How to identify the relevant metadata standard (for Life Sciences) ?

Marta Eide
Data & Models senior adviser
Centre for Digital Life Norway

Korbinian Bösl
Data management coordinator
ELIXIR Norway & Centre for Digital Life Norway

ELIXIR Europe

‘Data for Life’

Mission:

To operate a sustainable European infrastructure for biological information, supporting life-science research and its translation to society, the bio-industries, environment and medicine

https://elixir-europe.org/about-us/what-we-do

ELIXIR Members

Belgium
Czech Republic
Denmark
EMBL
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Luxembourg
Israel
Netherlands
Norway
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Sweden
Switzerland
United Kingdom

ELIXIR Observers

Cyprus

https://elixir-europe.org/about-us/who-we-are

ELIXIR Services

Data deposition:

ENA, EGA, PDBe, EuropePMC, …

https://elixir-europe.org/platforms/

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Data management:

Genome annotation
Data management plans

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Bio.tools, Benchmarking: OpenEBench

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Innovation and SME programme
Bespoke collaborations

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Industry:
Innovation and SME programme
Bespoke collaborations

Training:
TeSS, Data Carpentry, eLearning

https://elixir-europe.org/platforms/

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RDMkit

elixir CONVERGE

Your problem -

- Compliance monitoring
- Data analysis
- Data management plan
- Data organisation
- Data protection
- Data publication
- Data quality
- Data storage
- Data transfer
- Identifiers
- Licensing
- Metadata management
- Sensitive data

rdmkit.elixir-europe.org

ELIXIR in Norway

Distributed national Research Infrastructure

~ **34 FTE/a** - funded RCN, universities & users

https://elixir.no/

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Training events on bioinformatics & RDM

last 1.5a: **~330 registrations**

https://elixir.no/

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Dedicated data storage & analysis platform

Norwegian e-Infrastructure for Life Sciences - **NeLS**

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Deliverables to ELIXIR Europe

Tools and databases

https://elixir.no/

DSW

DATA STEWARDSHIP WIZARD

Filled questionnaire → Template → DMP in various formats

once

per funding body

.docx, .tex, .html, .jso

Full compliance:

SCIENCE EUROPE

European Commission

elixir-no.ds-wizard.org

https://ds-wizard.org
https://github.com/ds-wizard

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elixir NORWAY

nor seq

NORwegian MOLecular IMaging infrastructure

GBIF.no

NALMIN NORWAY

BioMedData

moba

NOR-openscreen

Biobank Norway

NORCRYST

NIMG

NAPI

elixir NORWAY

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NORCRYST

NIMG

NAPI

273 model/formats standards

FAIRsharing.org
standards, databases, policies

273 model/formats standards

Technology & domain specific

but often following the same concept:

Investigation

FAIRsharing.org
standards, databases, policies

273 model/formats standards

Technology & domain specific

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Investigation

Study(s)

FAIRsharing.org
standards, databases, policies

273 model/formats standards

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Study(s)

273 model/formats standards

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Assay(s)

but often following the same concept:

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Persons
Organizations
Publications

Study(s)

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273 model/formats standards

Technology & domain specific

Assay(s)

Measurement
Technology
Materials
Data

but often following the same concept:

Investigation

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Organizations
Publications

Study(s)

Design
Factor
Protocol

Assay(s)

Measurement
Technology
Materials
Data

Controlled Vocabularies
Ontologies
Standards

FAIRsharing.org
standards, databases, policies

273 model/formats standards

Technology & domain specific

Centre for Digital Life Norway (DLN 2.0)

facilitates transdisciplinary research, innovation, and education in Life Science

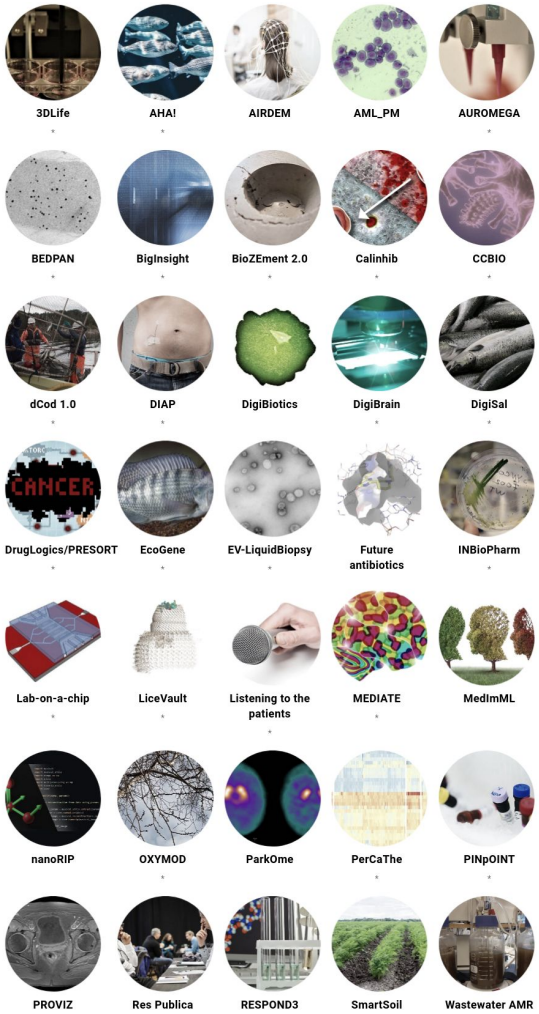
- Transdisciplinary collaborations
- Education and career development
- Responsible research and innovation
- Innovation and commercialisation
- Data management

www.digitallifenorway.org

NTNU · UiT The Arctic University of Norway · University of Oslo · University of Bergen · SINTEF · Norwegian University of Life Sciences · Oslo University Hospital

35 transdisciplinary biotechnology projects all over the country.

Biotechnology with digital technology: health, aquaculture, agriculture & industrial biotechnology.



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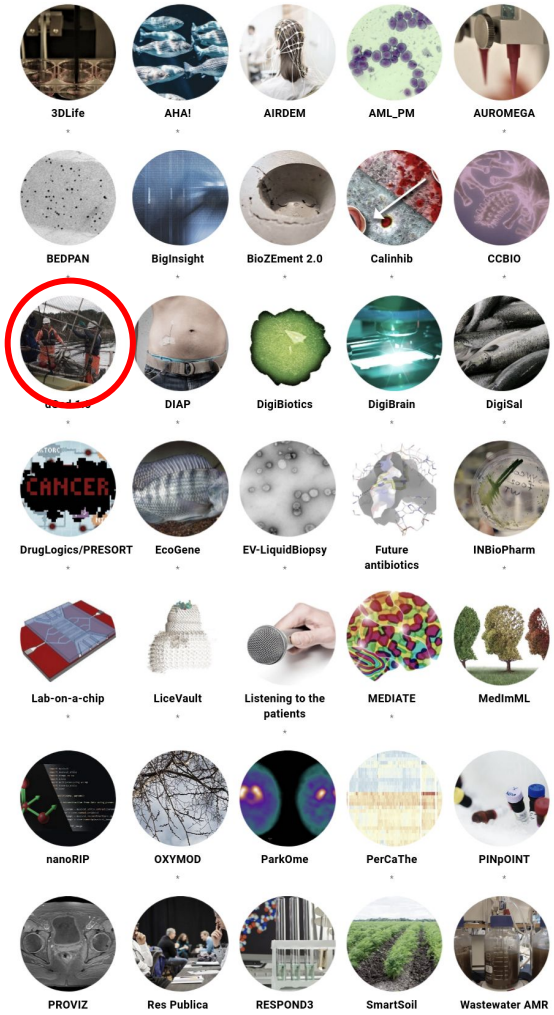
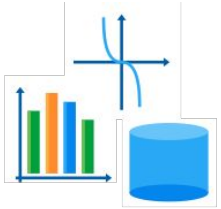


Biology

Informatics

Environmental toxicology



Mathematics

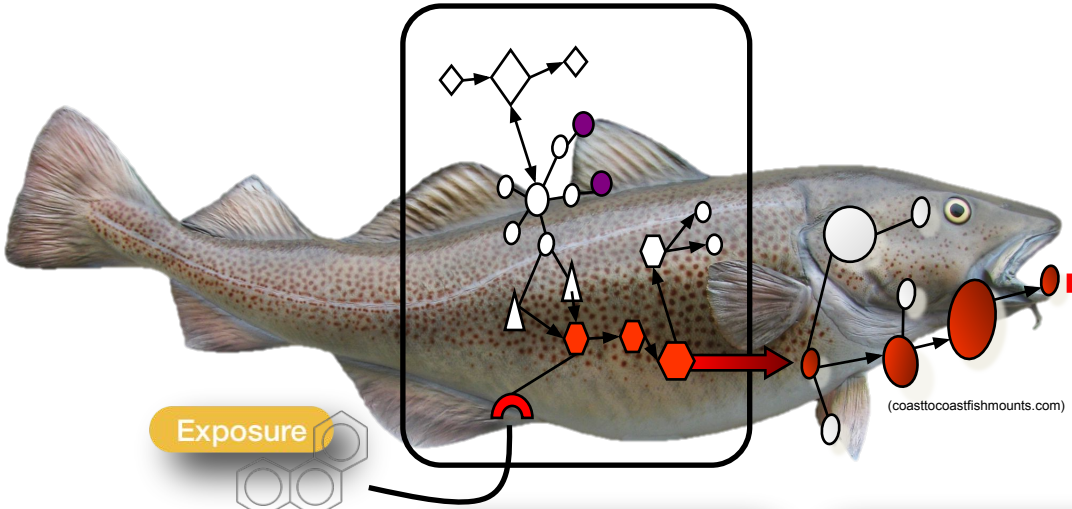
dCod 1.0

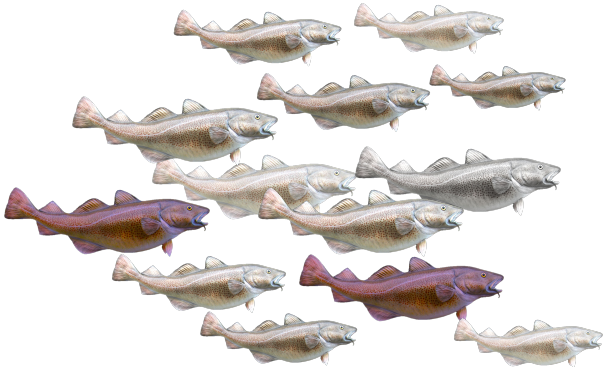
decoding the systems toxicology of atlantic cod

Responsible research and innovation (RRI)

Systems toxicology

Evolutionary and comparative aspects:
Why do species behave differently?





Exposure

Mechanistic understanding:
Where does it start?

Systems toxicology understanding:
What does it lead to?

Ecotoxicological understanding:
What are the ultimate consequences?

And: *How can we use this knowledge to develop tools for monitoring environmental and human health?*

dCod 1.0
decoding the systems toxicology of atlantic cod

dCod 1.0

decoding the systems toxicology of atlantic cod

WP9: Management, RRI, communication, outreach

WP7: Mathematical modelling

WP8: Biomarker technology

WP6: Bioinformatics

WP5: Pathology & physiology

WP3: Exposure analyses

WP4: Toxico-genomics

WP2: Field studies

WP1: In vitro and in vivo exposure studies

(coasttocoastfishmounts.com, 05.05.16)

Genome mining

Transcriptomics

Proteomics

Metabolomics - lipidomics

In our breakout:

Metadata standards

Structure and content of a metadata standard on one specific example

Brief overview of other metadata standards used in ELIXIR repositories

Tools to navigate standards and ontologies: FAIRsharing, Data Stewardship Wizard, OLS

elixir NORWAY

CENTRE FOR DIGITAL LIFE NORWAY

In our breakout:

Metadata standards

Structure and content of a metadata standard on one specific example

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How to track metadata

What kind of tools are out there?

SEEK: one possible solution (not only for Life Sciences)

Examples & Experiences from the dCod1.0 project

elixir NORWAY

CENTRE FOR DIGITAL LIFE NORWAY

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Find

Recommendations

Standards and/or databases recommended by journal or funder data policies.

Discover

Collections

Standards and/or databases grouped by domain, species or organization.

Learn

Educational

About standards, their use in databases and policies, and how we can help you.

https://fairsharing.org/askFAIRsharing/wizard

FAIRsharing.org

standards, databases, policies

BETA

Are you looking for a database, policy, and/or standard?

Step 1 of 4

Registry:	☐ **Databases** ☐ **Policies** ☐ **Standards** Please choose in which registry/registries you would like to search.

https://fairsharing.org/askFAIRsharing/wizard

RDMkit

elixir CONVERGE

inbuilt curated resources:

Repositories & Metadata standards

FAIRsharing

rdmkit.elixir-europe.org

RDMkit

elixir CONVERGE

inbuilt curated resources:

Repositories & Metadata standards

FAIRsharing

Software

elixir bio.tools

rdmkit.elixir-europe.org

RDMkit

elixir CONVERGE

inbuilt curated resources:

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FAIRsharing

Software

elixir bio.tools

Training

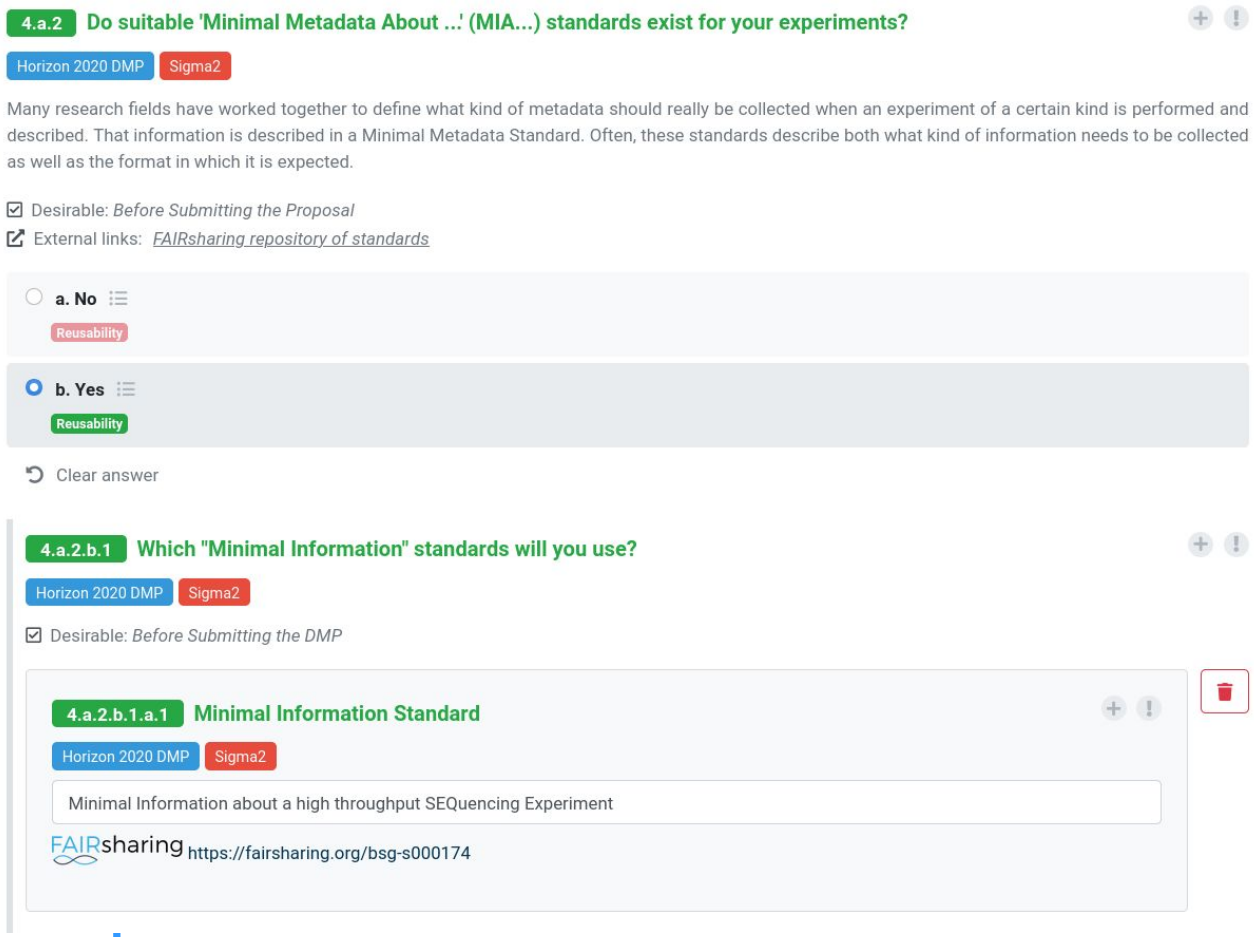
elixir TeSS

rdmkit.elixir-europe.org

DSW

DATA STEWARDSHIP WIZARD

Build your DMP by following a decision tree with defined questions



elixir-no.ds-wizard.org

https://ds-wizard.org
https://github.com/ds-wizard

Example MINSEQ - for quantitative sequencing

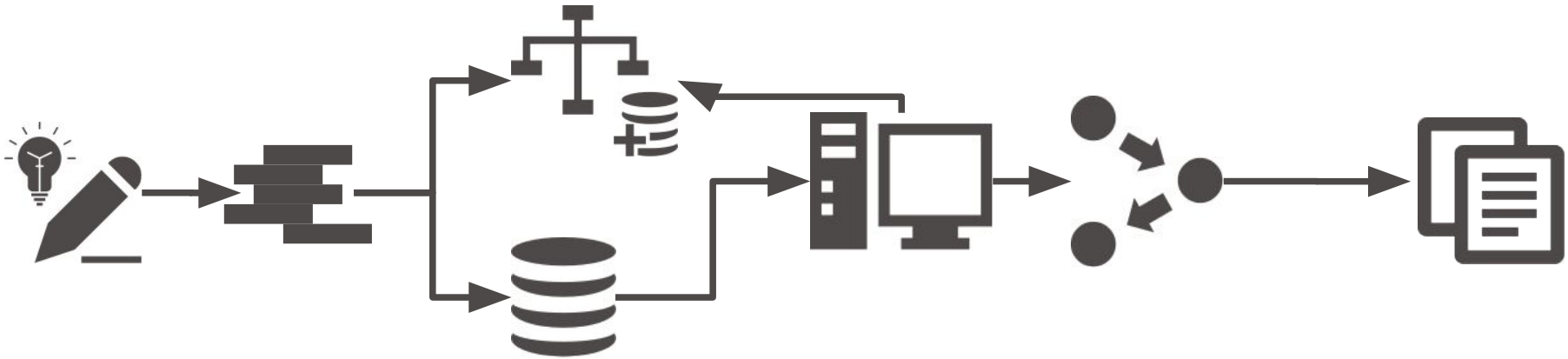
Minimum **I**nformation about a high-throughput **n**ucleotide **SEQ**uencing Experiment

Established 2012

Extension of MIAME (for Arrays)

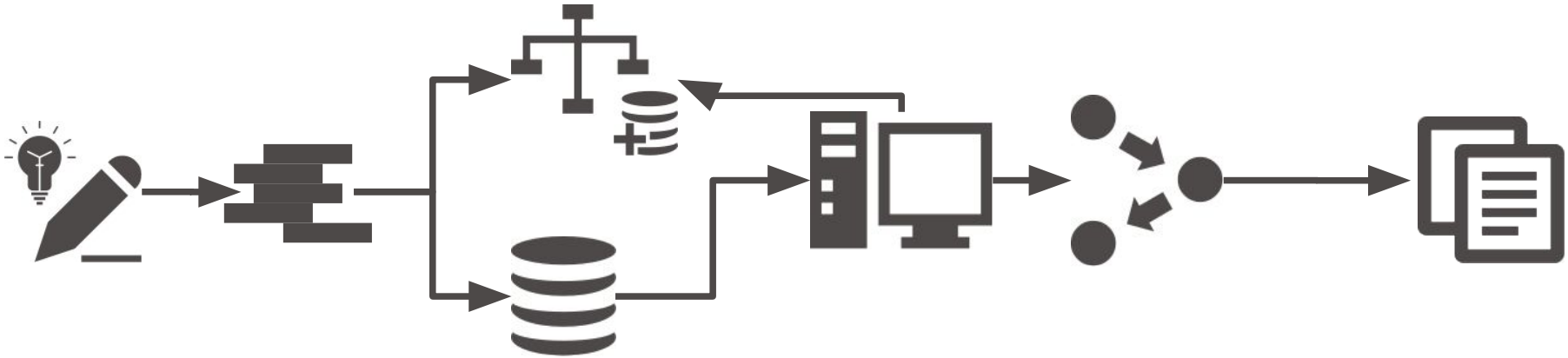
Governed by Functional Genomics Data Society

MINSEQE



MINSEQE

ArrayExpress



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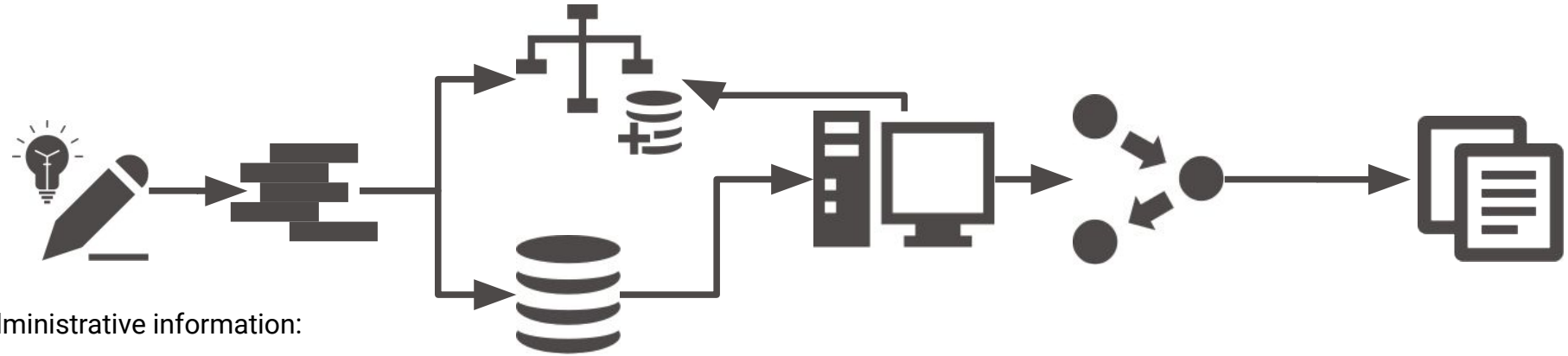


Administrative information:

Persons
Organizations
Publications

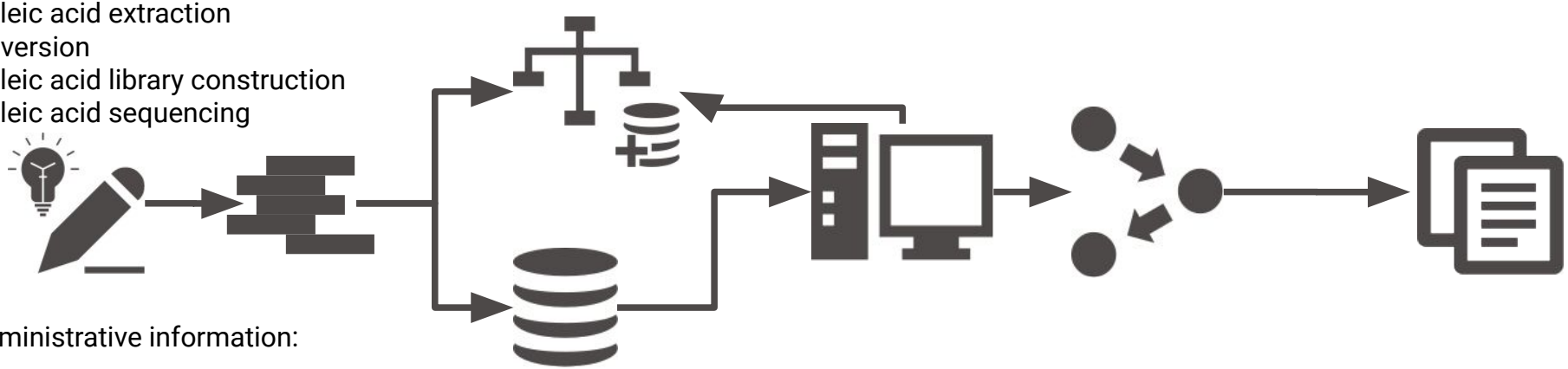
Experimental conditions/design

protocols:

MINSEQE

ArrayExpress

treatment
sample collection
growth
nucleic acid extraction
conversion
nucleic acid library construction
nucleic acid sequencing



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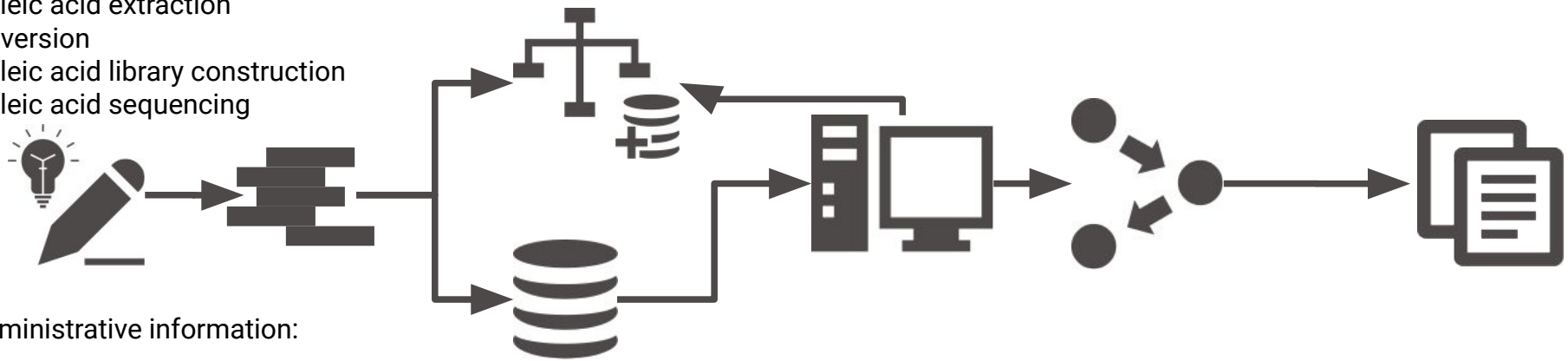

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fastq
bam
csv/tsv

protocols:

high throughput sequence alignment
normalization data transformation

ArrayExpress

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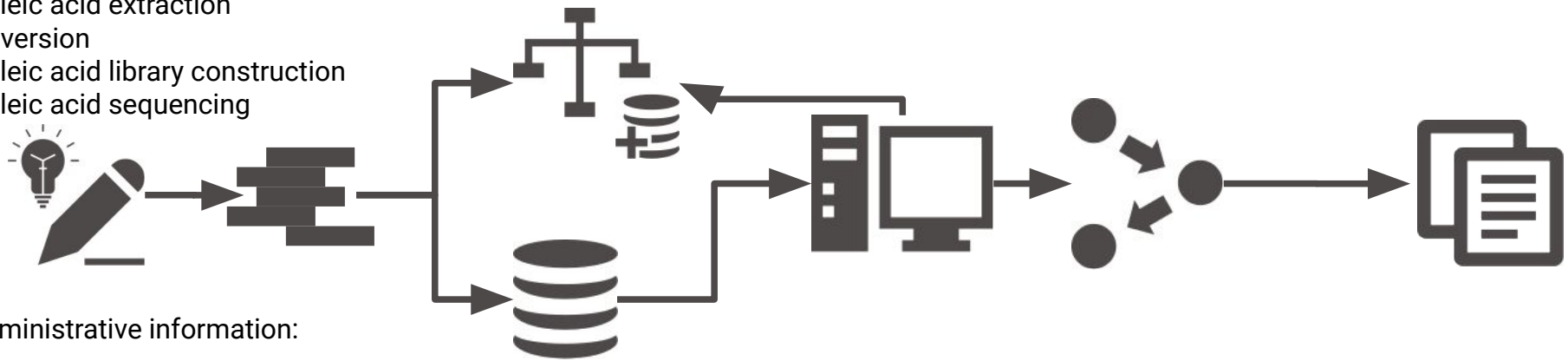

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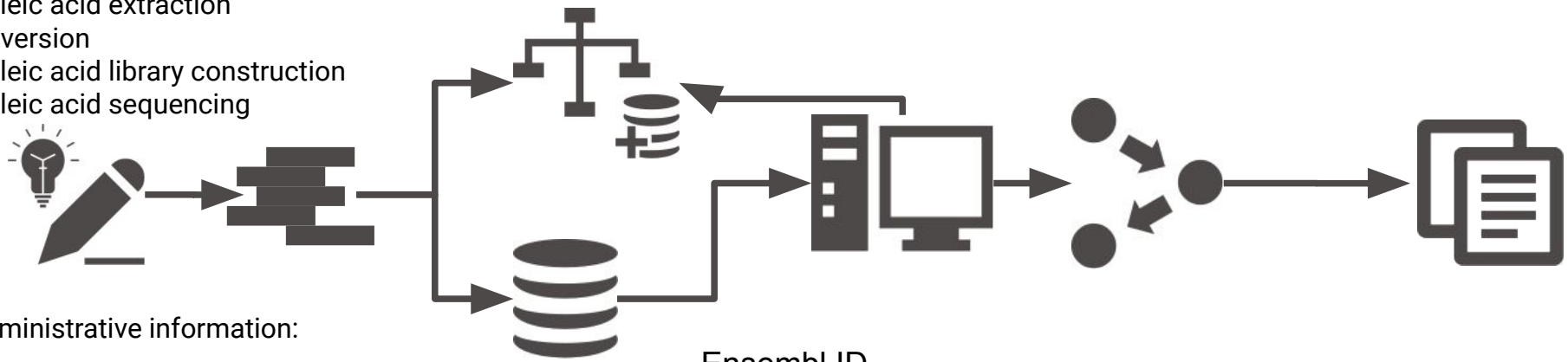

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high throughput sequence alignment
normalization data transformation

Ensembl ID
RefSeq ID

ArrayExpress

Experimental conditions/design

protocols:

Taxonomy

MINSEQE

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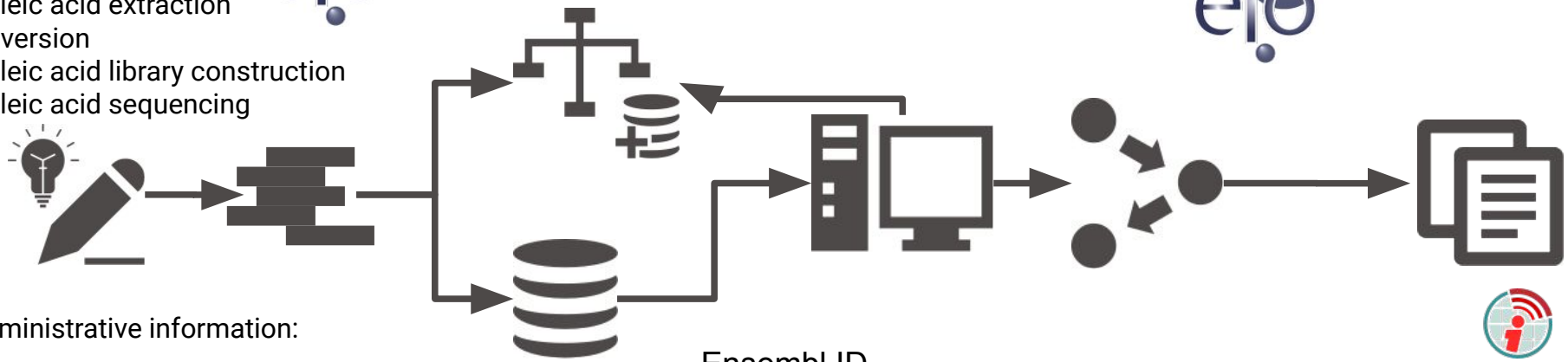

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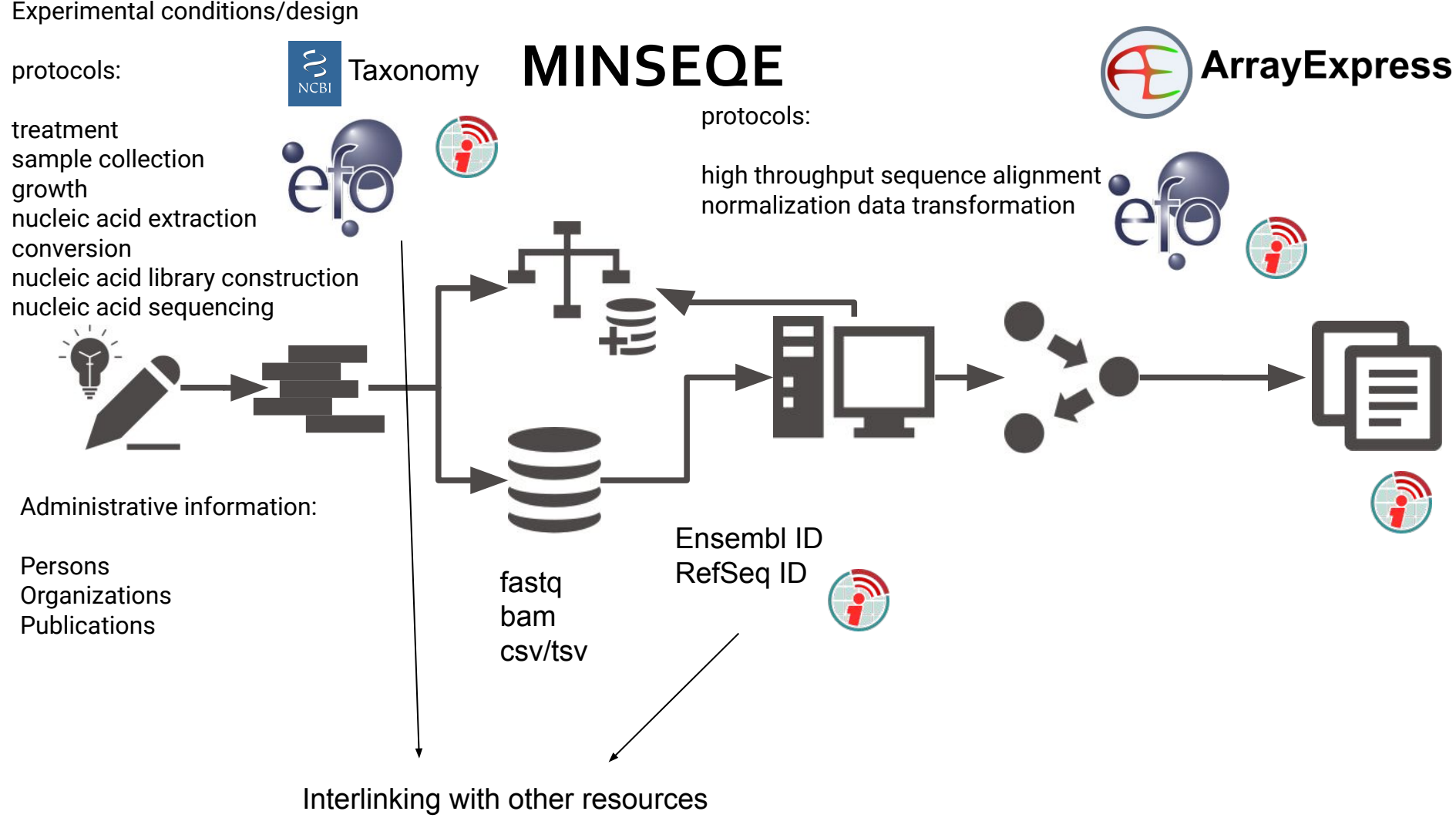
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NCBI
Taxonomy
MINSEQE
ArrayExpress
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efo
high throughput sequence alignment
normalization data transformation
efo
Administrative information:
Persons
Organizations
Publications
fastq
bam
csv/tsv
Ensembl ID
RefSeq ID
Interlinking with other resources

How many way can you say “female”?

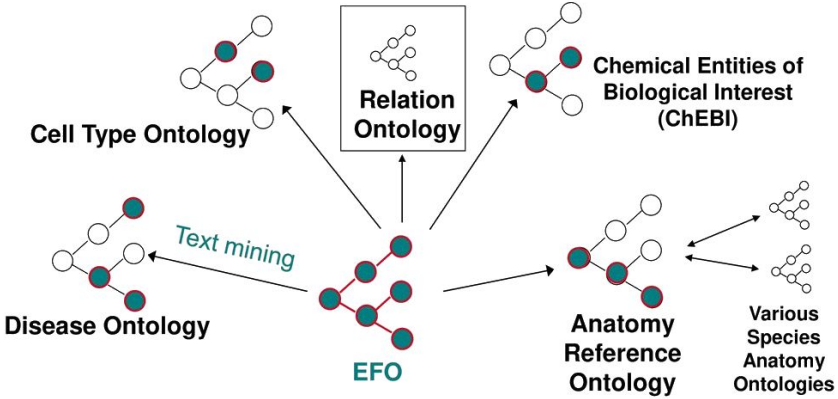
How many way can you say “female”?

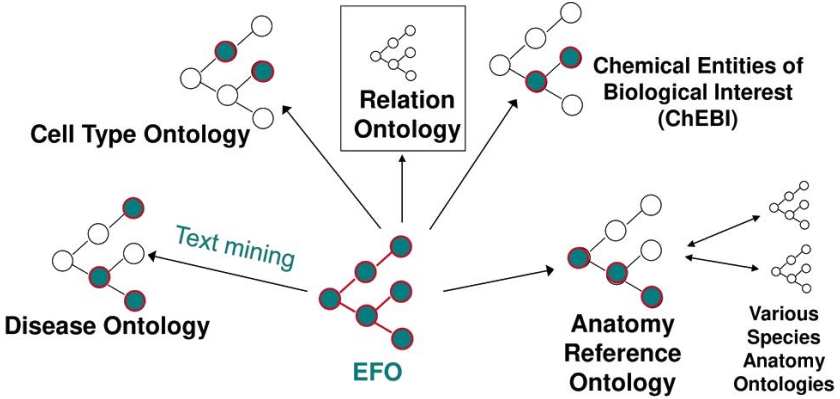
18-day pregnant females
2 yr old female
400 yr. old female
adult female
asexual female
castrate female
cf.female
cystocarpic female
dikaryon
dioecious female
diploid female
f
famale
femail
female
female - worker
female (alate sexual)
female (calf)
hen
female (lactating)
female (pregnant)
female (outbred)
female parent
female plant
female with eggs
female worker
female, 6-8 weeks old
female, virgin
female, worker
female(gynoecious)
femele
female, pooled
femalen
females
females only
gynoecious
healthy female
probably female (based on morphology)
individual female
lgb*cc females
mare
female (worker)
monosex female
ovigerous female
oviparous sexual females
worker bee
female enriched
pseudohermaprhoditic female
remale
semi-engorged female
sexual oviparous female
sterile female worker
strictly female
tetraploid female
thelytoky
female (gynoecious)
worker caste (female)
sex: female
female, other
female child
femal
3 female
female (phenotype)
female mice
female, spayed
femlale
metafemale
sterile female
normal female
sf
vitellogenic replete female
worker
hexaploid female
female (f-0)

female (note: this sample was originally provided as a \"male\" sample to us and therefore labeled this way in the brawand et al. paper and original geo submission; however, detailed data analyses carried out in the meantime clearly show that this sample stems from a female individual)"

Courtesy of N. Silvester, European Nucleotide Archive, EMBL-EBI

efo


Cell Type Ontology
Relation Ontology
Chemical Entities of Biological Interest (ChEBI)
Text mining
Disease Ontology
EFO
Anatomy Reference Ontology
Various Species Anatomy Ontologies



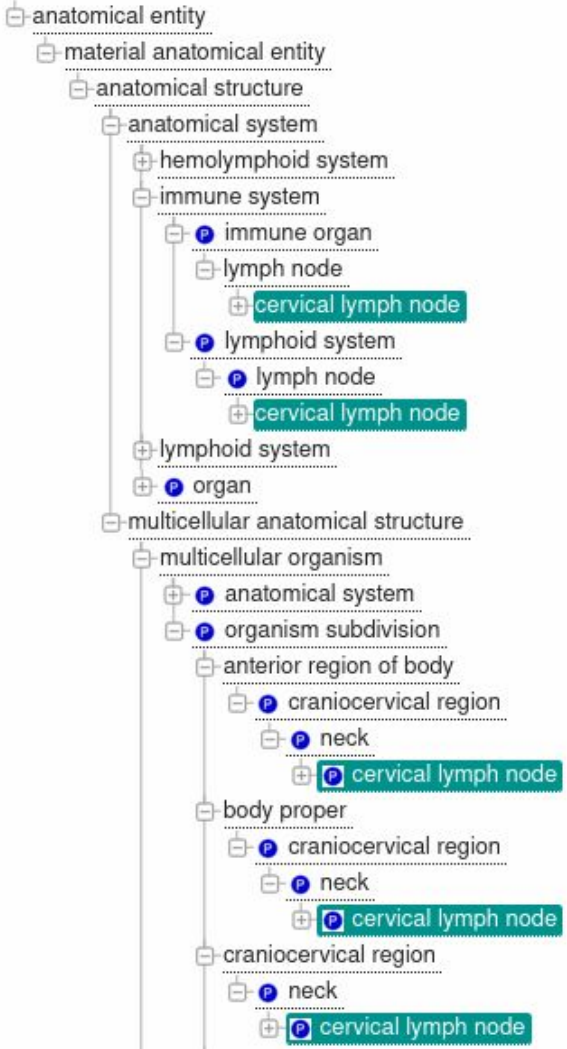
- experimental factor
  - material property
    - quality
      - sex
        - female

database cross reference

- MSH:D005260
- MO:506
- NCIt:C16576
- SNOMEDCT:248152002
- CARO:0000028
- PATO:0000383

Uberon

Onthologies
enable hierarchical searches



ONTOLOGY SEARCH

Home | Ontologies | Documentation | About

Welcome to the EMBL-EBI Ontology Lookup Service

Search OLS... Search

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, Zooma and Webulous services. OxO provides cross-ontology mappings between terms from different ontologies. Zooma is a service to assist in mapping data to ontologies in OLS and Webulous is a tool for building ontologies from spreadsheets.

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

Data Content

Updated 28 May 2021 08:03

- 264 ontologies
- 6,460,093 terms
- 32,279 properties
- 497,528 individuals

Tweets by @EBIOLS

EBISPOT OLS
@EBIOLS

Are you interested in deploying OLS, Zooma and OxO in your own environment? If so, please checkout our documentation in this regard github.com/EBISPOT/ontoto…. Many thanks to @_jmcl and @NicoMatentzoglu for their work on this. Great job!

EBISPOT/
ontotools-docker

Configuration to deploy ontotools using docker compose

3 Contributors 2 Issues 1 Stars 5 Forks

https://www.ebi.ac.uk/ols/index

The Ontology Lookup Service is part of the ELIXIR infrastructure

OLS is an Elixir interoperability service Learn more ›

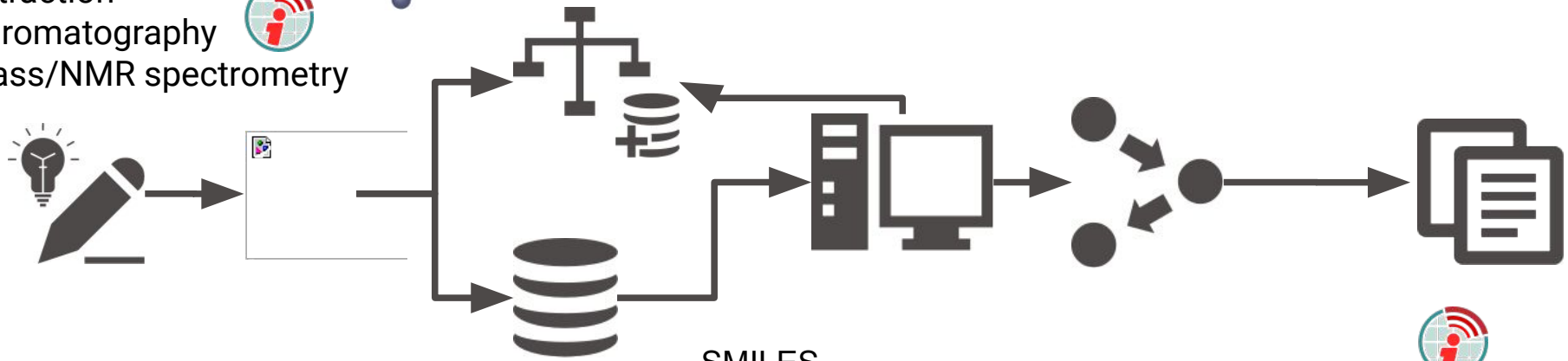
CIMR - ISA-tab

Experimental conditions/design

Protocols:
Sample collection
Extraction
Chromatography
Mass/NMR spectrometry

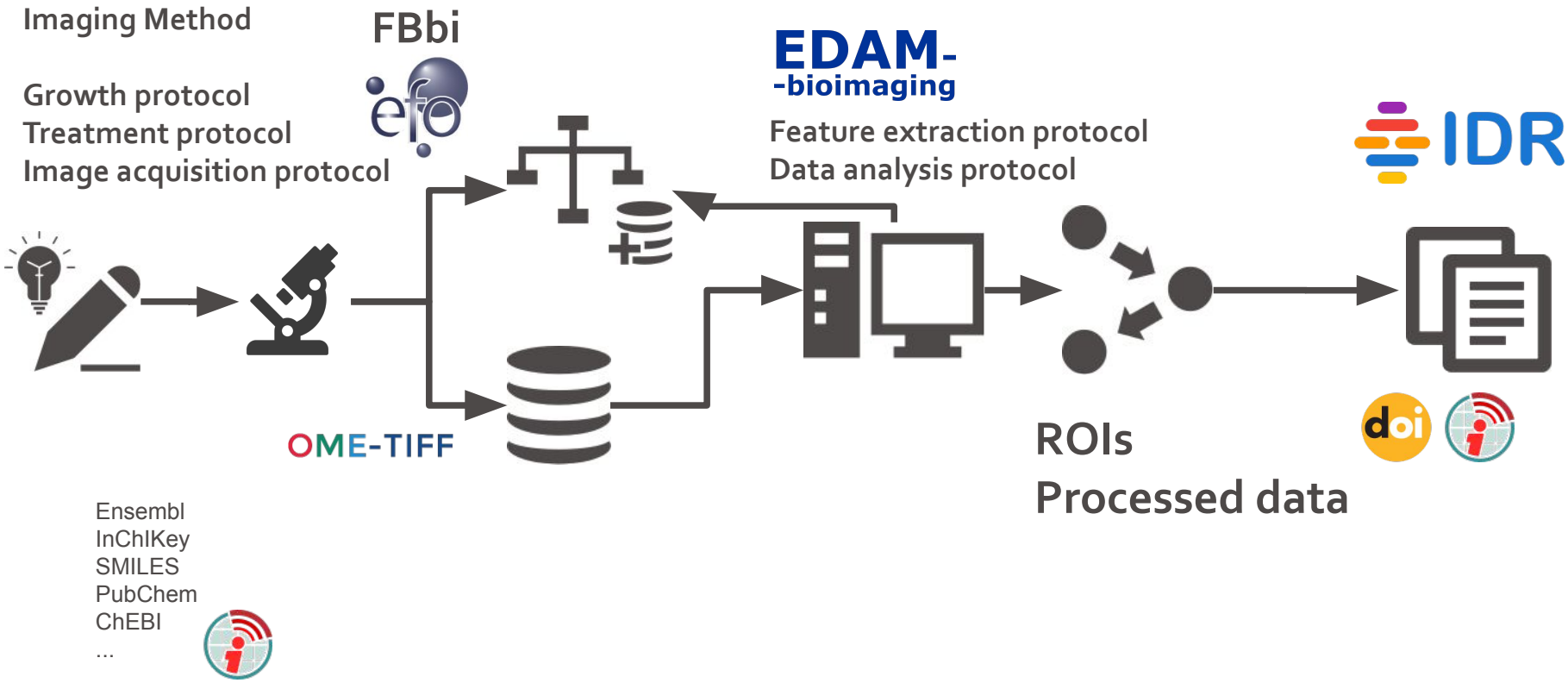
Protocols:
Data transformation
Metabolite identification

MetaboLights



mzML
nmrML

SMILES
InCh



IDR Submission guide

Where to deposit data?

https://elixir-europe.org/platforms/data/core-data-resources
https://elixir-europe.org/platforms/data/elixir-deposition-databases

. . .

Where to deposit data?

ENA
European Nucleotide Archive

EMBL-EBI

Archive

IDR

European Variation Archive

Data Submission Wizard

https://www.ebi.ac.uk/submission/

BioModels

PDBe
Protein Data Bank in Europe

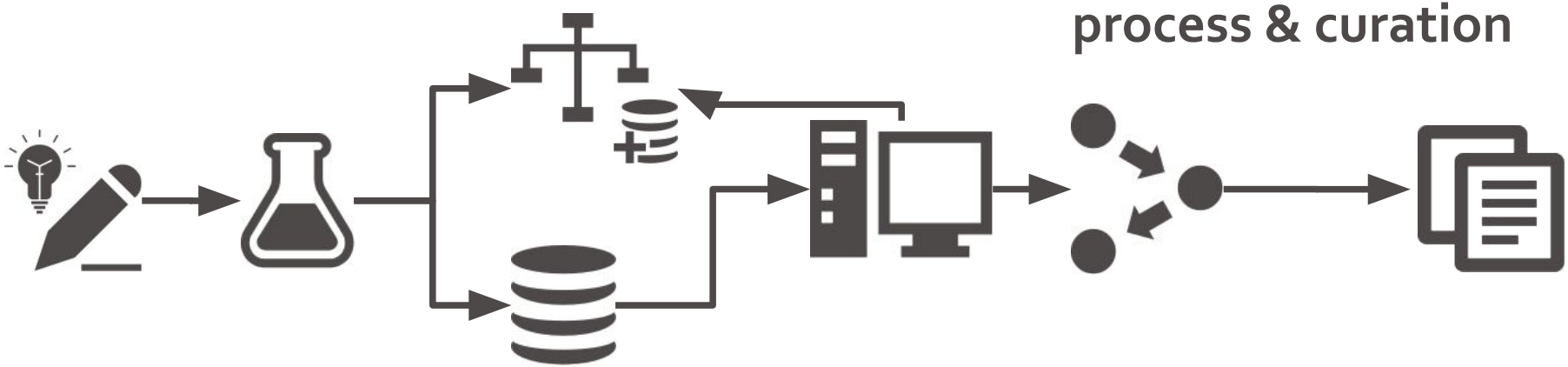
MetaboLights

https://elixir-europe.org/platforms/data/core-data-resources
https://elixir-europe.org/platforms/data/elixir-deposition-databases

. . .

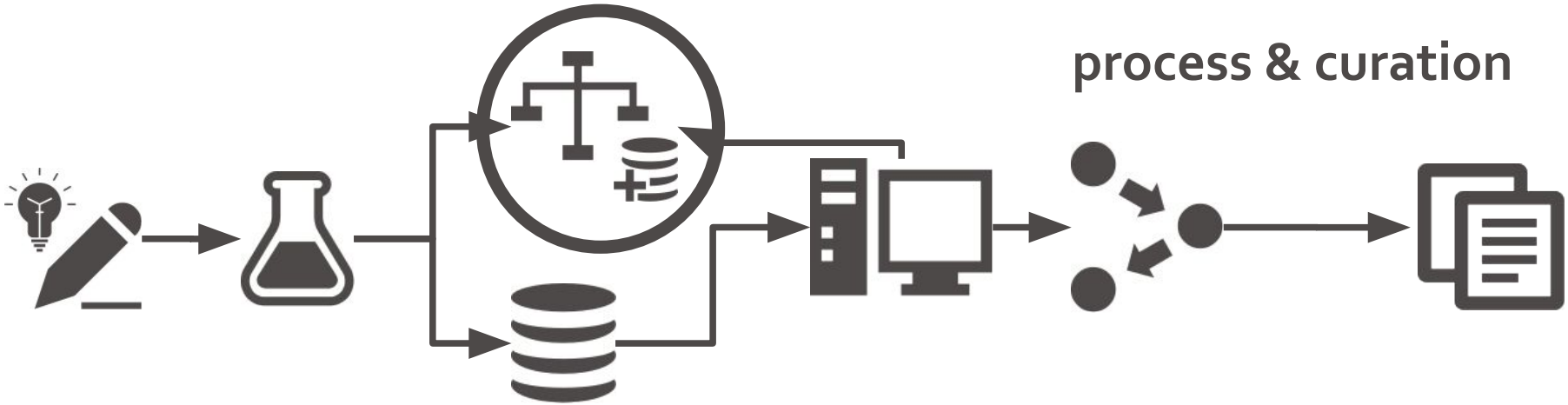
Guided submission

process & curation



Guided submission

process & curation



Metadata tracking platforms

Domain specific:

COPO for plant sciences

MOLGENIS for biobanking

…

MOLGENIS

https://copo-project.org/ https://www.molgenis.org/
https://openbis.ch/ https://seek4science.org/

Metadata tracking platforms

Domain specific:

- COPO for plant sciences
- MOLGENIS for biobanking
- …

Adaptable (configuration requires domain knowledge):

- Proprietary ELNs/LIMS - often poor support for ontologies
- openBIS - open source ELN/LIMS
- SEEK

https://copo-project.org/ https://www.molgenis.org/
https://openbis.ch/ https://seek4science.org/

Challenges

Standards & Repositories historically grown:

… some predate CC licenses (terms of usage ≈ public domain)

… some standards predate DDI, datacite, dublin core

… own PID system (identifiers.org), not all repos issue DOIs (yet)

→ searchability can depend on dataset search engine

… large curation effort for legacy data >160 PB (EBI repos 2018)

… parallel development: certification procedures: EDD|ECR vs CoreTrustSeal

Experiences from dCod 1.0 and SEEK

dCod 1.0

decoding the systems toxicology of atlantic cod

WP9: Management, RRI, communication, outreach

WP7: Mathematical modelling

WP8: Biomarker technology

WP6: Bioinformatics

WP5: Pathology & physiology

WP3: Exposure analyses

WP4: Toxico-genomics

WP2: Field studies

WP1: In vitro and in vivo exposure studies

(coasttocoastfishmounts.com, 05.05.16)

Genome mining

Transcriptomics

Proteomics

Metabolomics - lipidomics

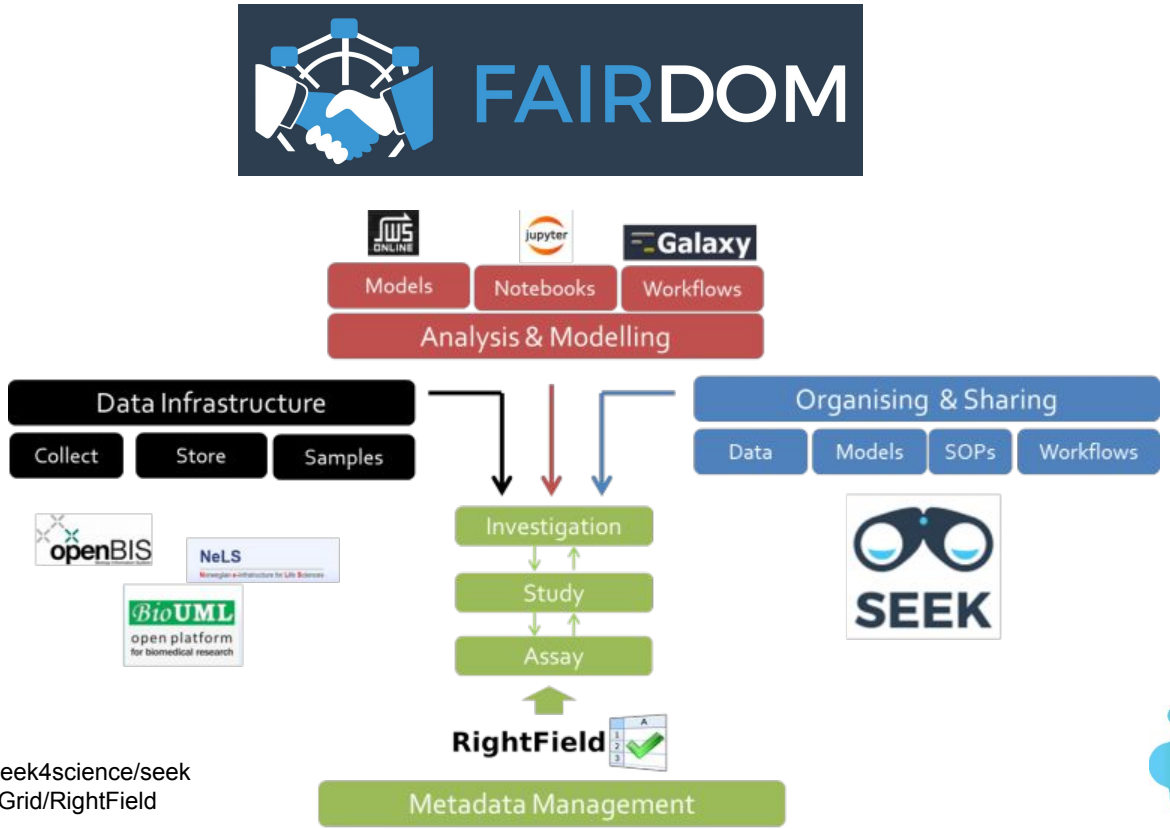
FAIRDOM

SEEK

FAIRDOM HUB

https://seek4science.org/
https://fairdomhub.org/

FAIRDOM integration



fair-dom.org
seek4science.org - github.com/seek4science/seek
rightfield.org.uk - github.com/myGrid/RightField

CENTRE FOR DIGITAL LIFE NORWAY

but often following the same concept:

Investigation

Persons
Organizations
Publications

Study(s)

Design
Factor
Protocol

Assay(s)

Measurement
Technology
Materials
Data

Controlled Vocabularies
Ontologies
Standards

FAIRsharing.org
standards, databases, policies

273 model/formats standards

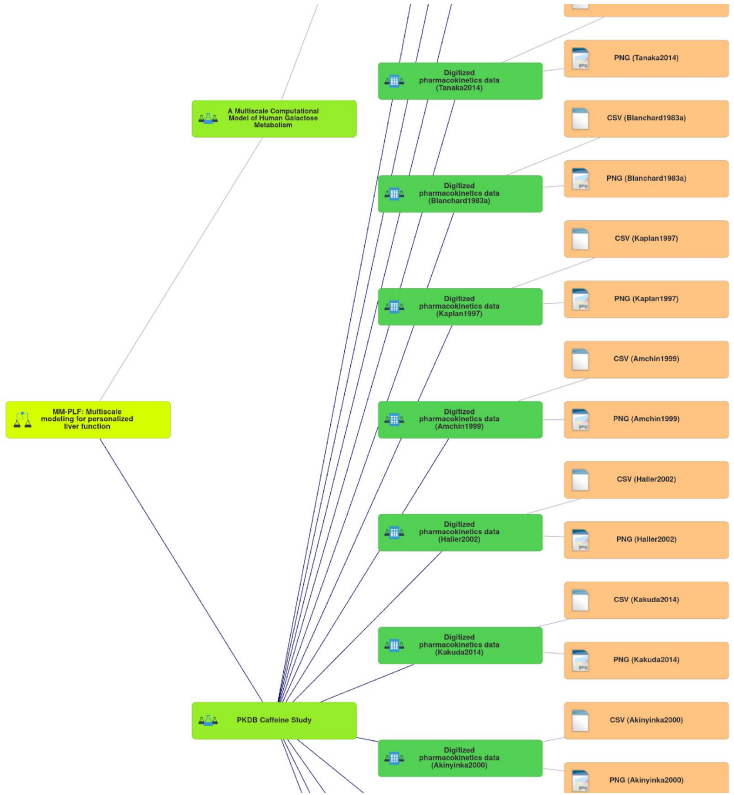
Technology & domain specific

SEEK

Investigation

Study

Assay



https://seek4science.org/
https://fairdomhub.org/

ISA example of dCod 1.0

Programme
dCod 1.0

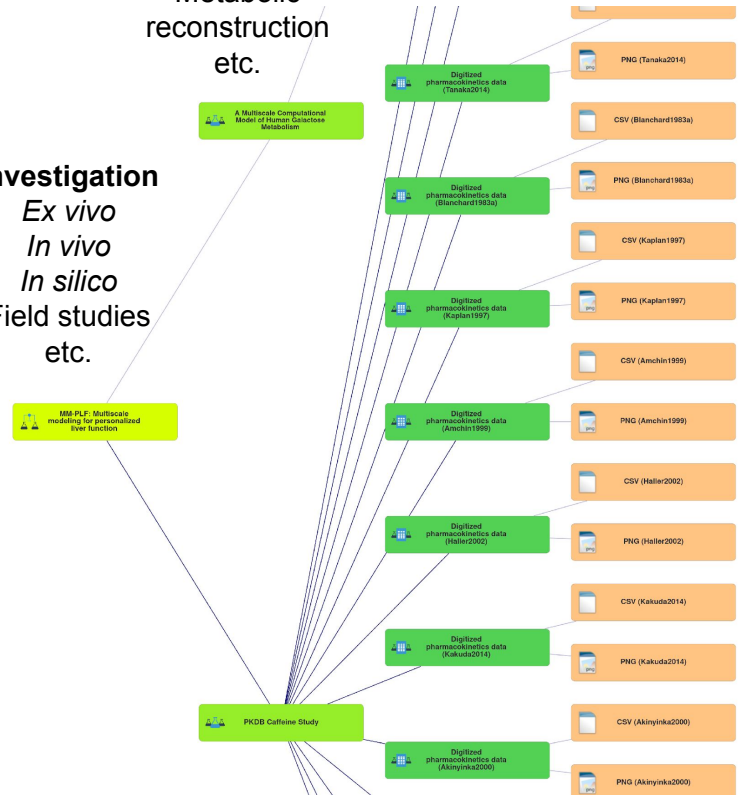
Project
Systems toxicology

Investigation
Ex vivo
In vivo
In silico
Field studies
etc.

Study
In vivo I-VIII
Metabolic reconstruction
etc.

Assay
Biometric data
Hormone levels
Omics
etc.

Data
Link to NeLS
Link to GEO
Metadata
SBML model
Publications
etc.



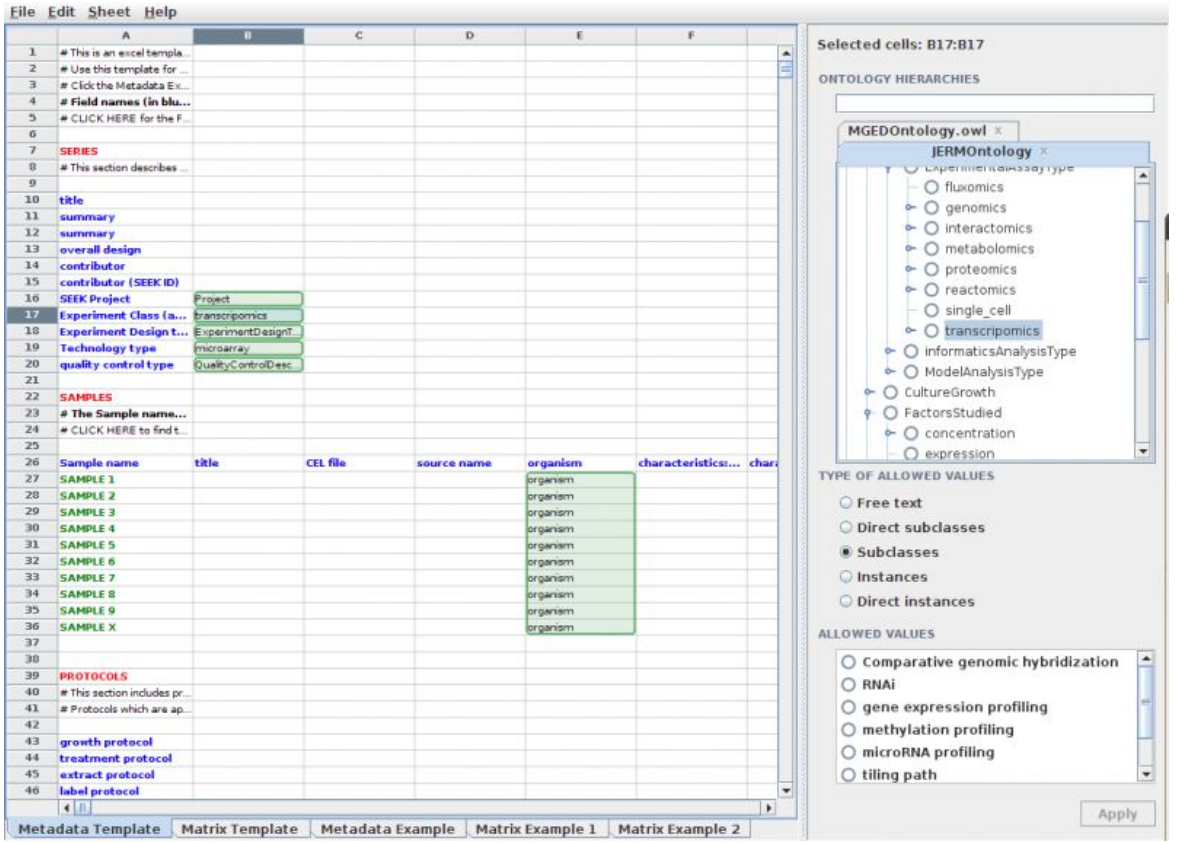
dCod 1.0
decoding the systems toxicology of atlantic cod

SEEK

https://seek4science.org/
https://fairdomhub.org/

RightField

SEEK



https://seek4science.org/
https://rightfield.org.uk/

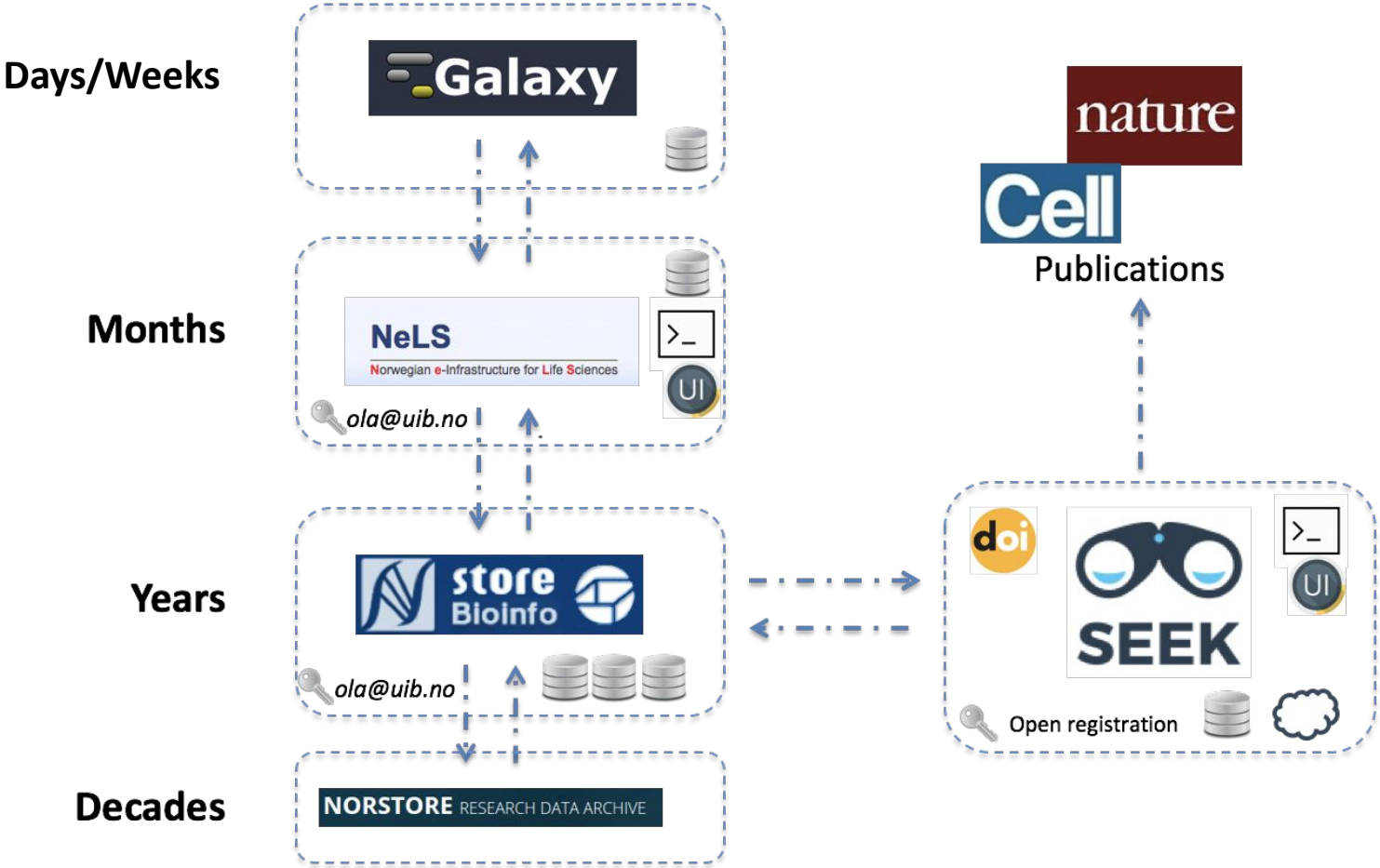
Integration of SEEK and NeLS

Norwegian e-Infrastructure for Life Sciences

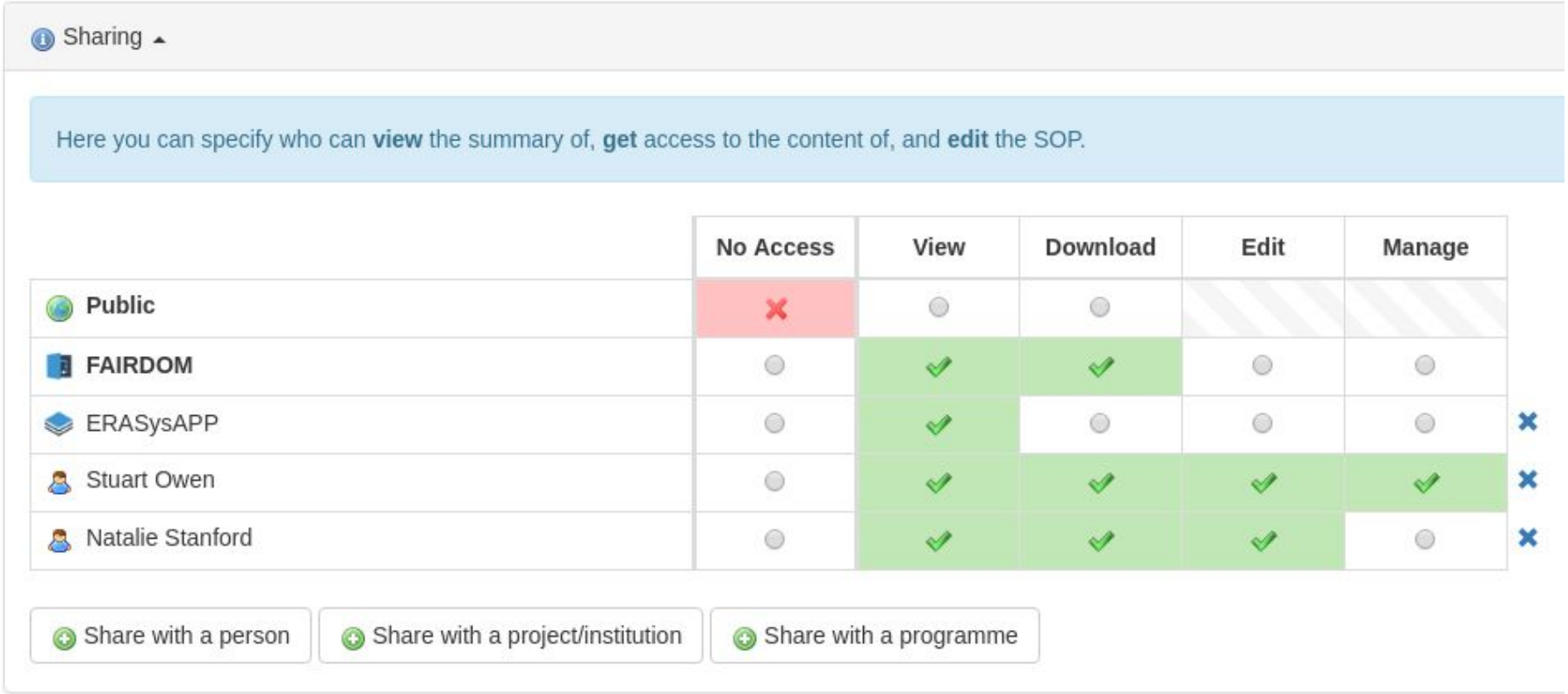
Reference data in NeLS in SEEK

Access data in NeLS through SEEK

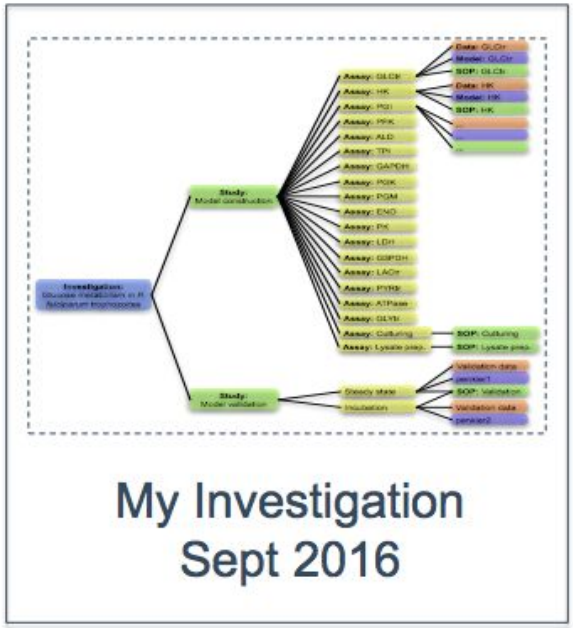
Save Metadata to SEEK through NeLS


Days/Weeks
Galaxy
Months
NeLS
Norwegian e-Infrastructure for Life Sciences
ola@uib.no
UI
Years
store
Bioinfo
ola@uib.no
Decades
NORSTORE RESEARCH DATA ARCHIVE
nature
Cell
Publications
doi
SEEK
UI
Open registration

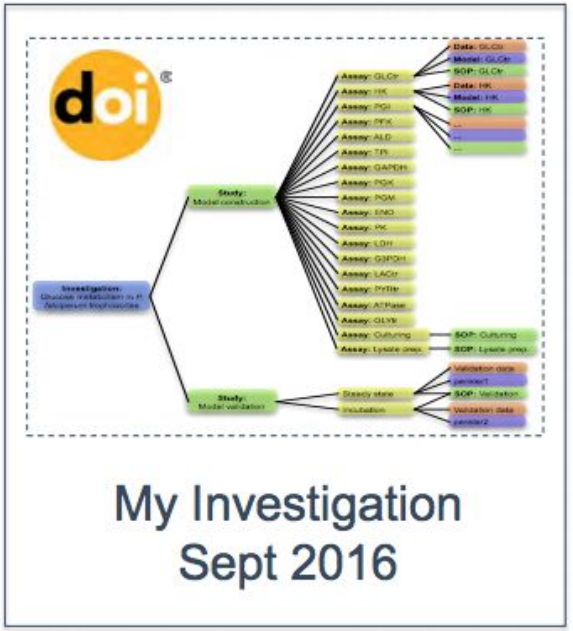
Administrate access



Generate snapshots and assign DOIs

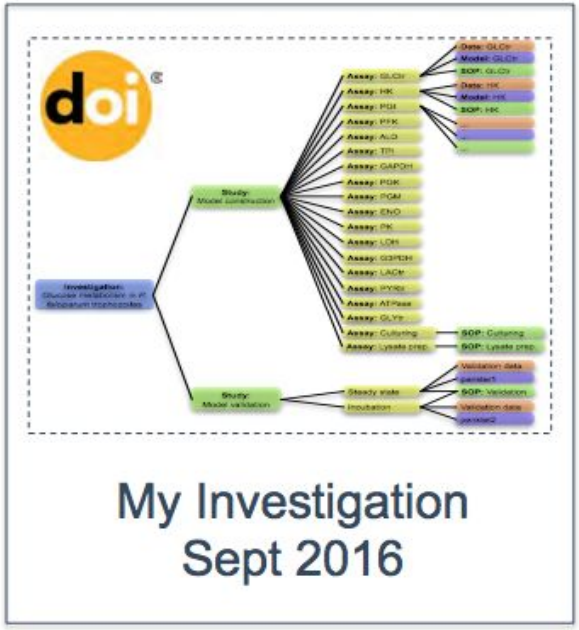


My Investigation
Sept 2016

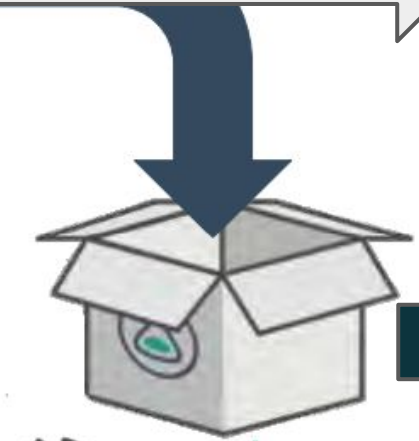


My Investigation
Sept 2016

Package snapshot as a Research Object



Publication



RO-Crate

research object.org

dCod 1.0
decoding the systems toxicology of atlantic cod

In vivo Nord 1: Chlorpyrifos-methyl

Unsubscribe | New Study based on this one | Add new | Actions

Aim: To investigate whether Atlantic cod that feed close to aquatic breeding facilities are affected by chlorpyrifos-methyl. Feeding experiment with chlorpyrifos-methyl, an organophosphorous pesticide detected in plant based salmon feed. Based on previous experiments using salmon.

Doses: 0, 0.5, 5.0, 25 mg/kg) chlorpyrifos-methyl. Duration: 30 days Set-up: Three tanks per treatment (12 in total)

Samples include: Liver, plasma, bile, brain. Analysis include: - Have RNAseq and metabolomics from 36 liver samples - Plasma cholinesterase, cortisol, ASAT, ALAT, and total protein (36 samples) - EROD on liver samples (36 samples) - Chemical levels of chlorpyrifos-methyl and main metabolite TCP in liver and bile (36 samples) - Hypoxia stress test (72 samples)

SEEK ID: https://fairdomhub.org/studies/593

Investigation: In vivo - Exposure studies on living Atlantic cod

Projects: Systems toxicology of Atlantic cod

Creators and Submitter

Creators

Marta Eide, Pål A. Olsvik, Karina Dale, Korbinian Bösl

Submitter

Marta Eide

Selected: In vivo Nord 1: Chlorpyrifos-methyl (Study)
Description: Aim: To investigate whether Atlantic cod that feed close to aquatic breeding facilities are affected by...
SEEK ID: https://fairdomhub.org/studies/593

Tree | Split | Graph

Fullscreen

- In vivo Nord 1: Chlorpyrifos-methyl
  - Fish biometrics in vivo Nord
    - In vivo Nord 1 biometrics
      - 36 samples
  - Transcriptomics
    - In vivo Nord 1 biometrics
      - 36 samples
    - File name information for RNA seq data
    - Effects of agricultural pesticides in aquafeeds on wild fish feeding on leftover pellets near fish farms
    - In_Vivo_Nord_1_Olsvik - reads
  - Metabolomics
    - Metabolomics_results
    - In vivo Nord 1 biometrics
      - 36 samples
  - EROD activity
    - Liver EROD activity
      - 36 samples
    - In vivo Nord 1 biometrics
      - 36 samples
  - Chemical analyses
    - CPM and TCP concentrations in liver and bile
      - 36 samples
    - In vivo Nord 1 biometrics
      - 36 samples
  - Plasma parameters
  - Effects of Agricultural Pesticides in Aquafeeds on Wild Fish Feeding on Leftover Pellets Near Fish Farms

dCod 1.0
decoding the systems toxicology of atlantic cod

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  - Plasma parameters
    - Effects of Agricultural Pesticides in Aquafeeds on Wild Fish Feeding on Leftover Pellets Near Fish Farms

Snapshots

Snapshot 2 (30th May 2021)
Snapshot 1 (29th May 2019) doi

Activity

Views: 202 **Downloads:** 0

Created: 29th May 2019 at 13:28
Last updated: 29th May 2019 at 13:28

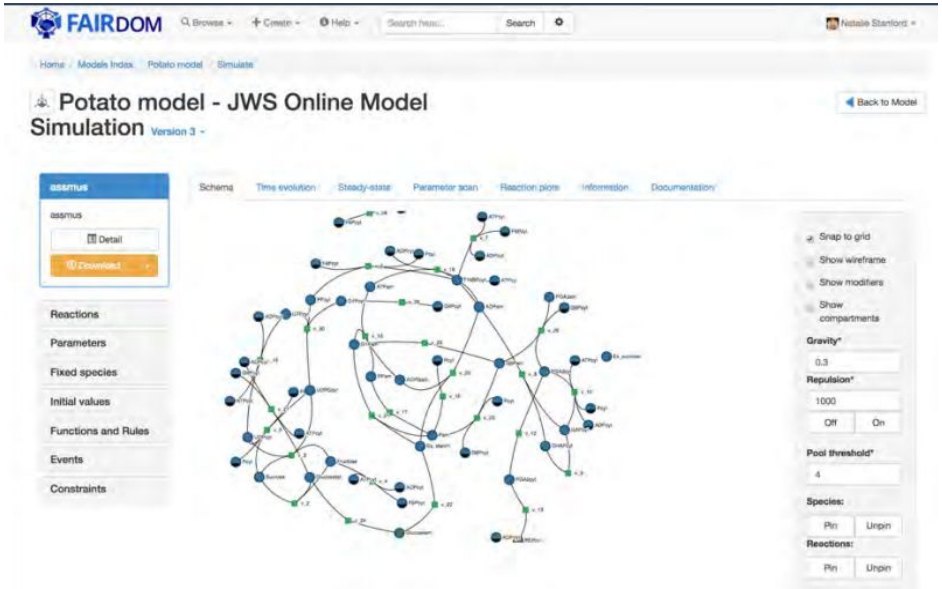
dcod 1.0
decoding the systems toxicology of atlantic cod

Models in SEEK

Integrated support for SBML models (Systems Biology Markup Language)

Allows for online simulations (JWS Online)

Reproduction of simulations (SED-ML)



dCod 1.0

decoding the systems toxicology of atlantic cod

Selected: ReCod - Draft Metabolic Reconstruction of Atlantic cod (Study)
Description: No description
SEEK ID: https://fairdomhub.org/studies/423

Tree | Split | Graph

Fullscreen

- In silico - computational bioinformatics, reconstruction, and modeling
  - ReCod - Draft Metabolic Reconstruction of Atlantic cod
    - Draft metabolic reconstruction model of Atlantic cod liver
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMor3 and iHepatocyte2322
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMorTrinity and iHepatocyte2322
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMor1 and iHepatocyte2322
      - Visualization of gap filling of subsystem "Metabolism of xenobiotics by cytochrome P450"
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMor3 and iHepatocyte2322
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMorTrinity and iHepatocyte2322
      - Draft metabolic reconstruction model of Atlantic cod liver generated from gadMor1 and iHepatocyte2322
    - ReCodLiver0.9: Overcoming Challenges in Genome-Scale Metabolic Reconstruction of a Non-model Species

Experiences from dCod 1.0

dCod 1.0
decoding the systems toxicology of atlantic cod

- Little data management experience
  - traditional repositories (like GEO and ArrayExpress)
- No allocated funds in project budget
  - no specified data manager
  - ...but received funding from DLN for getting started and coursing

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- Transdisciplinary projects need good data management!
  - An eye-opener for the possibilities of data management
- How to change old (bad) habits?
  - Support
  - Clear guidelines and expectations
  - Carrots?

khrono.no, 12.12.2020

Khrono

Nyheter Debatt Student

DEBATT • BRAUTASET, JONASSEN, BÖSL OG TORHEIM

På tide å sette av fem prosent av prosjektmidlene til datahåndtering?

Forskningen som gjøres i forbindelse med den pågående pandemien, er et godt eksempel på at god datahåndtering er livsviktig, skriver kronikkforfatterne.

For at forskersamfunnet skal få fullt utbytte av dataene må forskerne sikre at dataene har god kvalitet gjennom gode datahåndteringsrutiner, skriver forfatterne. Bildet er fra Mikrobiologisk avdeling på Rikshospitalet. Foto: Skjalg Bøhmer Vold

DMP writing workshops

15-16th of June - **free spots!**

DM implementation course

TBA online

NeLS/usegalaxy.no

Q3/21 online

tess.elixir-europe.org elixir-norway.org digitallifenorway.org

elixir.no
digitallifenorway.org

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marta.eide@uib.no
korbinian.bosl@uib.no

@elixirnorway
@DigitaltLiv
@MartaEide
@BoslKorbinian

Horizon 2020
Research Infrastructure
Program

With funding from
The Research
Council of Norway

The Data Steward Wizard is provided by: