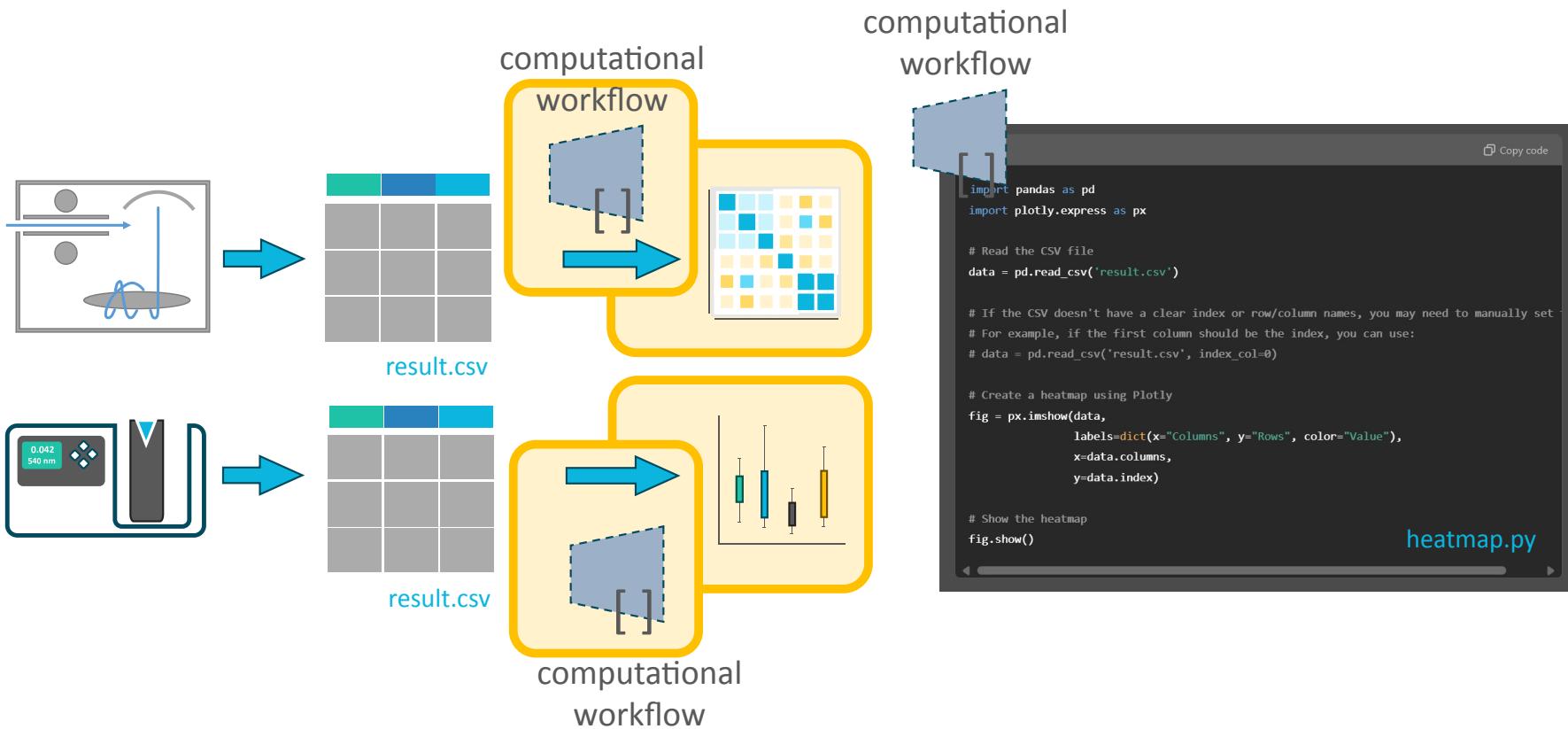
Until step **Add assay data**

Hands-on part 3: Data

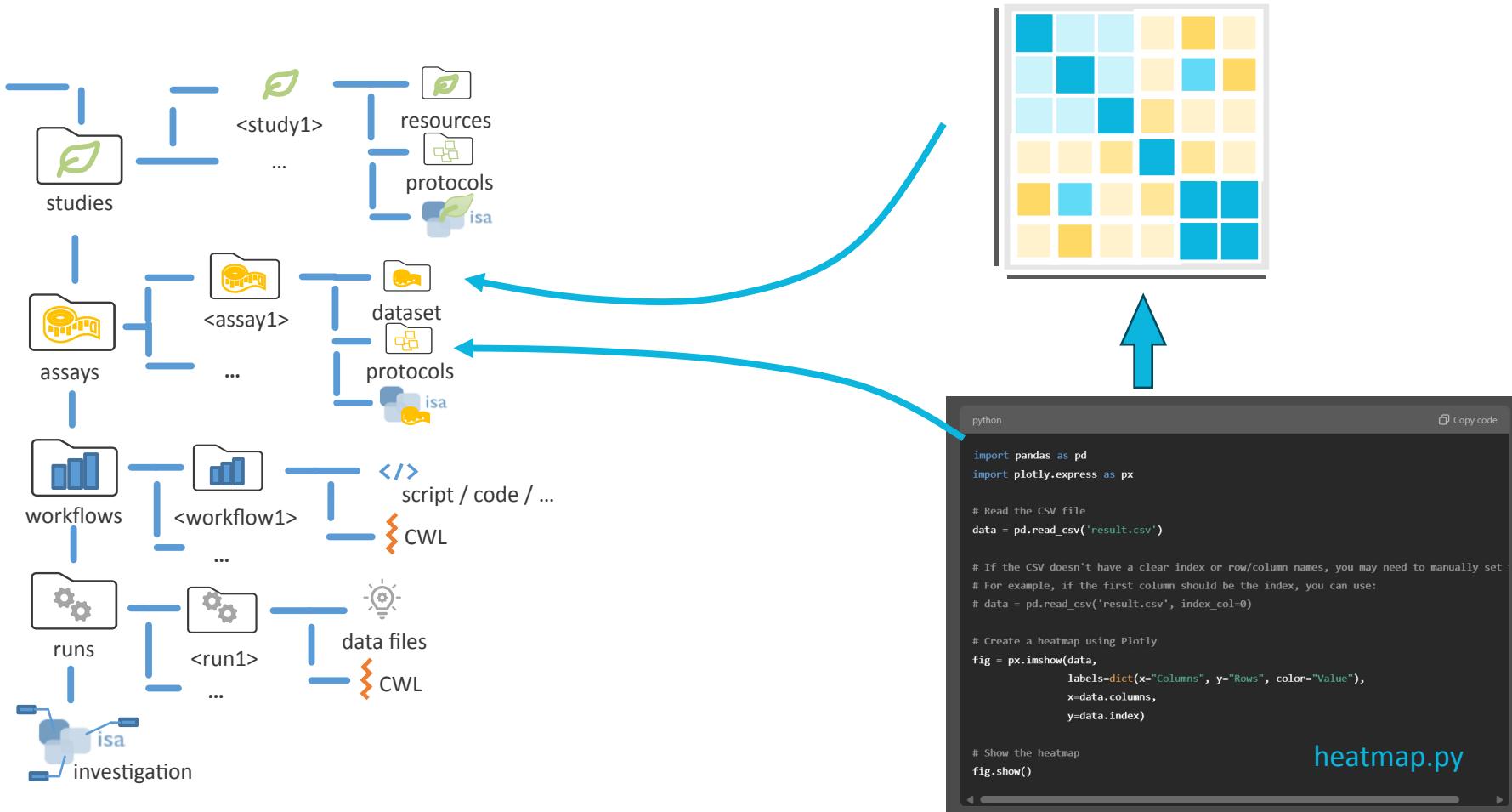
Options to annotate the data analysis



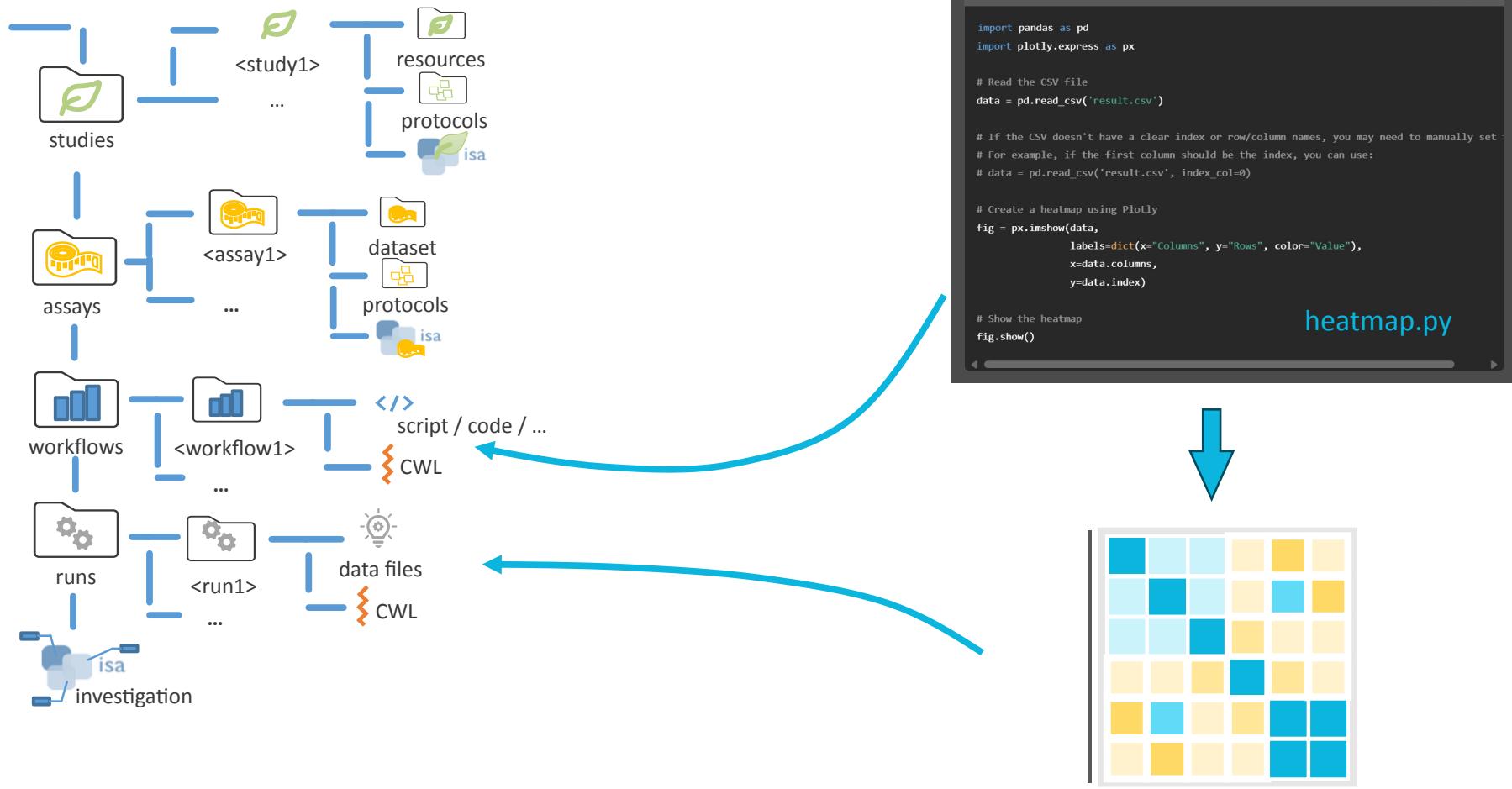
A computational workflow is like a protocol



Option I: Create a virtual assay

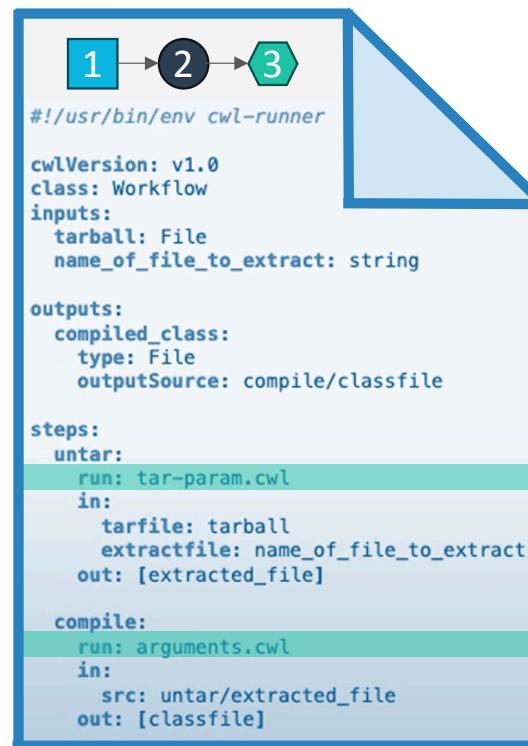


Option II: Create a workflow and run



Use CWL to wrap your workflow

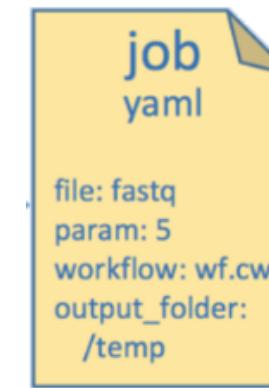
CWL workflow document (*.cwl)



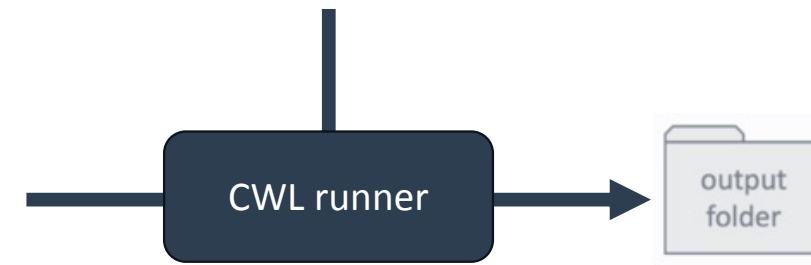
```
graph LR; 1[1] --> 2((2)); 2 --> 3[3];  
#!/usr/bin/env cwl-runner  
cwlVersion: v1.0  
class: Workflow  
inputs:  
  tarball: File  
  name_of_file_to_extract: string  
  
outputs:  
  compiled_class:  
    type: File  
    outputSource: compile/classfile  
  
steps:  
  untar:  
    run: tar-param.cwl  
    in:  
      tarfile: tarball  
      extractfile: name_of_file_to_extract  
      out: [extracted_file]  
  
  compile:  
    run: arguments.cwl  
    in:  
      src: untar/extracted_file  
      out: [classfile]
```

CWL
tool descriptors (*.cwl)

CWL job parameter (*.yaml)



```
file: fastq  
param: 5  
workflow: wf.cwl  
output_folder:  
  /temp
```



Hands-on part 3: Data

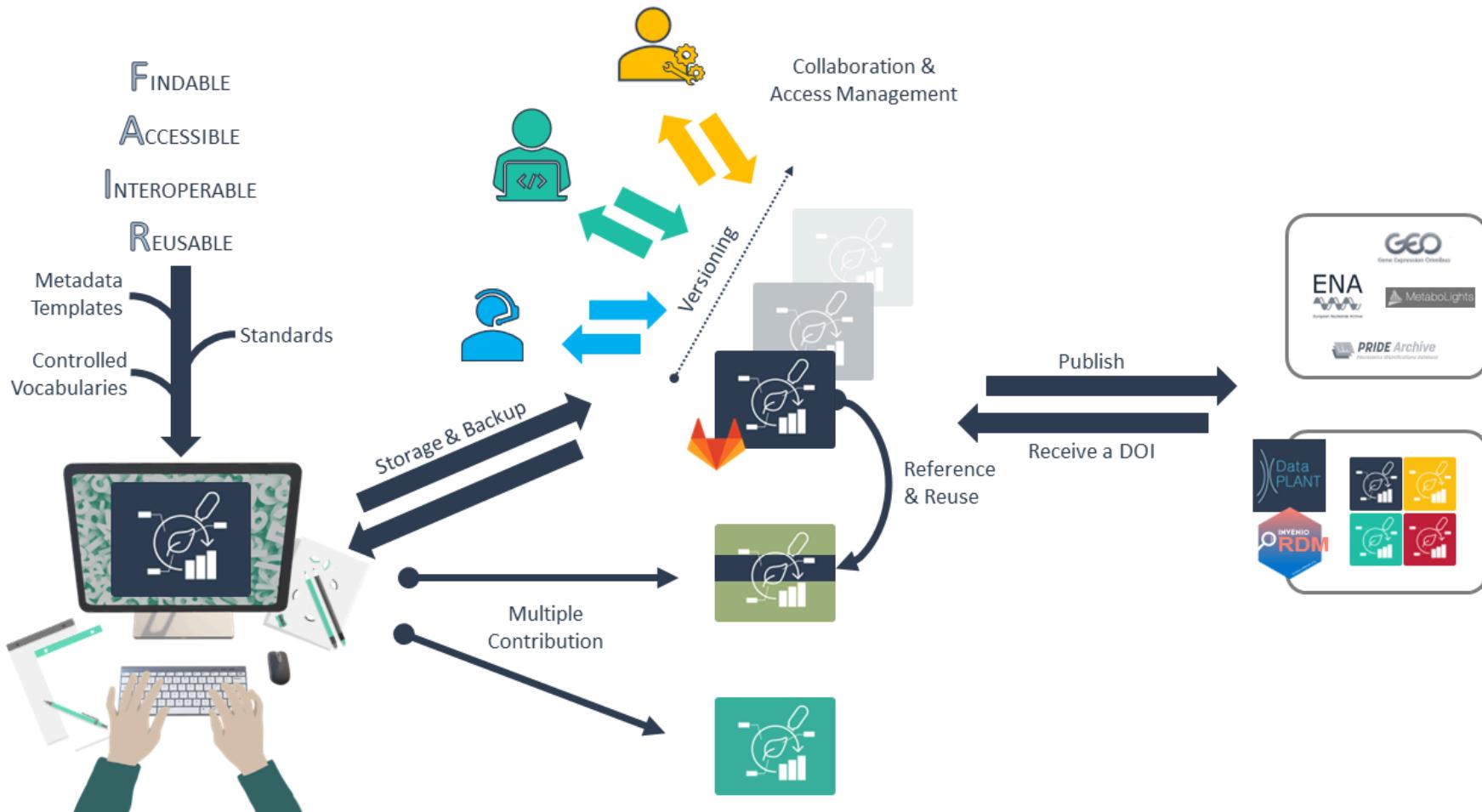
Continue the [Start Here](#) guide in the DataPLANT knowledge base.



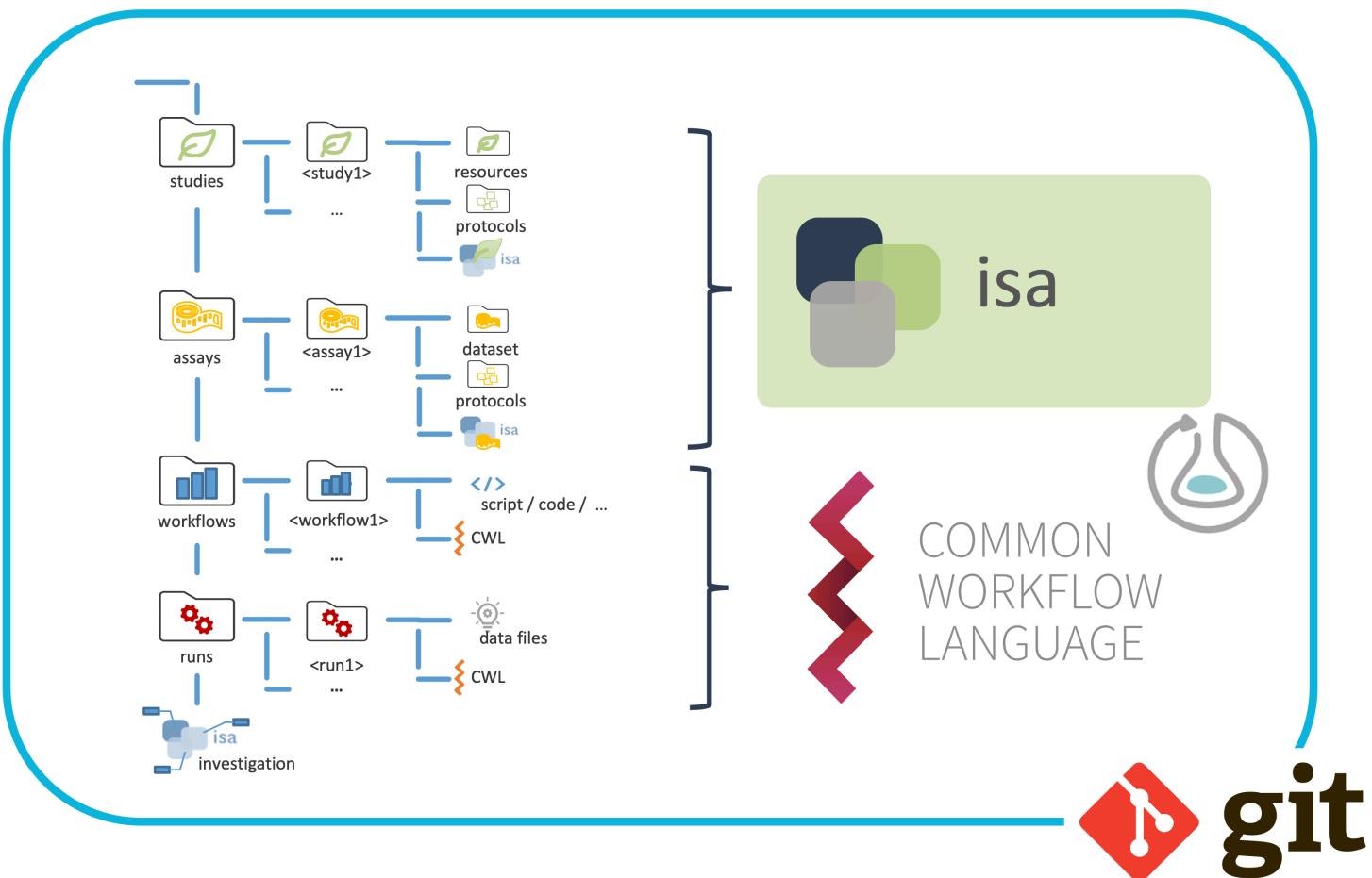
Until step **Data analysis**

Hands-on part 4: DataHUB

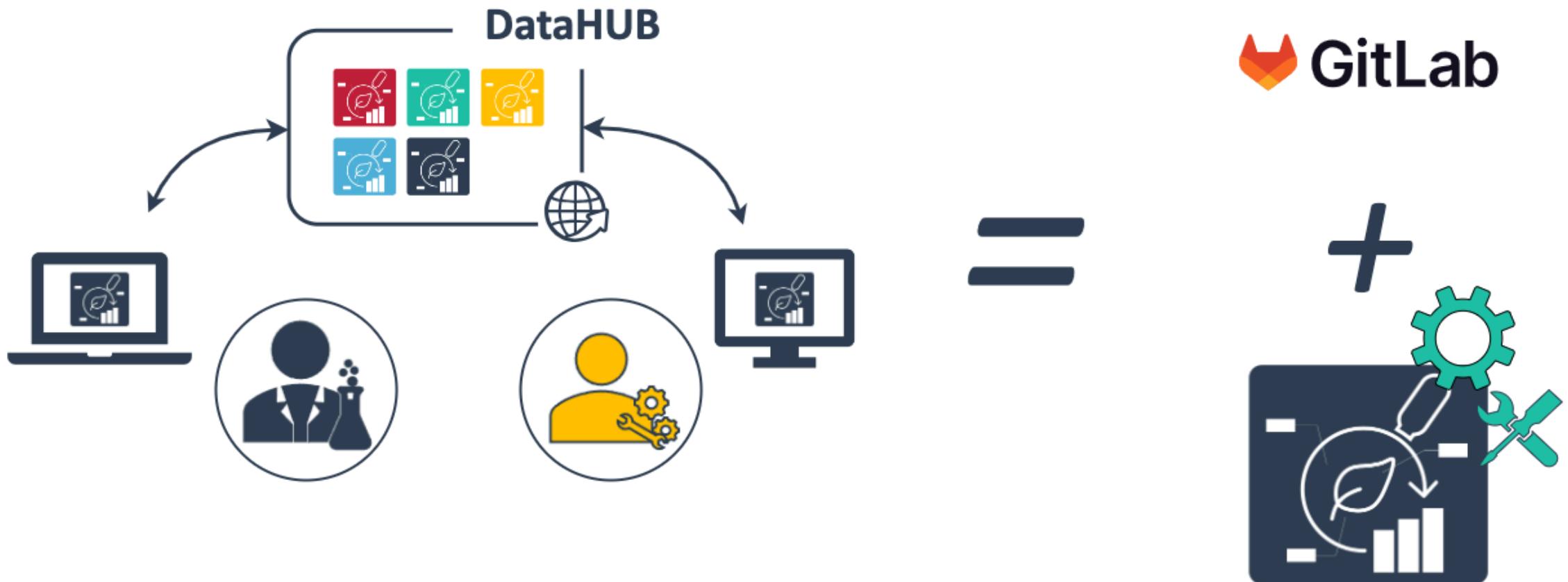
DataHUB overview



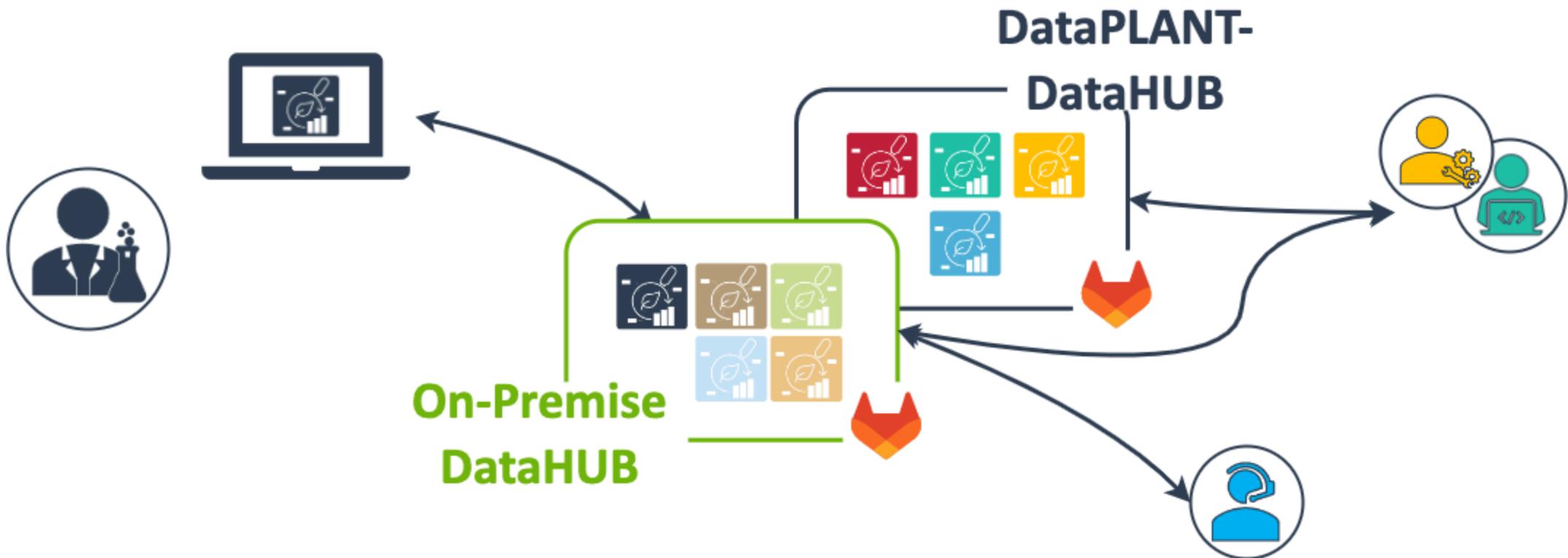
ARC builds on standards + Git



The DataPLANT DataHUB – a GitLab *Plus*

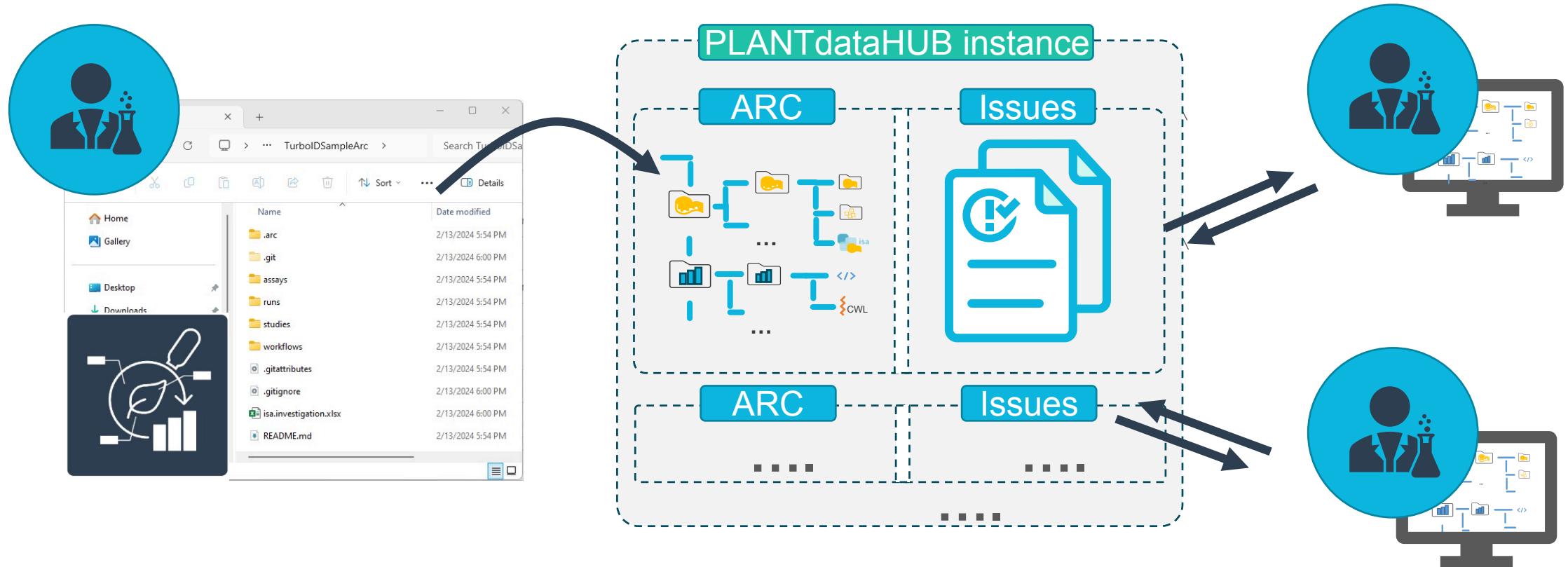


On-premise DataHUBs

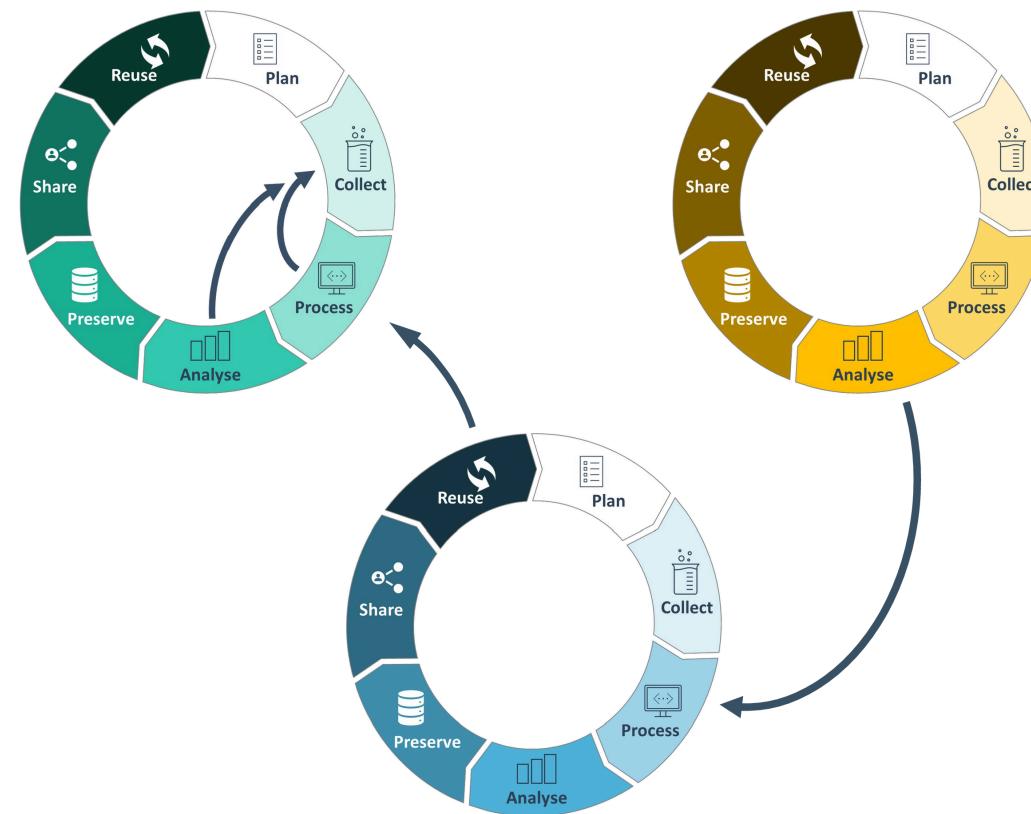


ARC services are available as on-premise option

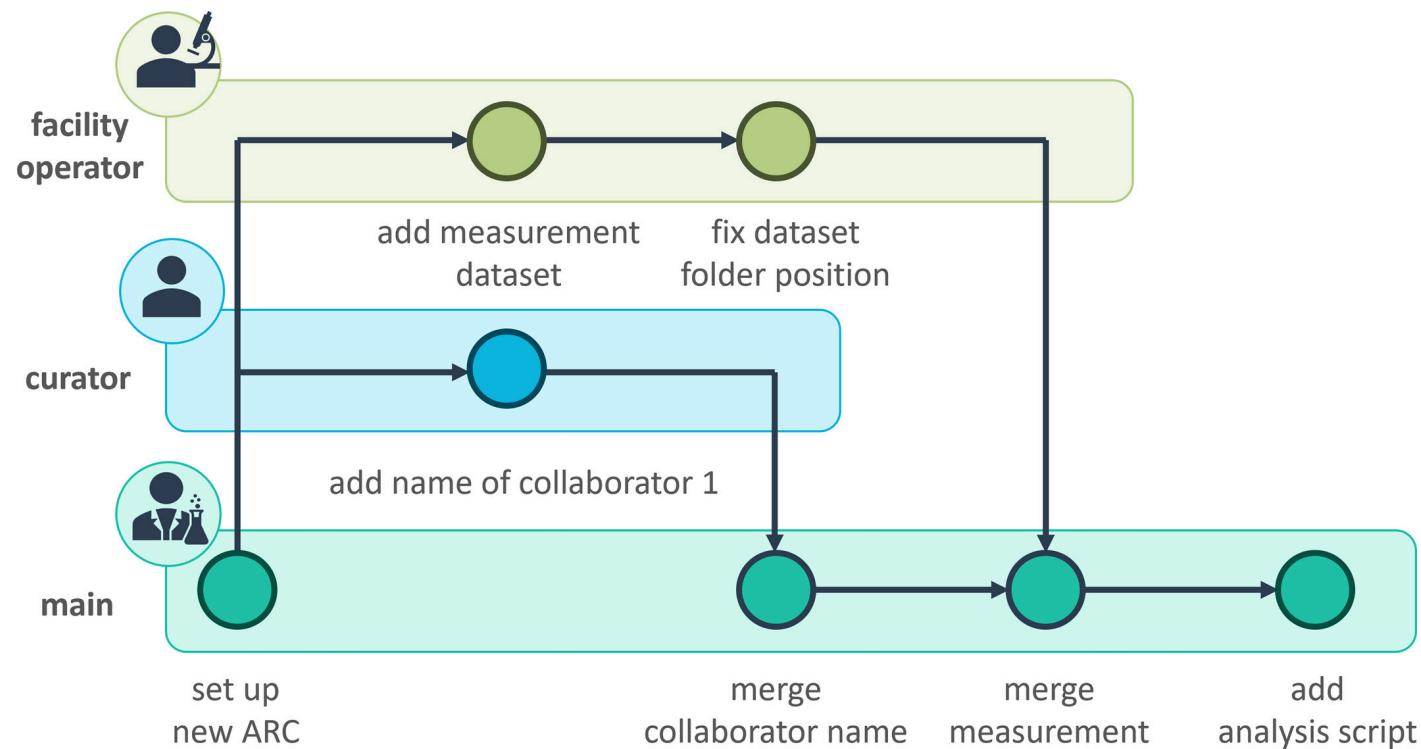
Using the DataHUB to collaborate



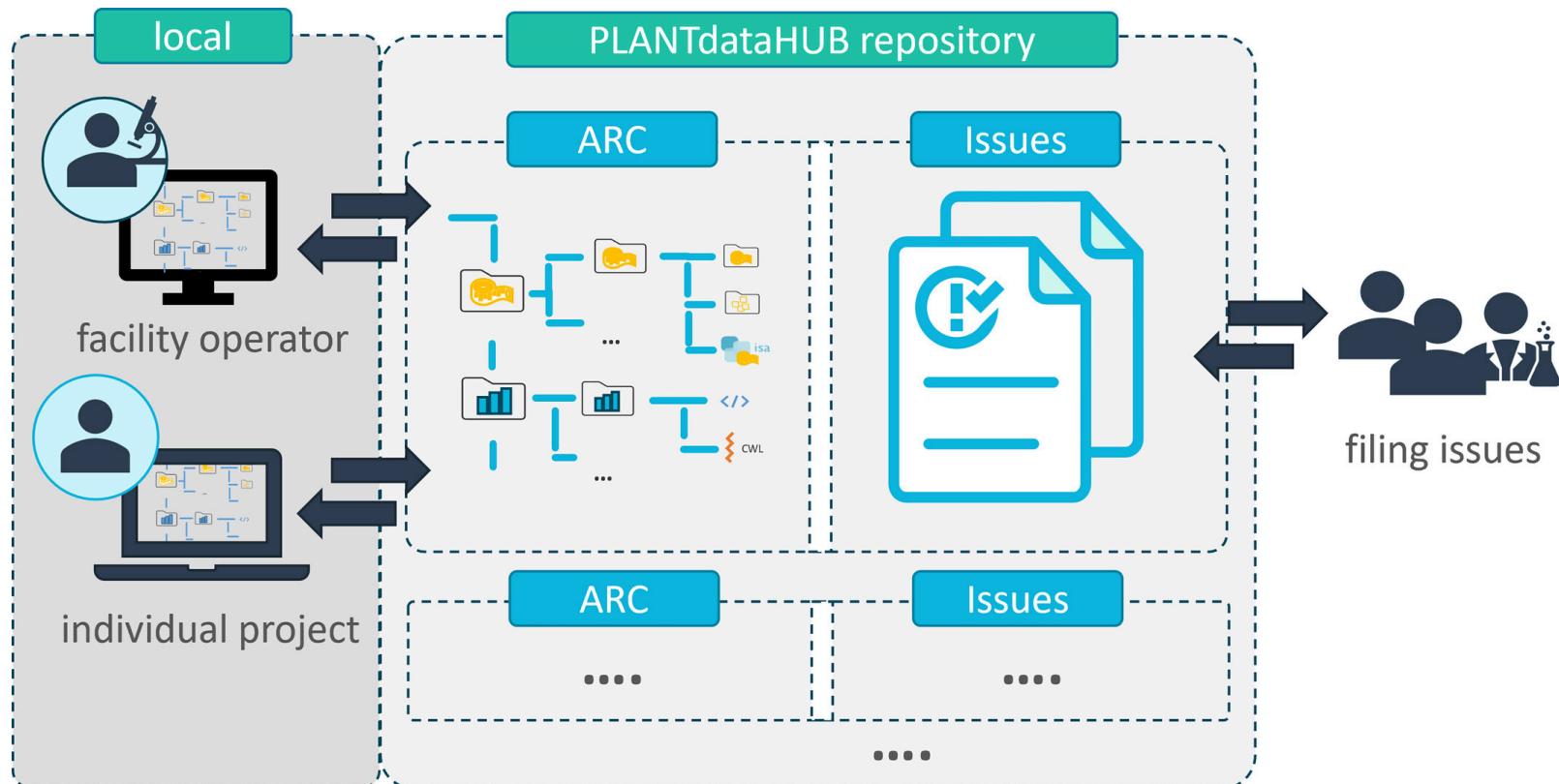
The Research Data Lifecycle *is mutable*



Mutable data life cycle



Project management



ARCs come with their own wiki space

- directly associated to your ARC
- same access rights as your ARC
- share meeting minutes or ideas with collaboration partners
- keep ARC clean of files that are not considered "research data"

The screenshot shows a DataHub interface for an ARC named 'Demo_ARC'. The sidebar on the left contains links for Project (Demo_ARC), Pinned, Manage, Plan, Issues (0), Issue boards, Milestones, Wiki (which is currently selected), Code, Build, Secure, and Help. The main content area has a header 'Home' and a message about CQC pipelines. It includes sections for 'Home' (last edited by Demo User just now), 'Meeting Schedule' (with a list of dates: 2024-06-12 Kick-off, 2024-06-27 Proposal discussion, 2024-07-04 Discuss RNA-seq pipeline), and 'Ideas and drafts' (Golden Gate protocol).

Hands-on part 4: DataHUB

Continue the [Start Here](#) guide in the DataPLANT knowledge base.



Until the final **complete** step

DataHUB terminology and data sharing

Choosing the proper role

When inviting new members to an ARC or group, you can choose between different levels.

Permissions & Roles

Roles are assigned when adding a user to an ARC or to a group. This is a very simplified summary.

Guest – Can only see the ARC's wiki

Reporter – Can read, but not add or edit data

Developer – Reporter permissions + can read, add, and edit data

Maintainer – Developer permissions + can add new members

Owner – Maintainer + can delete ARC, manage memberships and permissions

 By default you are **Owner** of an ARC you create or upload to the DataHUB.

Projects and Groups are not the same

- "Project" = ARC
- "Groups" = Group of users

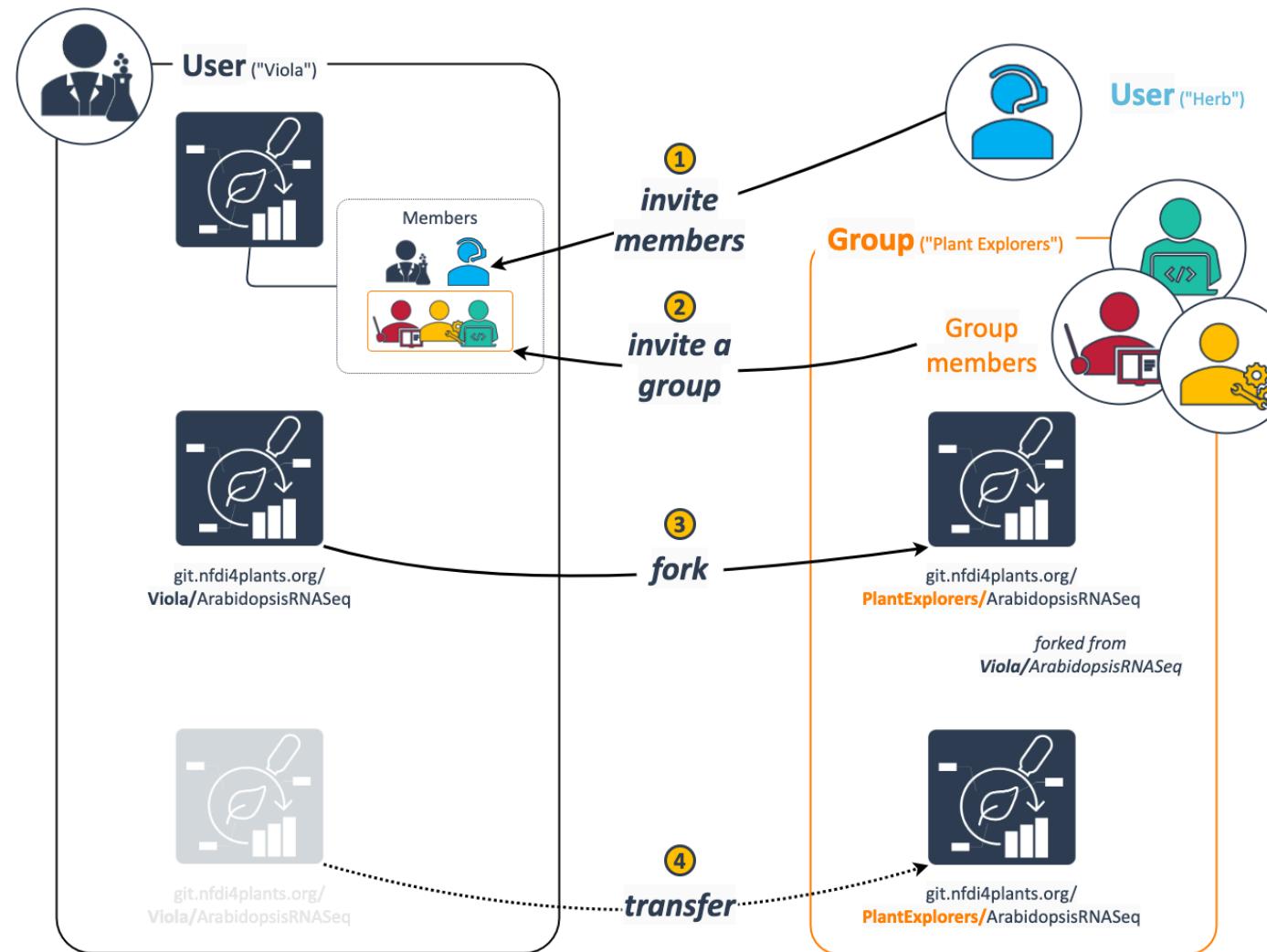
Project = ARC

- In the DataHUB, ARCs are called "projects"; they are the same.
- An ARC can be shared with individual users (invited as "members") or a group.

DataHUB Groups = Group of members (e.g. lab)

- A "Group" is a group of users with specific permissions
- A group can share ARCs
- A group can be invited to an ARC
- Groups can have subgroups

Options to share an ARC via the DataHUB



Namespaces

- Every user has a personal namespace, where they can upload or create new ARCs
- Every group and subgroup has its own namespace

Type	URL	Namespace	Name
A personal ARC	https://git.nfdi4plants.org/brilator/Facultative-CAM-in-Talinum	brilator	Dominik Brilhaus
An group-shared ARC	https://git.nfdi4plants.org/hhu-plant-biochemistry/Samuilov-2018-BOU-PSP	hhu-plant-biochemistry	HHU Plant Biochemistry

 **Personal** is not the same as **private**

Visibility

The visibility of ARCs and groups can be managed individually for each ARC or group

Visibility

The visibility of each ARC can be managed in the settings of the ARC



Private – ARC access must be granted explicitly to each user or group.



Internal – ARC can be accessed by any logged in user.



Public – ARC can be accessed without authentication.



By default every ARC and every group is set to **private**.

ARC DataHUB members // ARC Investigation contacts

The screenshot shows the 'Members' section of a GitLab project named 'Samuilov-2018-BOU-PSP'. It lists four project members:

Account	Source	Max role	Expiration	Activity
Adriano Nunes-Nesi @nunesnesi	HHU Plant Biochemistry by Sebastian Triesch	Maintainer	Expiration date	User created: Jul 05, 2023 Access granted: Jul 10, 2023 Last activity: Aug 09, 2023
Andreas Weber @andreas.weber	HHU Plant Biochemistry by Sebastian Triesch	Maintainer	Expiration date	User created: Mar 10, 2023 Access granted: Jul 31, 2023 Last activity: Sep 11, 2023
Dominik Brilhaus It's you @brilator	Direct member by Dominik Brilhaus	Owner	Expiration date	User created: Feb 21, 2022 Access granted: Dec 06, 2023 Last activity: Mar 26, 2024
Franziska Fichtner @franziska.fichtner	HHU Plant Biochemistry by Sebastian Triesch	Maintainer	Expiration date	User created: Aug 11, 2023 Access granted: Aug 11, 2023 Last activity: Aug 11, 2023

DataHUB: ARC members

https://git.nfdi4plants.org/hhu-plant-biochemistry/Samuilov-2018-BOU-PSP/-/project_members

The screenshot shows the 'Investigation Contacts' section of the ARCTect interface for the 'Samuilov-2018-BOU-PSP' project. It lists ten contacts with their ORCID IDs and scores:

Contact	Score
Sladjana Samuilov <orcid>	4/10
Nadine Rademacher <orcid>	3/10
Samantha Flachbart <orcid>	3/10
Leila Arab <orcid>	3/10
Saleh Alfarraj <orcid>	3/10
Franziska Kuhnert <orcid>	3/10
Stanislav Kopriva <orcid>	3/10
Andreas P. M. Weber <orcid>	4/10
Tabea Mettler-Altmann <orcid>	3/10

ARCTect: Investigation Contacts

Investigation contacts are not automatically invited as members to the ARC.

Version control

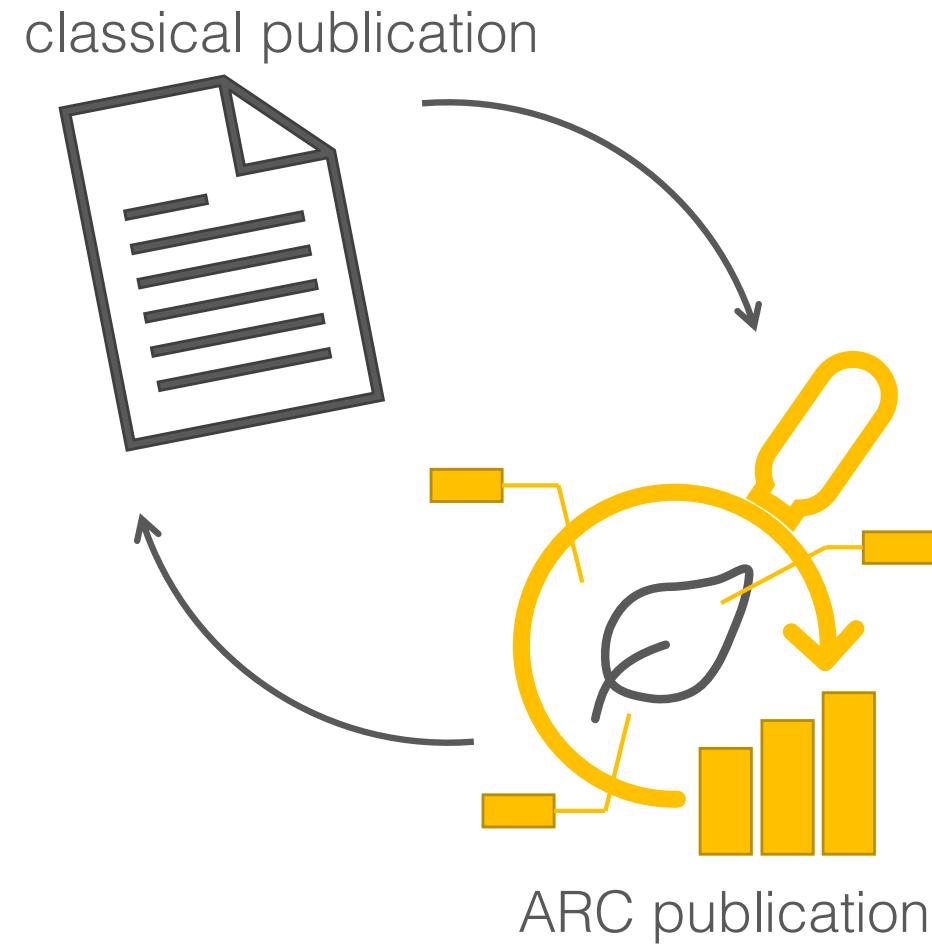
Check out the **commit history** of your ARC via Repository (2) or directly via commits (7)

The screenshot shows the 'Demo User / Demo_ARC' project interface. On the left, a sidebar lists project management options: Manage (1), Plan (2), Code (3), Build, Secure, Deploy, Operate, Monitor, Analyze, Settings (4), and Help. The main area displays the 'Demo_ARC' repository (5). The repository header includes a search bar, a lock icon, and a commit count of 13. Below the header is a navigation bar with branches ('main'), a '+' button, and a commit history button (7). The commit history table (6) shows the following entries:

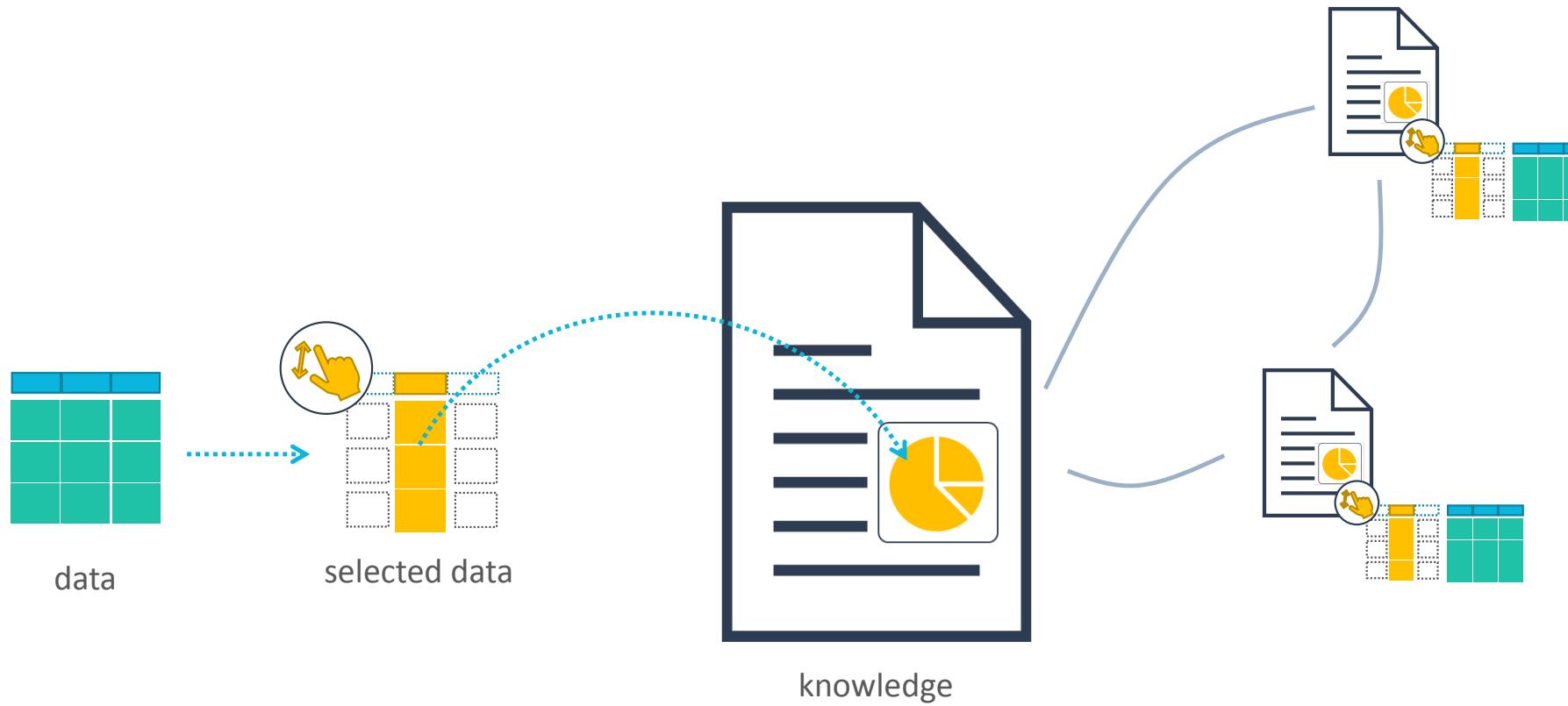
Name	Last commit	Last update
assays	arc init	4 minutes ago
runs	arc init	4 minutes ago
studies	arc init	4 minutes ago
workflows	arc init	4 minutes ago
.gitignore	arc init	4 minutes ago
isa.investigation.xlsx	arc init	4 minutes ago

To the right of the commit history is a 'Code' dropdown menu (8) containing 'History', 'Find file', 'Edit', and 'Code'. The 'Project information' section shows a pipeline status of 'passed' and a 'Publish ARC' button. It also lists project statistics: 1 Commit, 2 Branches, 0 Tags, and 7 KiB Project Storage. Below these are links for Auto DevOps, README, LICENSE, CHANGELOG, CONTRIBUTING, Kubernetes cluster, Wiki, and Integrations. At the bottom, it shows the project was created on July 13, 2024.

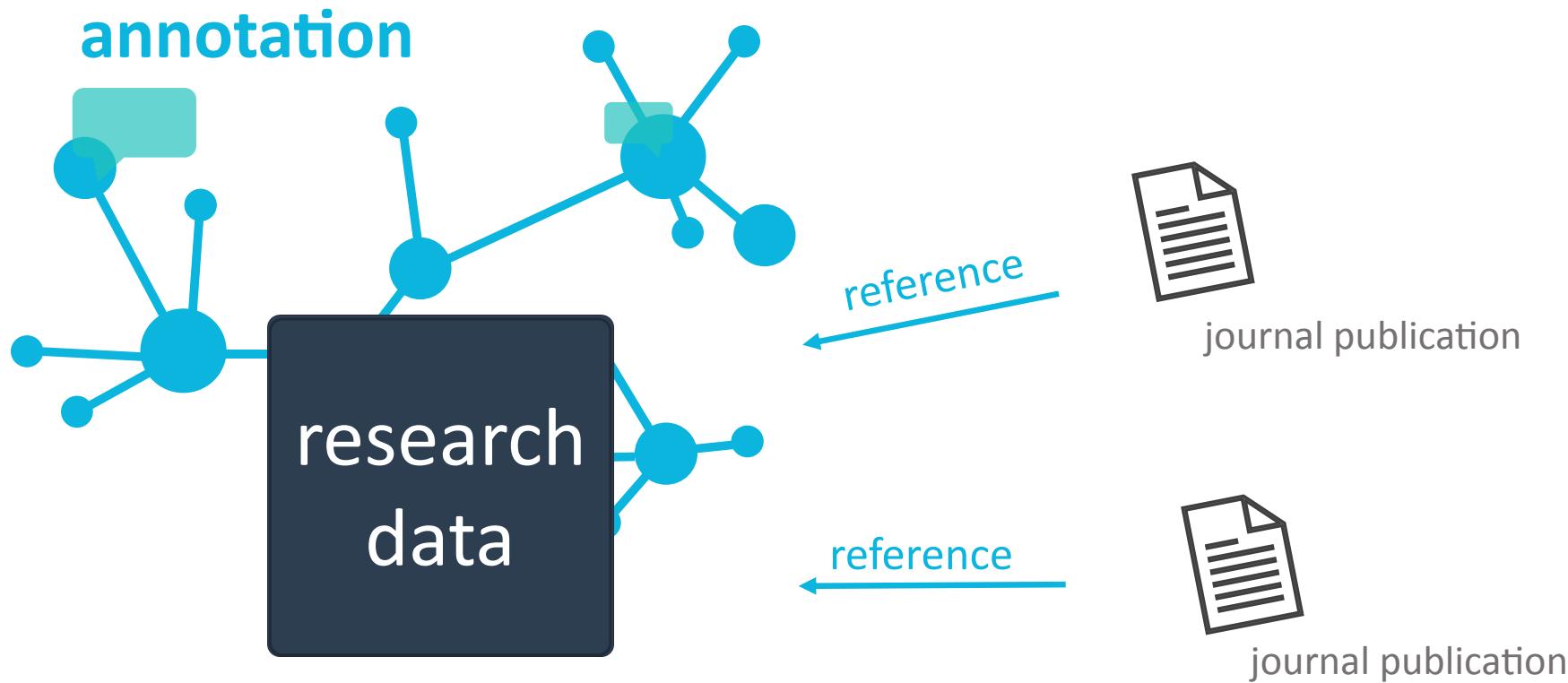
Hands-on part 5: ARC data publication



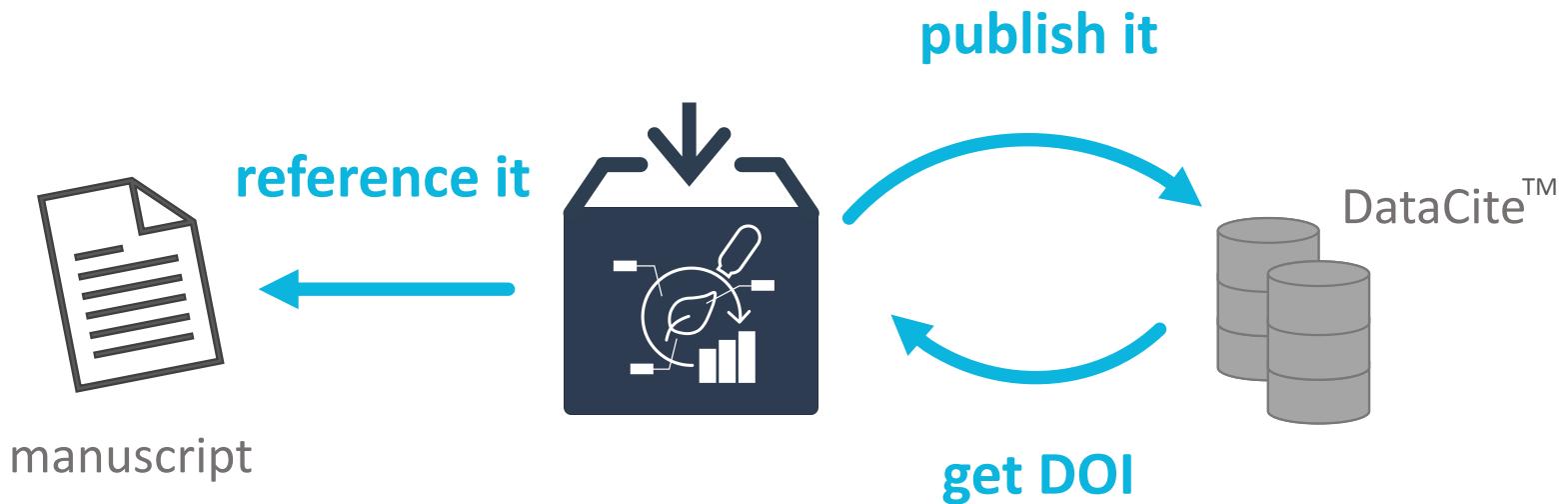
Moving from paper to FAIR data publication



Moving from paper to data publications



Publish your ARC, get a DOI



Publish your ARC with a few clicks

The screenshot shows a bioRxiv project page for 'Ru_ChlamyHeatstress'. The project icon features a green cell with a鞭毛 (flagella) and a red thermometer icon. The project ID is 122. The page displays 53 commits, 1 branch, 0 tags, and 293.9 GB of project storage. Topics include Chlamydomonas, abiotic stress, proteomics, and more. A note states: 'Algae cultures were grown mixotrophically (TAP). After 24h of 35°C/40°C the cells were shifted back to room temperature for 48h. 'omics samples were taken.' At the bottom, there are three numbered buttons: 1. pipeline (passed), 2. Publish ARC (blue button with a heart icon), and 3. arc quality (yellow button showing 301/301).

Ru_ChlamyHeatstress

Project ID: 122

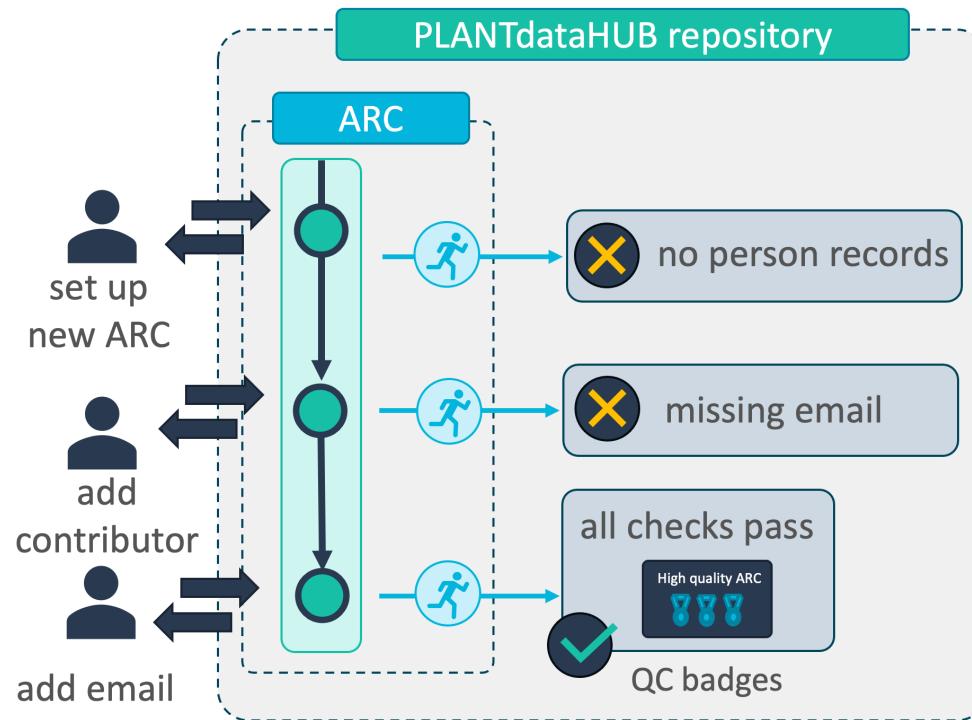
53 Commits 1 Branch 0 Tags 293.9 GB Project Storage

Topics: Chlamydomonas, abiotic stress, proteomics, + 1 more

Algae cultures were grown mixotrophically (TAP). After 24h of 35°C/40°C the cells were shifted back to room temperature for 48h. 'omics samples were taken.

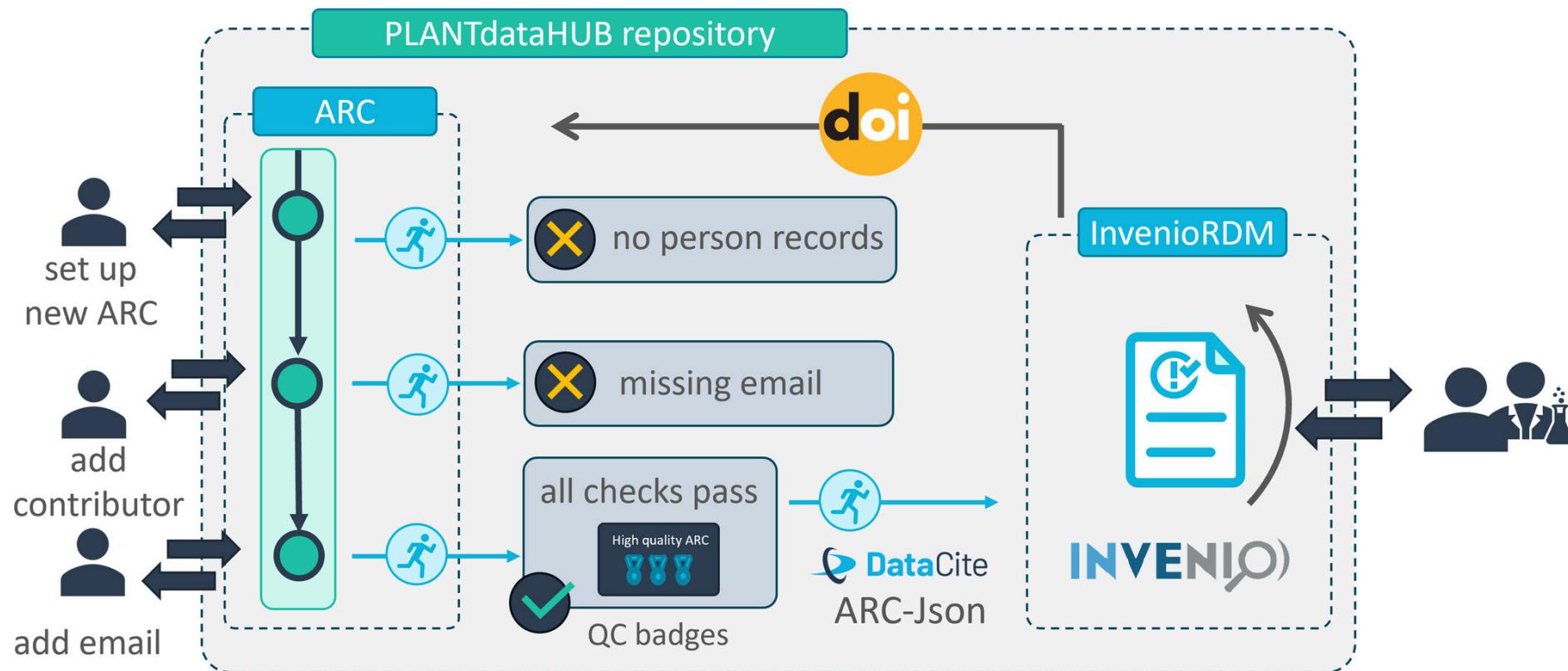
1 pipeline passed 2 Publish ARC 3 arc quality 301/301

Validation



adapted from Weil, H.L., Schneider, K., et al. (2023), PLANTdataHUB: a collaborative platform for continuous FAIR data sharing in plant research. Plant J. <https://doi.org/10.1111/tpj.16474>

Validate & publish



Validation towards publication

Receive a DOI

Published September 7, 2023 | Version v1

Dataset  Open

Systems-wide investigation of responses to moderate and acute high temperatures in the green alga *Chlamydomonas reinhardtii*.

Zhang, Ningning¹; Mattoon, Erin¹; McHargue, Will¹ ; Venn, Benedict² ; Zimmer, David² ; Pecani, Kresti³; Jeong, Jooyeon¹; Anderson, Cheyenne¹; Chen, Chen⁴; Berry, Jeffrey¹; Xia, Ming¹; Tzeng, Shin-Cheng¹ ; Becker, Eric¹; Pazouki, Leila¹; Evans, Bradley¹; Cross, Fred³; Cheng, Jianlin⁴; Czymmek, Kirk¹ ; Schröda, Michael⁵ ; Mühlhaus, Timo² ; Zhang, Ru¹ 

Show affiliations

Style APA 

1

Citation

Zhang, N., Mattoon, E., McHargue, W., Venn, B., Zimmer, D., Pecani, K., Jeong, J., Anderson, C., Chen, C., Berry, J., Xia, M., Tzeng, S.-C., Becker, E., Pazouki, L., Evans, B., Cross, F., Cheng, J., Czymmek, K., Schröda, M., ... Zhang, R. (2023). Systems-wide investigation of responses to moderate and acute high temperatures in the green alga *Chlamydomonas reinhardtii*. [Data set]. DataPLANT. <https://doi.org/10.60534/9e5jx-75d83>

2

Details

DOI

DOI [10.60534/9e5jx-75d83](https://doi.org/10.60534/9e5jx-75d83)

Resource type

Dataset

Publisher

DataPLANT

Export

JSON

Export

Description

hosted on: <https://git.nfdl4plants.org/projects/122>

Files

arc-summary.md

[Data set] Systems-wide investigation of responses to moderate and acute high temperatures in the green alga *Chlamydomonas reinhardtii*.

File contents:

- root
 - isa.investigation.xlsx
 - README.md
 - runs

Hands-on part 5: Data publication

1. ARC validation
2. (Towards) ARC publication

Q&A and Wrap-up

DataPLANT Resources – join the open source movement

DataPLANT Website: <https://nfdi4plants.org/>

Knowledge Base: <https://nfdi4plants.org/nfdi4plants.knowledgebase/>

DataHUB: <https://git.nfdi4plants.org>

GitHub: <https://github.com/nfdi4plants>

HelpDesk: <https://helpdesk.nfdi4plants.org>

 You can help us by raising issues, bugs, ideas...

 NEW! ARC website: <https://arc-rdm.org>

Continuous support

Data managers in Düsseldorf, Cologne, Jülich and close by (CEPLAS, MibiNet, TRR341) offer support.

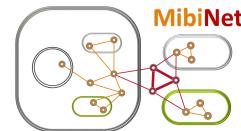
1. Slack Workspace for ad hoc support
2. Monthly user meeting (2nd Friday of the month)

→ [Details](#).



trr_341

plant
ecological
genetics



Five-Finger-Feedback



Contributors

If not referenced otherwise, figures and slides presented here were created by members of DataPLANT (<https://nfdi4plants.org>).

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