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Agenda

Introduction to Benchling and best practices

~ 30 min

Hands-on

~ 15 min



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~ 15 min



What is a LIMS?





What is a LIMS?

L.I.M.S = Laboratory Information Management System

- It keeps track of laboratory data associated with samples and experiments
- At Biosustain, we use **Benchling**, a Cloud-based platform



biosustain.benchling.com



Main functionalities



Samples storage

 Samples transfer in boxes/plates

Molecular Biology tool

- Import of sequences
- Plasmid design and annotation

Requests

- Samples submission for analysis
- Lab material order request











Working with Benchling

Benefits

- Facilitates passing over of projects
- Foster collaboration
- Promotes data capture in a defined place preventing its loss
- Make knowledge findable
- Promotes the adoption of **common practices** across research groups

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Working with Benchling

Obstacles

- Adapting to a new way of working
- Software limitations and "pain points"
- Learning curve
 - Many functionalities
 - Complex / confusing data model



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- ✓ Record all necessary information to make your experiment clear to others and reproducible
- ✓ Register important data (strains, media, plasmids...)
- ✓ Keep your project folders organized and use **clear names** and **descriptions**



Make sure not to save relevant data in the Biosustain Training project folder

e e	Projects / Biosustain Training /	We noticed that the list include real data
	Inventory 🏚 Saved Searches 👻	
ĉ	Q Search	
Q	< > 1-100 of 2227 items 📚	



- ✓ <u>Reach out</u> when struggling using the platform
- ✓ There might be a quicker and easier way to do what you are doing !

Submit your questions to lims_support@biosustain.dtu.dk



Get hands-on Benchling support

Mondays 13:00 -14:00 (Room 222)





Getting started

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Step 1: Create your project folderStep 2: Create your experiment ELN & register samples

Step 3: Navigate through your data



Step 1: Create your project folder





Your Project folder will contain:

- ✓ your Electronic Notebook pages (called "Entries")
- ✓ your registry items (called "Entities") strains, plasmids,....





Example of folder structure







To create a New Project:

- Click on the "Project" icon
- Click on the "+" icon
- Give the folder a clear name (e.g., your PhD project title)







Star ***** your Project:

 This way, it will appear on top of every other Project that you have access to







Give access to your team

- Almost all Research groups
 have a Benchling Team
- When possible, add your
 Team among the collaborators of the Project

My PhD proje	ect title 🌣 👻	
Q Search		
ject Settings		
ie"		
y PhD project title		
Search for a user, emai	II, team, organization, or	r app Add collaborator
User / App / Organization / Team	Access policies	Auditor
Members of DTU Blosustal	n NONE	~
Ester Milesi	ADMIN	✓
DNA Foundry (NGS)	READ	✓
	GS) ADMIN	~
	GS) ADMIN	~

Projects





Benefits

- ✓ You don't have to add each member one-by-one
- When new researchers join the Team, they get automatically access to all shared Project folders

	My PhD project t	iitle 🌣 🔽
Project	t Settings	+ ×
Name"		
My PhD) project title	
Mana	age collaborators	
Se	earch for a user, email, tea	am, organization, or app Add collaborator
Colla	borators	
Use Tea	er / App / Organization / m	Access policies Auditor
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DN	A Foundry (NGS)	READ ~
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Draiaata





Creating subfolders

To create a subfolder:

- Enter your newly created
 Project
- Click on the "+" icon
- Select "Folder"

e	Projects / My PhD project title 🌣 🔽	+		
Ê	Q Search	Se	earch	
٩	Type 👻 \Xi Filters		Folder	
+	No items found	D	Entry	>
			Protocol	
		X	DNA / RNA Sequence	>
8		4	AA Sequence	>
.th		4	Oligo	>
		*	CRISPR	>
<u>Lili</u>			Entity from Schema	>
		•••	Mixture	>
		Мо	re	>





Step 2: Create your experiment ELN & create samples





To create a new Entry:

- Go to the relevant folder (e.g., "Experiments")
- Click on the "+" icon
- Select "Entry"





Option 1:

Blank entry

Option 2:

New Entry from Template

--- you can create your own!





Option 3:

- Blank entry + Sub-Template
- --- you can create your own!





To create a Template or a Sub-template:

- Go to your profile
- Go to Feature settings
- Go to Template collections

Registry settings +Ħ Inventory settings EM Monomer library Template collections Ħ DTU Entry review processes DTU Biosustain Run schemas * IPC Analytics **Result schemas** Р Purchasing 2 **Request schemas** RA Registry Admins Ø 2 Workflow schemas Feature settings ա Molecular biology settings S 3 Data export Help + Create or join organization [+ Sign out

Create your own!



To create a Template or a Sub-template:

- Go to your profile
- Go to Feature settings
- Go to Template collections

Template Collections	> My temp	lates		
Q Search ≪ < > ≫ 1-4 of 4 items	All items V	Filtering by: N	lot archived $ \checkmark $	Create - Template
NAME	TYPE	AUTHOR	CREATED	Sub-template

Create your own!



In your Entry you can:

- Take notes
- Add attachments/files
- Create tables

Click on **Insert** to see the whole list of options





In your Entry you can:

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- Register strains, media, etc. • using Registration tables
- Assign storage location to ٠ registered entities



REVIEW

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My experiment

5 C METADATA

Н 🔻

В

RELEVANT ITEMS

NOTES

Insert -

ADD PROTOCOL

= more of this in the Hands-on

A Registration table for strains

MY TEST PROTOCOL

More -



In your Entry you can:

- Tag your plasmids, sequences, etc. (everything that you create)
- Tag another ELN or SOP



My experime	nt	3	×				
ADD PROTOCOL	NOTES	METADATA	REI	_EVAN	IT ITEMS	F	REVIEW
- 5 C	Insert -	H 🕶 H	BI	U	ۍ ۵		A -
ELN23002	866						
li My	/ exp	erin	lei	nt			
THURSDAY,	01/06/2023						
又 PUC18							
SOP		Link t	оа	pla	smi	d	
	Lii	nk to a	SO	Ρ			



Step 3: Navigate through your data



Global search

It allows to search through all your data and filter by:

- Data type (samples, boxes...)
- Folder
- Metadata field

Filter
 None
🕨 🚖 LIMS administration biosustain
LIMS administration - shared biosustain
My PhD project title biosustain
Purchasing system - Processed Orders & Suppliers biosustain
Registry biosustain



The Novo Nordisk Foundation Center for Biosustainability



Global search

Expand view to do bulk actions on your data:

- Bulk edit of metadata fields
- Bulk registration of imported sequences
- Bulk transfer to a different folder
- Bulk archive



2 -





Benchling entities: what you need to know





1. Entities can store different information





Entity types that can store:

- metadata
- a sequence

O DNA sequence
 ⇒ DNA oligo
 ▲ A sequence

lata			
	O Iraining plasmid esterm X		
Innca	SEQUENCE MAP	LINEAR MAP PLASMID DESCRIPTION M	IETADATA RESULTS •••• [2] S
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	BsaXI TfiI PvuII	Training plasmid esterm	🖻 🖆 🔛 🚥
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D I	1 1 1 1 1 1 1 10 20 30 40 50 60 70	Authors Ester Milesi	Project Location
ence	actggaaagcgggcagtgagcgcaacgcaattaatgtgagttagctcactca	Registry IDs PL7248 DTU Biosustain	Created 04/04/2022 14:07
	tttatgcttccggctcgtatgttgtgtggaattgtgagcggataacaatttcacacaggaaacagctatgacca	Aliases 🕇	
	Laco M13-rev »	This entity has no aliases.	
	150 160 170 180 190 200 210 220		
	Acc65I EcoRI	Schema	Edit
	HincII TspMI ApoI AccI BsoBI BamII	Plasmid V	
	BspMI Sali XmaI Eco53kI BfuAI Sbfi AvaI B¢eAI	Cannot change schema of registered entities	
	HindIII SphI PstI XbaI BamHI SmaI KpnI Sa¢I	FIELD	VALUE AUTO-FILL PARTS
	actaatgcggttcgaacgtacggacgtccagctgagatctcctaggggcccatggctcgagcttaagtgaccgg	Responsible person/group	LIMS support
Sequence		Usage	This is a training plasmid
ocquence	230 240 230 200 270 200 230	Status	Planned
	BmrI gtcgttttacaacgtcgtgactgggaaaaccctggcgttacccaacttaatcgccttgcagcacatcccccttt	Parent plasmids	Ö Training parent plasmid
	cagcaaaatgttgcagcactgacccttttgggaccgcaatgggttgaattagcggaacgtcgtgtagggggaaa	Cloning sites	
	I I	Antibiotic resistance	



DIU	
en 1	

Entity types that can store:

- metadata
- Custom entity

Estormtost 01	
EStermitest_OT	
Authors	Project location
Ester Milesi	🖿 Experiments 🔔
Registry ID	Registered in
STRAIN25640	Strains registration 21/03/2024 Esterm
DTU Biosustain	
Created	
21/03/2024 13:44	
Aliases +	
This entity has no aliases.	
Schema	Edit
Strain	×
Cannot change schema of registered entities	
FIELD	VALUE
Organism	🛷 Escherichia coli
Designed by	
Status	
Host strain	
Parent strain	



Entity types that can store:

metadata •

Mixture

••

media ingredients and recipe •

(with amount)

Recipe







2. Entities are assigned a "schema"

→ The "type" only tells you which information the entity stores

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The various sample types are described by "schemas"

	Entity type: "DNA sequence"
	Schemas
gene	
	terminator
plasmid	
picolitic	promoter
origin of rep	olication



2. Entities are assigned a "schema"

A schema specifies:

sample type

Q

- required information to fill-in
- links to other schemas

Entity type: "DNA sequence" Schemas	
gene terminator	
plasmid promoter	
origin of replication)



2. Entities are assigned a "schema"

A schema specifies:

sample type

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- required information to fill-in
- Iinks to other schemas

Entity type: "DNA sequence" Schemas	
gene terminator	
plasmid promoter	
origin of replication	



2. Entities are assigned a "schema"

For example, the schema "Strain" can link to another strain (parent) and to a plasmid

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Links % allow to track the sample "history"





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....

÷.

3. You can create entities 1-by-1 or in bulk

To create entities 1-by-1:

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- Go to Registry > Click on the "+" icon
- Select the entity type e.g., "DNA sequence"
- Select the schema e.g., "Plasmid"

Registri DTU E	_{es /} Biosustain 🌣		< +
Q Sea	arch		Import entities Update entities
			Import mixture ingredients Reimport DNA / RNA sequences
	- DNA Fragment	ے ا	DNA sequence
	- Gene - gRNA		DNA oligo AA sequence
	MarkerOrigin of Replication		Custom entity Mixture
	り Plasmid - Promoter		
	– Tag – Terminator		





3. You can create entities 1-by-1 or in bulk

To create entities in bulk:

DTU

• Upload a **spreadsheet** Select *import* or *update entities*

(make sure that the values in the cells are the one that Benchling expects)







3. You can create entities 1-by-1 or in bulk

To create entities in bulk:

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 Use a registration table directly in the Electronic Notebook

Click "**Insert**" > "Registration table" > Select Schema

ADD PR	отос	COL	NOTES	METADAT	A				
₽∨	C	C	Insert 🗸	$\rm H \checkmark$	В	I	U	÷	Ø
		Ste	p 1 - Register	Experir	nent				
		Ste	p 2 - Registe	r Media					
		Ste	n 3 - Registe	r Strains					

- Step 4 Register Fermentation Cultures and
- Step 5 Register Timepoint Samples
- Step 6 Register Analytical Submission Sam
- Step 7 Move Analytical Submission Sample

Tip: To create multiple entities of the same so





4. Some entities have "batches" schemas

Batches = physical samples

- When storing your sample long-term, create batches in Benchling
- This helps your team to track
 where samples are stored







4. Some entities have "batches" schemas

Batches = physical samples

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- When storing your sample long-term, create batches in Benchling
- This helps your team to track where samples are stored





5. Entities can exist outside of the Registry

Sometime, entities are not automatically registered

Q

- In order to register an entity, you need to select the Schema (entity type)
- Registering the entity will add a
 unique identifier to your
 sample

🔀 My test plasi	mid pDOG8	×			
SEQUENCE MAP	LINEAR MAP	PLASMID	METADATA	000	☑ Share
My test plas pDOG8	mid		₽ ≓ Reg	gister	
Authors					- 11
Ester Milesi			When y	our entit	y is
Created 31/05/2023 10:2	29		ready, c	lick " Re ę	gister"





DTU

(If you haven't done this consistently during your project)

At the end of your project:

- Re-organize your registered samples and entries and give access to your team
- ✓ Register important strains/other samples and their location, and print the label for the Box before moving it in the freezer





Storage: track your samples





The Inventory

DTU

Benchling allows you to track the location of your samples

Room > Fridge > Box > Vial

If your fridge/location is not registered, let RDM support know



Create new box/plate/vial



The Inventory

Storable samples include:

- Batches (e.g., "Strain batch")
- Fermentation cultures
- Submission samples (e.g., for analysis)



Error showed in an Inventory table in the Notebook when trying to move a "Strain" in a Vial instead of a "Strain batch"

The Inventory

Benchling allows you to track the volume or concentration in of each vial

• Example of a **Box** in Benchling

pecified	20	
		uL v
Training box esterm	×	
Training box esterm Barcode 81BOX984 Location ⊟ DTU Building 220	⁷ Training Location 🛨 ×	Move 🗎 🖬 🔞
1 2 3 4 5 6	7 8 9	
A 1 2 3 4 5 6	7 8 9 Actions •	
C 19 20 21 22 23 24	25 26 27	
D 28 29 30 31 32 33	34 35 36	Container Quantity U
E 37 38 39 40 41 42	43 44 45 I A1	Training vial e 20 uL
F 46 47 48 49 50 51	52 53 54 🗹 2 A2	Training vial fc 40 uL
G 55 56 57 58 59 60	61 62 63	
	70 71 72	
H 64 65 66 67 68 69		



Lastly: Archiving





Archiving entities

Nothing can be deleted but only archived

- You can archive
 - ✓ Project folders
 - ✓ ELN entries
 - ✓ Entities

If you created them **by mistake** or if they are not relevant

	Proj Exp	ects / My PhD project title / Deriments 🌣 🛛 Saved Se	arches 🔻			< +
ê	٩	Search		Type 🔻 🖬 Archiv	<i>v</i> e	
q	< :	🕨 1-5 of 5 Items 😓	3 rows selected			More 🔻
		Name	\checkmark	Inventory	ID 🗸	Modified
+	D	Fed-batch experiment FB	E001		ELN23000128	11/01/2023
		Culture FBE001 - 3 FCULT	Г6728	No Inventor	FCULT6728	06/01/2023
	•	Culture FBE001 - 2 FCUL	Г6726	No inventor	FCULT6726	06/01/2023
₿	•	Culture FBE001 - 1 FCULT	6727	No Inventor	FCULT6727	06/01/2023
л.		FBE001 EXPT1951		No Inventor	EXPT1951	06/01/2023
÷.		Culture FBE001 - 1 FCULT FBE001 EXPT1951	6727	No Inventor	FCULT6727 EXPT1951	06/01/2023





Archiving entities

It is still possible to go trough archived items and unarchive them •

> • In the search tab, filter by "Archive" status







Questions?





Agenda

Introduction to Benchling and best practices

~ 30 min

Hands-on

~ 15 min



Agenda

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Hands-on

~ 15 min



Explore the Notebook functionalities

8	Project		Create entry from template	
	Entry	> 🖿 Blank entry	Template*	Initial day*
-	Protocol	Entry from template	Select an Entry template	✓ 2024-09-27
Q	Z DNA / RNA sequence		basics	Project folder* Biosustain Trai
+	AA sequence		Entry schema Please select a template first	
		3 SAVE IT IN THE BIOSU Folder* Choose Folder	STAIN TRAINING FOLDER	



Additional useful template to use:



Submit samples for analysis to the Analytics team



3

2 CHOSE "AC Analytical Sam	ple Submission" TEMPLATE
Create entry from template	×
Template*	Initial day*
*Submission templates / AC Analytical Sample Submission [YOUR USERNAME]	2024-10-02
Name*	Project folder*
AC Analytical Sample Submission [YOUR USERNAME]	Biosustain Training

SAVE IT IN THE BIOSUSTAIN TRAINING FOLDER

Folder*	Choose Folder		
	CHOOSE FOLDER	Projects	
		Filter	\leq
		 Biosustain Training biosustain Notebook 	



Additional useful template to use:

CREATE ENTRY FROM TEMPLATE



Registration and storage of Strain

		â	Project		
		lì	Entry >	È	Blank entry
			Protocol	Ē	Entry from template
	Q	X	DNA / RNA sequence		
1		•	AA sequence		

3



SAVE IT IN THE BIOSUSTAIN TRAINING FOLDER

older*	Choose Folder		
	CHOOSE FOLDER	Projects	
		Filter	K
		 Biosustain Training biosustain Notebook 	