openBIS Training

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https://openbis-training.ethz.ch/openbis/webapp/eln-lims/?
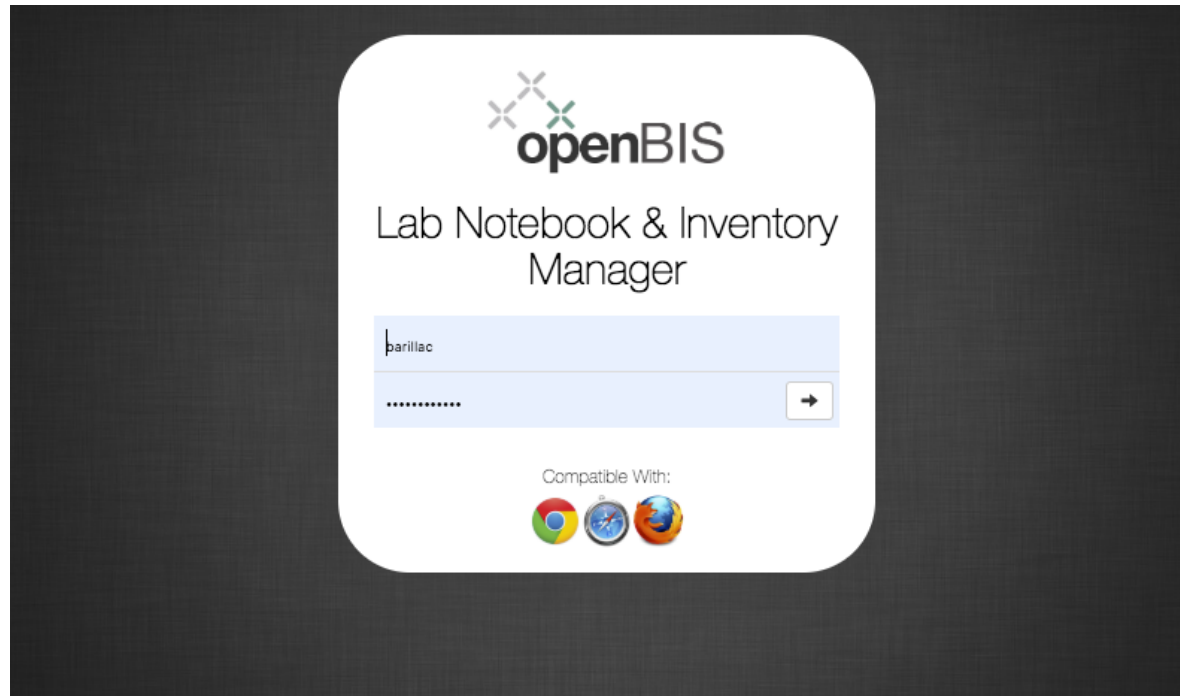
Overview of training course

1. Introduction to basic openBIS concepts

2. Hands-on tutorial:

    1. Registration of samples in openBIS Materials Inventory

    2. Registration of protocols in openBIS Methods Inventory

    3. Recording experiments and uploading data in openBIS Lab notebook

Basic openBIS concepts

openBIS data structure

Space
Project
Experiment/Collection
Object/Sample
Data Set
Data Set
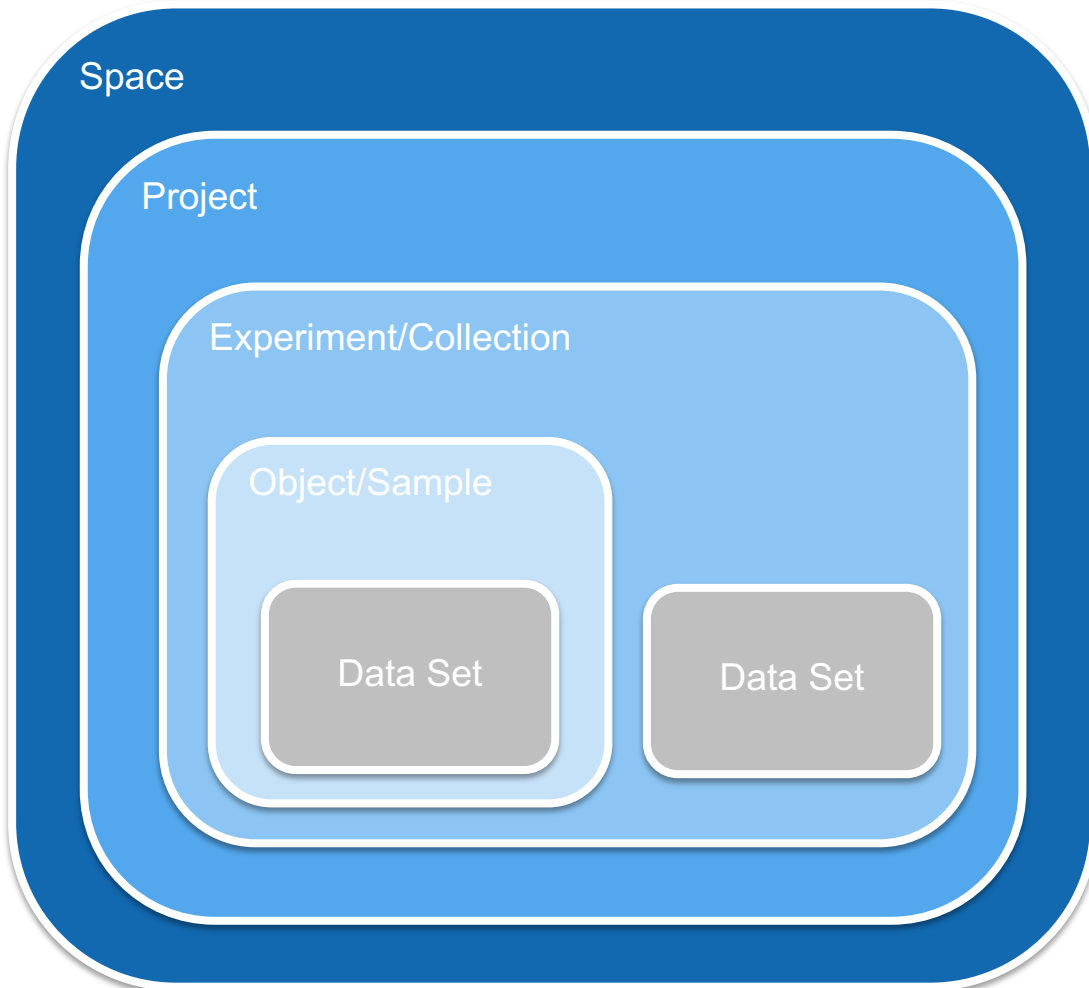
1. **Folder with only code + description**

2. **Folder with code + description**

3. **Folder with code + user-defined properties**. There can be several types of Experiment/Collection, each defined by different properties. Example: *microscopy experiment, PCR experiment, etc…*

4. **Basic entity with code + user-defined properties**. There can be several types of Objects/Samples, each defined by different properties. Examples: *Antibody, Chemical, Sensor, Chip, General protocol, Experimental Step…*

5. **Folder for storing data files with code + user-defined properties**. There can be several types of Data sets, each defined by different properties.

Linking objects and datasets

- Objects can be linked to other objects, datasets to other datasets with *N:N* relationship

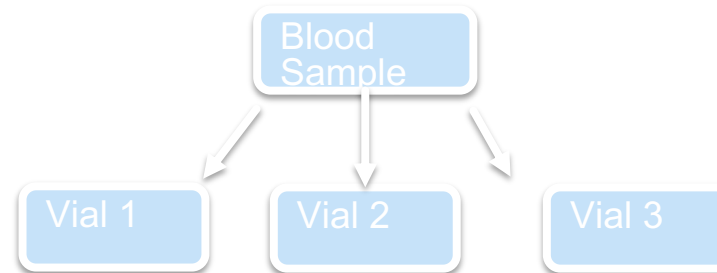- In openBIS terms, these are "parent-child" relationships
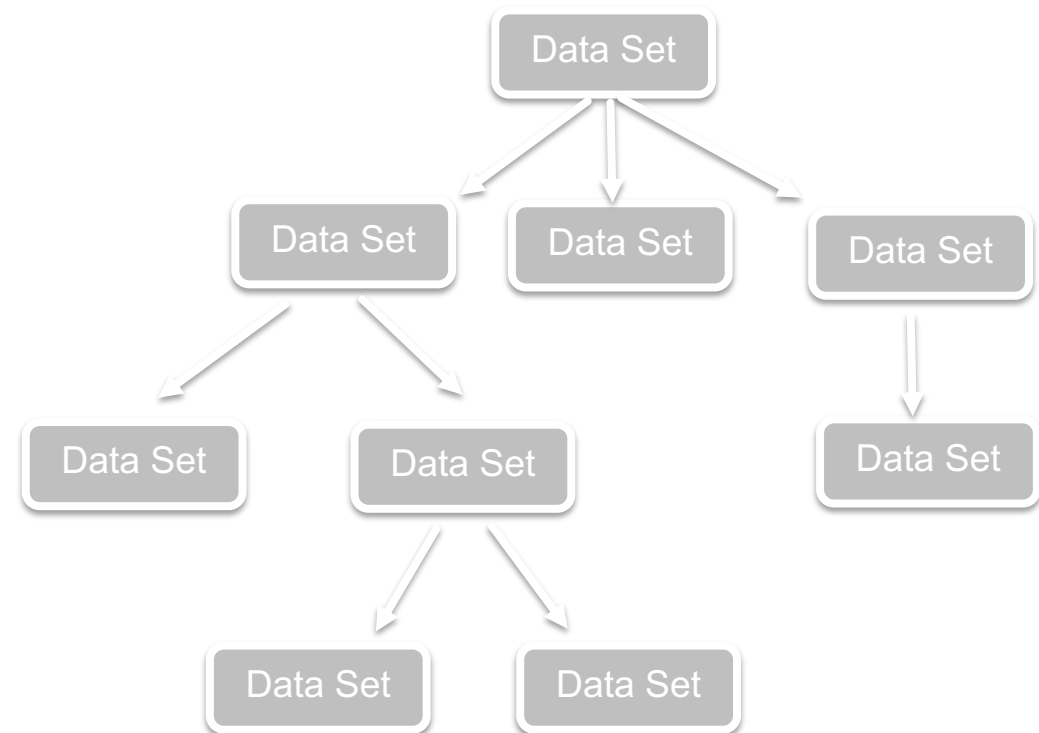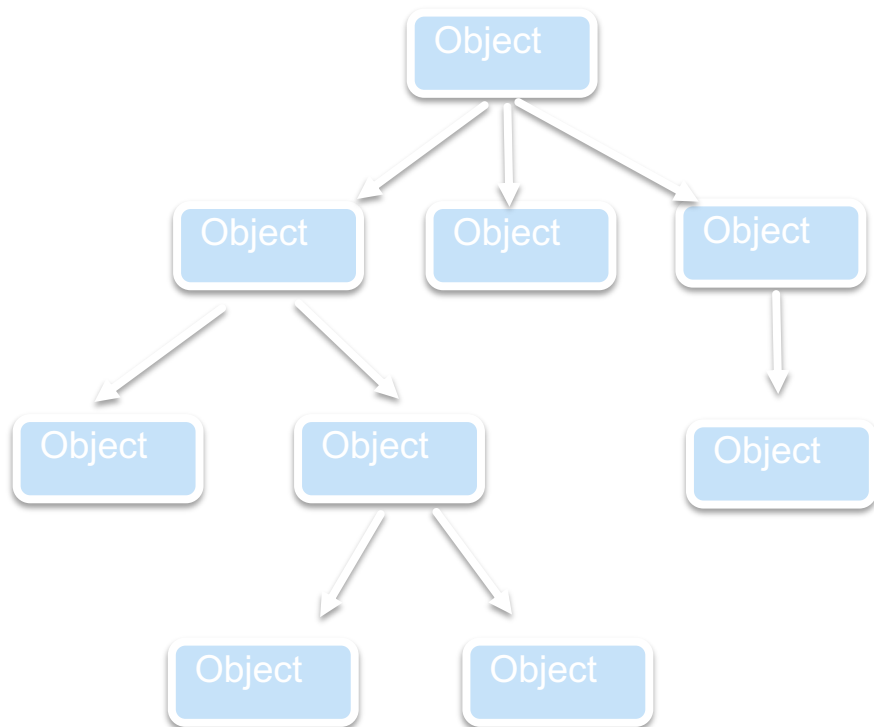
What are "parents" and "children"?

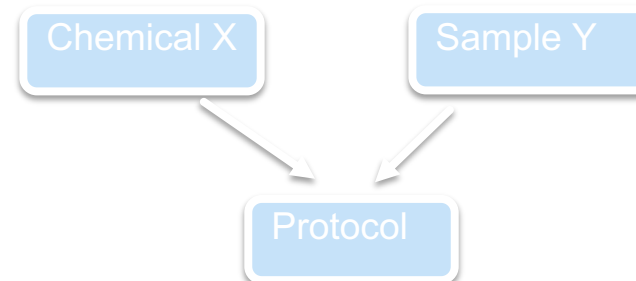- They are a way of connecting entities together.

- Examples:

1. One sample is split into several vials and each of them is used for different types of measurements.

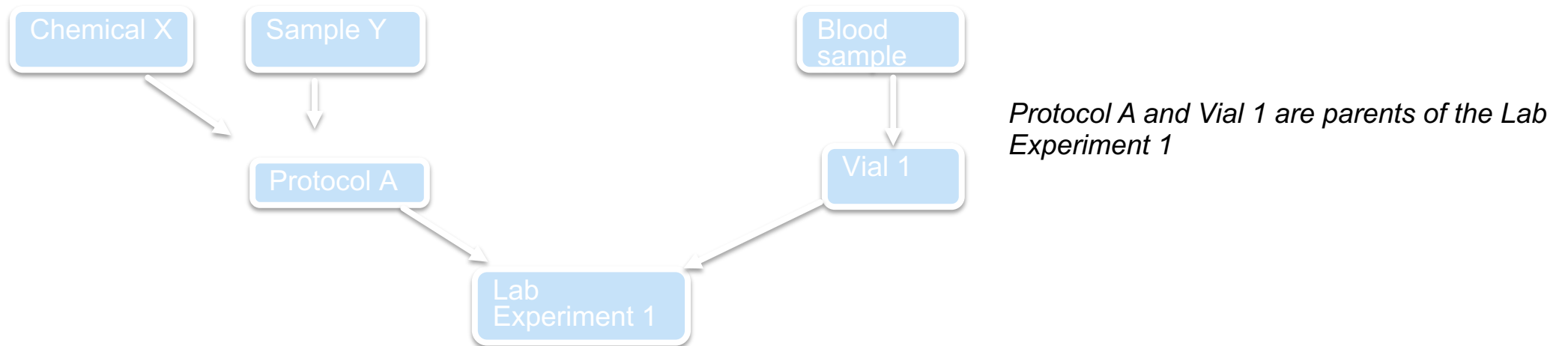*The Blood Sample is parent of the samples in each vial*

2. You write a protocol, and want to keep track of the samples used.

Chemical X and Sample Y are parents of the protocol

What are "parents" and "children"?

3. You describe an experiment and you want to keep track of the protocol(s) and samples used

Protocol A and Vial 1 are parents of the Lab Experiment 1

4. You make one experiment in several steps and you want to link each step to the previous one
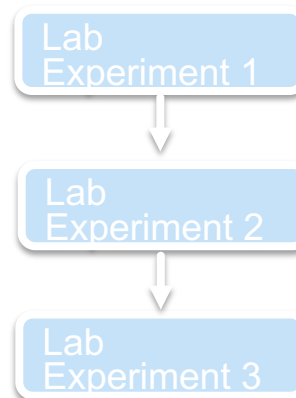
Roles

Role	Capabilities
Observer (Space or Instance)	Read-only access to given spaces or to the whole instance.
Space/Project user	Create + edit Object, Experiment. Edit Project .
Space/Project power user	User rights +create Projects . Delete object, experiment, project, datasets. Add, update vocabulary terms.
Space/Project admin	Power user rights+ list roles; create and delete space roles; edit datasets.
Instance admin	Space admin rights + create types. Has access to everything.

Informatikdienste

Freezing entities

It is possible to "freeze" every level of the openBIS hierarchy.

Freezing entities

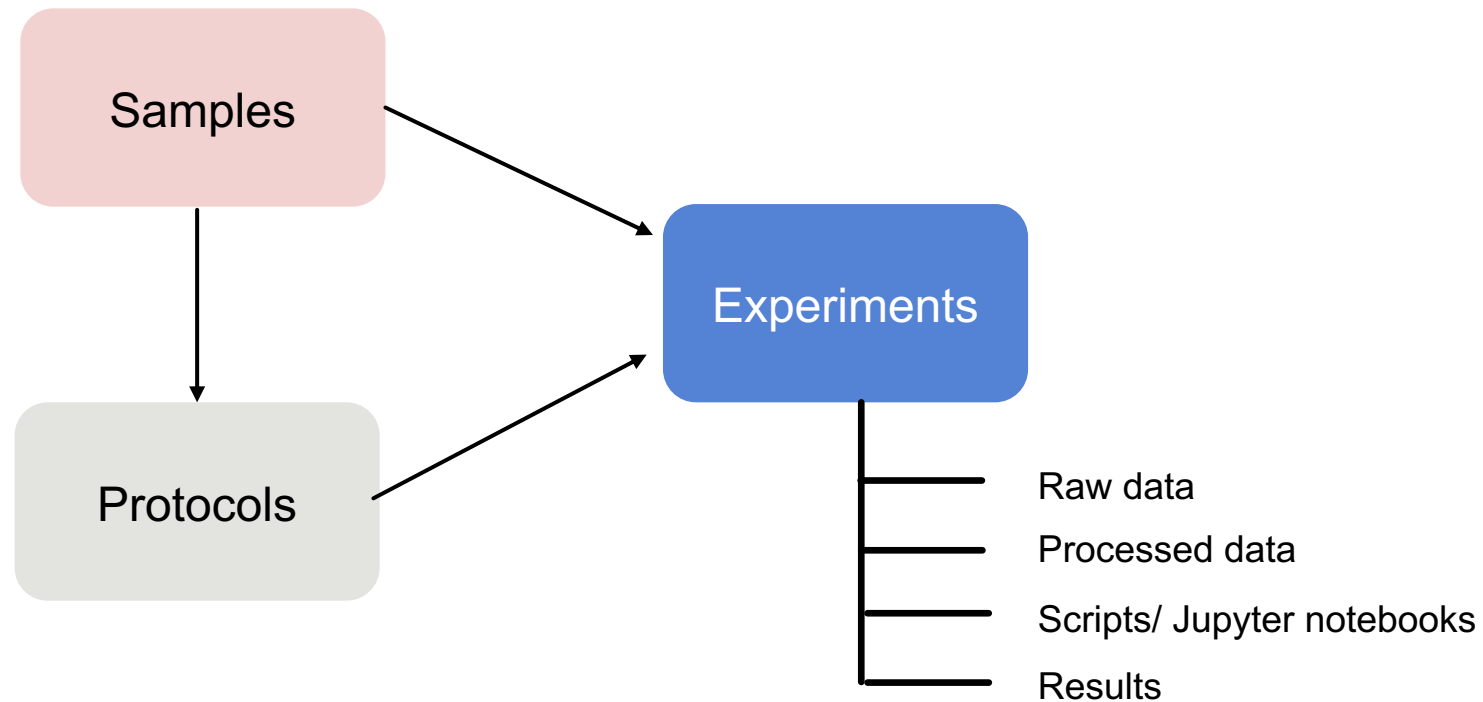At every level, everything below is always selected to be frozen. Selection can be modified.

How to use the openBIS Inventory & Lab Notebook

Inventory

Shared by all lab members.

Lab Notebook

Personal space. Can be shared.

Samples

Protocols

Experiments

Raw data

Processed data

Scripts/ Jupyter notebooks

Results

Informatikdienste

Organization of openBIS Lab Notebook

- In the Lab Notebook part of openBIS, usually each user has a **personal Space** where to organize **Projects** and **Experiments**

- An openBIS **Experiment** is a specific scientific question. The single attempts to answer this question can be modelled as **Experimental Steps**.

- **Experimental Steps** can be linked to samples, protocols, other Experimental Steps

- Data (raw, processed, analysed, final results) can be attached to Experiments or Experimental steps in **Datasets**

openBIS Lab notebook
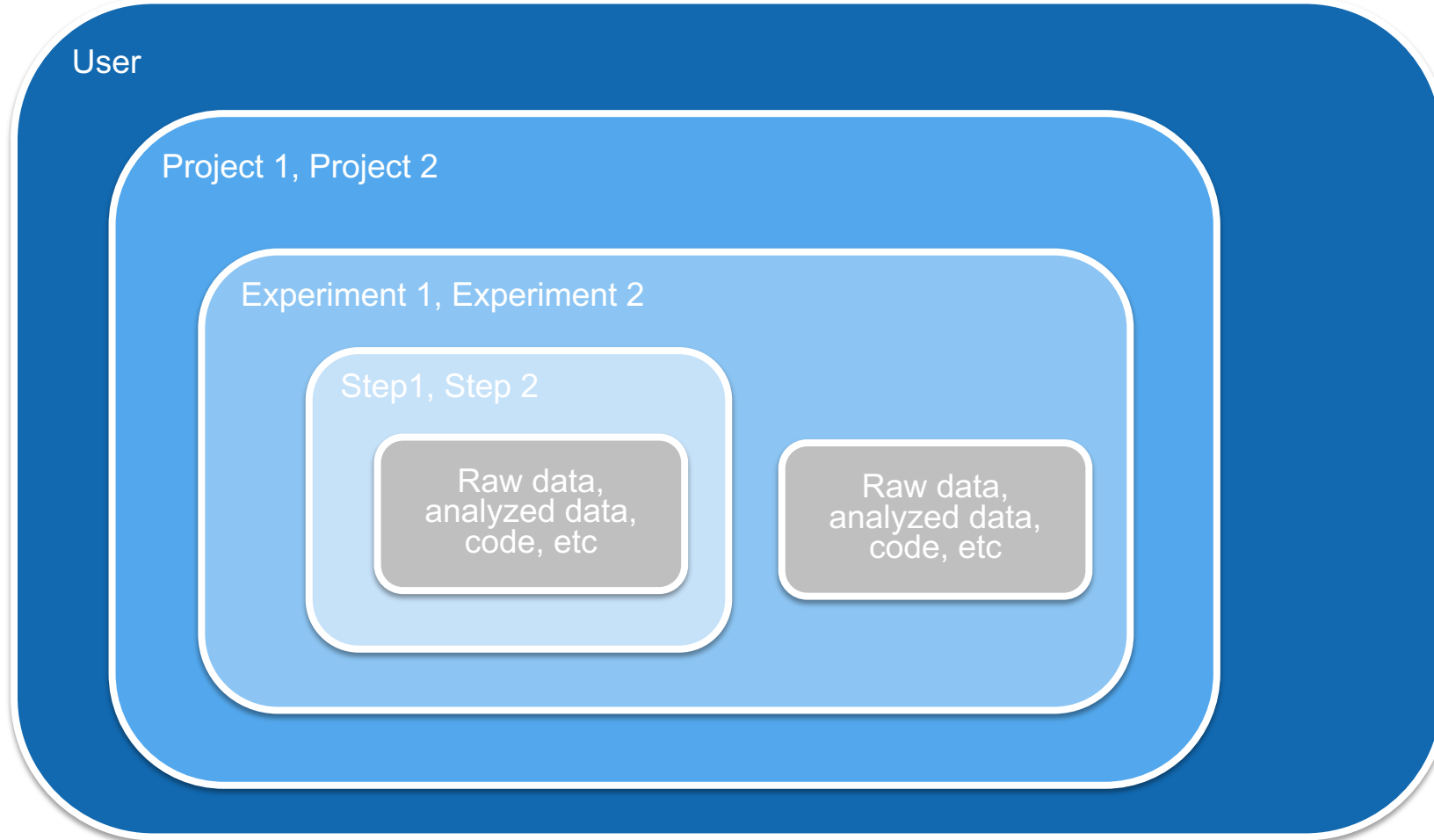
Protocols or Experimental Steps?

- Protocols are standard procedures used in the lab that need to be shared with all lab members

- Every time a given protocol is followed when performing one Experimental Step, the protocol can be linked as parent and the experimental details should be recorded in the Experimental Step itself.
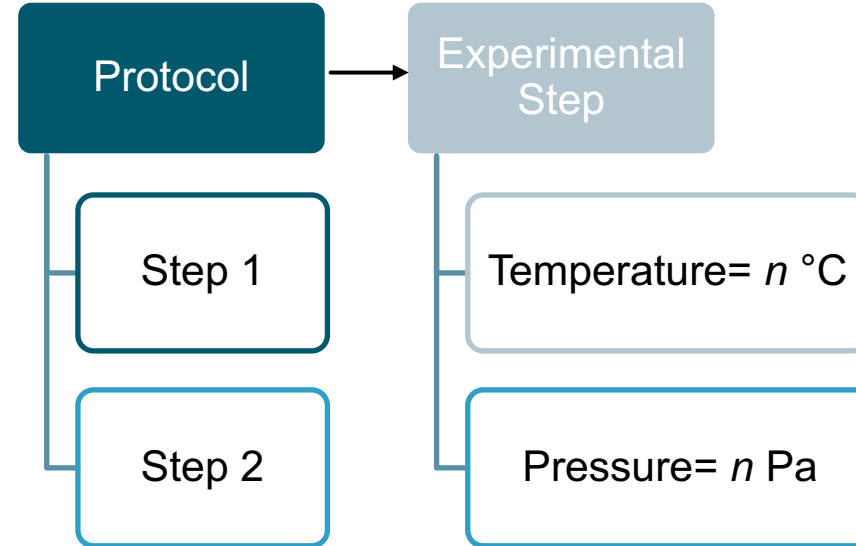
Example

Protocol: muffins recipe

Ingredients

- 2 medium eggs
- 125ml vegetable oil
- 250ml semi-skimmed milk
- 250g golden caster sugar
- 400g self-raising flour (or same quantity plain flour and 3 tsp baking powder)
- 1 tsp salt
- 100g chocolate chips or dried fruit such as sultanas or dried cherries (optional)

Method

1. Heat oven to 200C/180C fan/gas 6. Line 2 muffin trays with paper muffin cases. In a large bowl beat 2 medium eggs lightly with a handheld electric mixer for 1 min.

2. Add 125ml vegetable oil and 250ml semi-skimmed milk and beat until just combined then add 250g golden caster sugar and whisk until you have a smooth batter.

3. Sift in 400g self-raising flour and 1 tsp salt (or 400g plain flour and 3 tsp baking powder if using) then mix until just smooth. Be careful not to over-mix the batter as this will make the muffins tough.

4. Stir in 100g chocolate chips or dried fruit if using.

5. Fill muffin cases two-thirds full and bake for 20-25 mins, until risen, firm to the touch and a skewer inserted in the middle comes out clean. If the trays will not fit on 1 shelf, swap the shelves around after 15 mins of cooking.

6. Leave the muffins in the tin to cool for a few mins and transfer to a wire rack to cool completely.

Experimental Step: making muffins

- I use 240 ml of whole milk, instead of 250 ml semi-skimmed

- I add a teaspoon of sodium bicarbonate

- I cook the muffins for 30 mins at 180°C

The protocol gives me directions and defines the steps; When I perform my experiment I can change some parameters and this needs to be recorded.
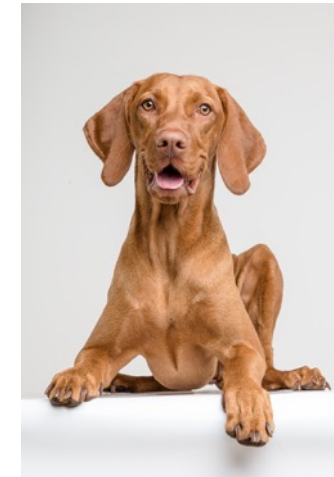
Overview of today's openBIS tutorial

Example: RNA sequencing study of 8 different dog breeds
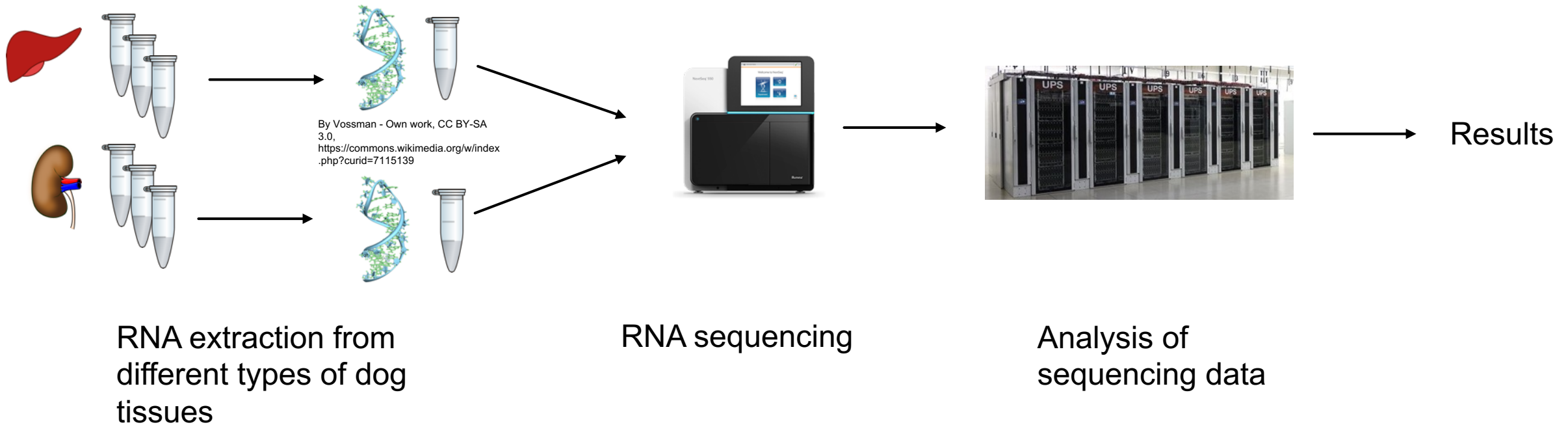
Goal of the study: *understand intra breed genetic variability of dogs with special reference to Beagle dog, since Beagles are used as an animal model for compound testing in the pharma industry.*

The eight different dog breeds are as follows:

1. Beagle
2. GSD
3. Golden Retriver
4. Terrier
5. King Charles
6. Poodle
7. Rottweiler
8. West Highland White Terrier

Overview of the study process

By Vossman - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7115139

RNA extraction from different types of dog tissues

RNA sequencing

Analysis of sequencing data

Results

Overview of the study process

Experiments:

1. RNA extraction
2. RNA sequencing
3. Data analysis

Protocols:

1. RNA extraction
2. RNA sequencing

Samples:

1. Tissues
2. Chemicals
3. RNA extracts

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How does the process look like in openBIS?

# How does the process look like in openBIS?

Management of samples and protocols

We will register a few samples and one protocol in the inventory, covering different topics:

1. Single sample registration

2. Batch registration of samples

3. Batch modification of samples

4. How to assign storage positions to samples

5. How to register a standard lab protocol

Lab notebook

Intra breed genetic variability of dogs

RNA analysis of 8 dog breeds

RNA extraction

Sequencing read of RNA extracts

Fasta files

Data analysis
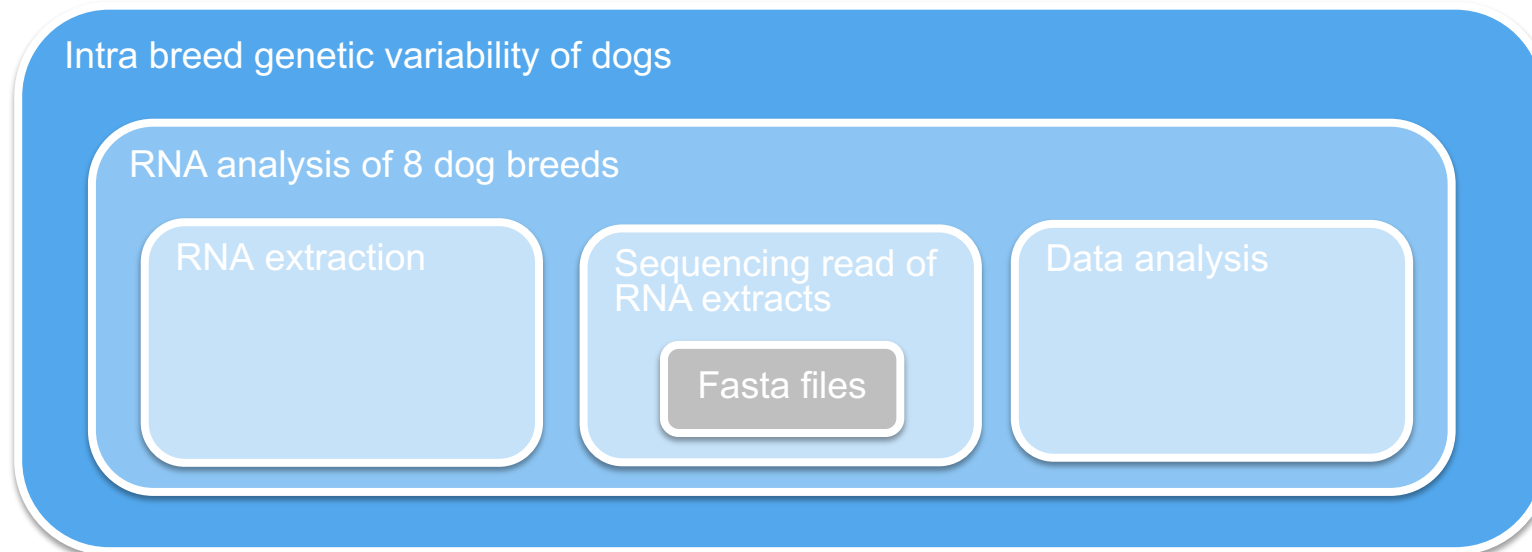
- We will create **1 Project, 1 Experiment and 3 Experimental Steps** in your personal space.

- We will see how we can **link** samples and protocols stored in the Inventory to the Experimental Step.

- We will **upload data** to the Experimental Step.

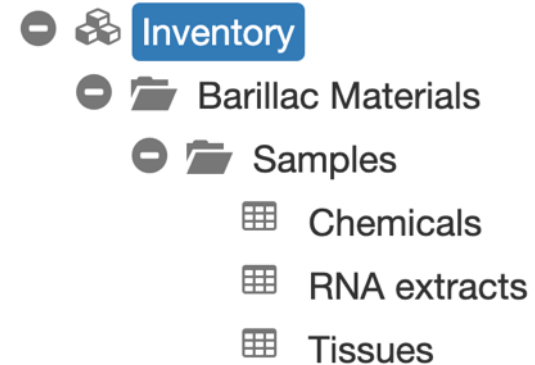# Practical sessions

Session 1

➤ Registration and copy of tissue samples: *sections 3.1.1 + 3.1.2 on pages 3, 4*

➤ Batch registration of chemical samples: *section 3.1.3, page 4*

➤ Deletion of duplicate objects: *section 3.1.4, page 4*
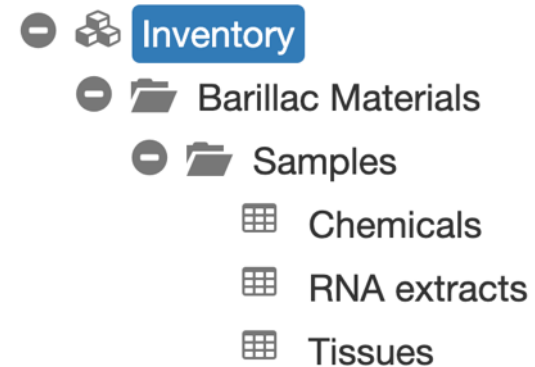
10 min

Session 2

➢ Batch modification of chemical samples: *section 3.1.5, page 5*

🔴 To do together

Session 3

➢ Visualization of storage positions in the Storage Manager: *section 3.2, pages 5,6*

🔴 To do together

Session 4

➤ Registration of RNA extraction protocol: *section 3.3.1, page 6*

5 min

⊖ 📂 Barillac Methods
⊖ 📂 Protocols
⊞ RNA extraction protocols

Short break

15 min

Session 5

➢ Registration of project and experiment: *section 4.1, 4.2 pages 7,8*

5 min

Intra breed genetic variability of dogs

RNA analysis of 8 dog breeds

Session 6

- ➢ Registration of an Experimental Step: *section 4.3, pages 8, 9*

5 min

Intra breed genetic variability of dogs

RNA analysis of 8 dog breeds

RNA extraction

Session 7

➤ Registration of RNA extacts in Inventory: *section 4.3.1, page 9*

➤ Registration of RNA sequencing Experimental Step + data upload: *sections 4.3.2, 4.3.3, pages 9, 10*

10 min

Session 8

➢ Registration of Data Analysis Entry: *section 4.3.4, page 10*

5 min

Intra breed genetic variability of dogs

RNA analysis of 8 dog breeds

RNA extraction

Sequencing read of RNA extracts

Fasta files

Data analysis

Session 9

➢ Data visualization + data export: *sections 4.3.5, 4.4, page 11*

🔴 To do together

Session 10

➢ Assign access rights to notebook: *section 4.5, page 11*

➢ Searching the ELN: *sections 5.1, 5.1.1., 5.2, pages 12, 13*

10 min

Session 11

➢ Freezing entities: *section 6, page 13*

🔴 To do together

Contacts & useful info

Documentation & video tutorials: https://openbis.ch/

SIS website: https://sis.id.ethz.ch/

Twitter: https://twitter.com/ETH_SIS

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