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PHenoImageShare(PHIS)

An online repository of genotype-phenotype metadata integration & annotation for bio-images

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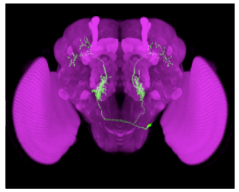
Outline of Presentation

- Overview
- Pilot Dataset
- Standards & Ontologies
- Demo
- Technologies
- Challenges
- Conclusion & Future Work

Overview of PhenoImageShare

- Online platform enabling semantic discovery, browsing & annotation of federated phenotype image resources



- Cross-species integration
  - **mouse**, **fly brain (pilot)**, human, zebrafish, & plant
- Integration with atlas frameworks (e.g. EMA)
- Web-based end user tools for image annotation & discovery
- Support for ROI drawing, ontology terms & free-text annotations

Images source: http://www.virtualflybrain.org/ & http://www.ebi.ac.uk/panda-srv/tracer /

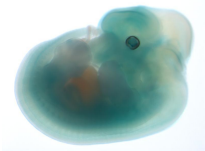
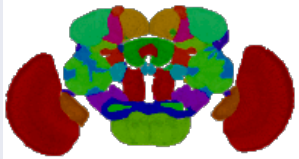
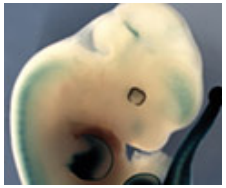
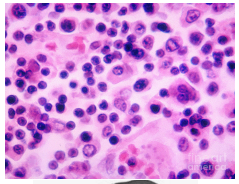
Objectives of PhenoImageShare

- To provide platform to support integration, discovery & sharing of open-access data through freely available APIs
- To provide responsive & user-friendly tools for data integration in phenotyping & bio-image research areas
- To promote interoperability with existing data annotated with standard ontologies
- To develop open standard exchange format for image annotations & metadata

https://www.flickr.com/photos/hagens_world/

https://www.flickr.com/photos/hilts_uk/

Data to demonstrate feasibility of PHIS

Data source	No. of images	
Wellcome Trust Sanger Institute, KOMP2 (*Mus musculus*)	**93, 861**	
EMAGE Mouse Atlas Project	**3, 566**	
Virtual Fly Brain (*Drosophila melanogaster*)	**19, 853**	
TRACER database	**702**	
Histopathology Project • *images of adult tissues from EUCOMM tools*	*coming soon…*	
Deciphering the Mechanisms of Developmental Disorders (DMDD)	*coming soon…*	

PHIS uses standard ontologies

Annotations	Ontologies used
Anatomy	*Drosophila* gross anatomy (**FBbt**) Mouse adult gross anatomy (**MA**) Mouse gross anatomy & development (**EMAP**, **EMAPA**)
Developmental stage	Drosophila development (**FBdv**) Mouse development (**mmusdv**)
Phenotype	Mammalian phenotype (**MP**)
Imaging methods	Biological Imaging Methods - **FBbi**

PhenoImageShare organizes image metadata: search

Filters

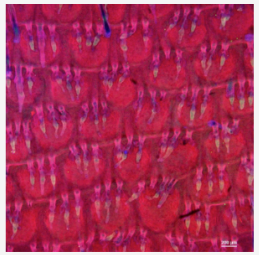
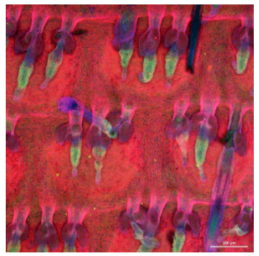
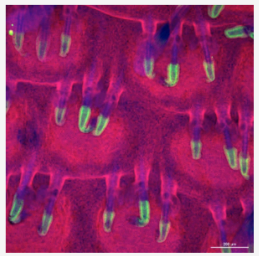
- Mutants 1059
- Wildtype 3
- Imaging Method 1062
- Stage 1062
- Species 1062
- Anatomy
  - Anatomy term Go!
- Gene
  - Gene symbol Go!
- Phenotype
  - Phenotype term Go!

abnormal hair follicle morphology Search

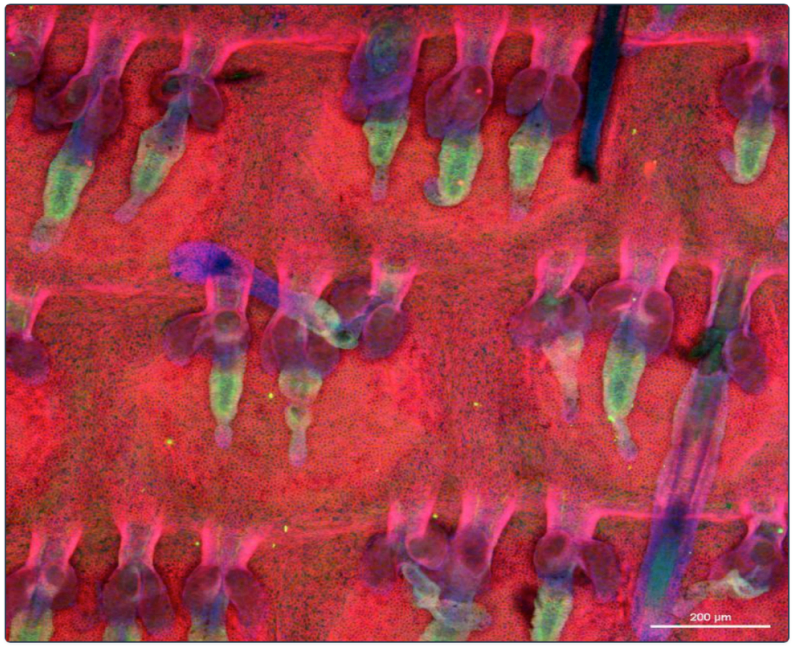
Examples: cornea ulcer, eye, Sesn3 Clear

1062 images found in database

10 images per page Filter images:

Image	Description
	**Phenotype:** abnormal hair follicle morphology,abnormal hair follicle bulge morphology,abnormal hair follicle bulge morphology,abnormal hair follicle morphology **Genotype:** | Tmem98 | HETEROZYGOUS | null mutation |
	**Phenotype:** abnormal hair follicle morphology,abnormal hair follicle bulge morphology,abnormal hair follicle bulge morphology,abnormal hair follicle morphology **Genotype:** | Tmem98 | HETEROZYGOUS | null mutation |
	**Phenotype:** abnormal hair follicle morphology,abnormal sebaceous gland morphology,abnormal sebaceous gland morphology,abnormal hair follicle morphology **Genotype:** | Gpc5 | HOMOZYGOUS | null mutation |

PhenoImageShare organizes image metadata: details



Annotation Tool

Search term: abnormal hair follicle morphology

Metadata & Genotype

Metadata

Organism:	Mus musculus
Age:	15.9w (at death)
Sex:	FEMALE
Stage:	postnatal stage
Method:	confocal microscopy
Image:	wtsi_komp2_289775

Attribution

Generated By:	WTSI
Repository:	Mouse Phenotype

Genotype

Genotype:	| Tmem98 | HETEROZYGOUS | null mutation |
Sample type:	MUTANT
Zygosity:	HETEROZYGOUS

Regions of Interest

Copy CSV Excel PDF Print

Show / hide columns

Annotations	Channels
Phenotypes: abnormal hair follicle morphology	
Phenotypes: abnormal hair follicle bulge morphology	

Curator:

Created:

Updated:

Modify:

Annotations

ID	Term	Type	Curator	Created	Edit/Delete
0	abnormal hair follicle bulge morphology	phenotype	User	Created	Edit/Delete

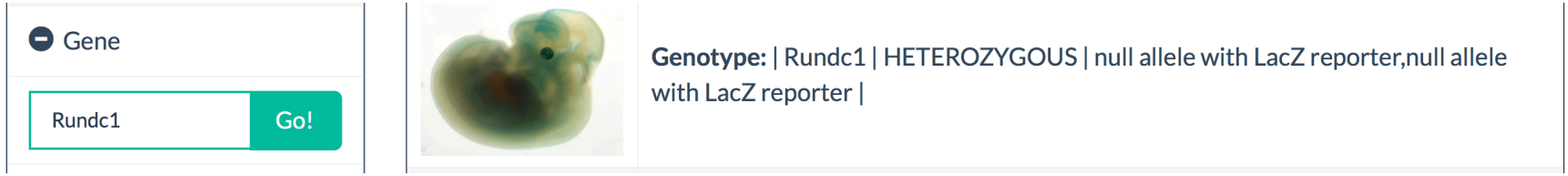
Phenotypes: abnormal hair follicle bulge morphology

Phenotypes: abnormal hair follicle morphology

Showing 1 to 4 of 4 entries

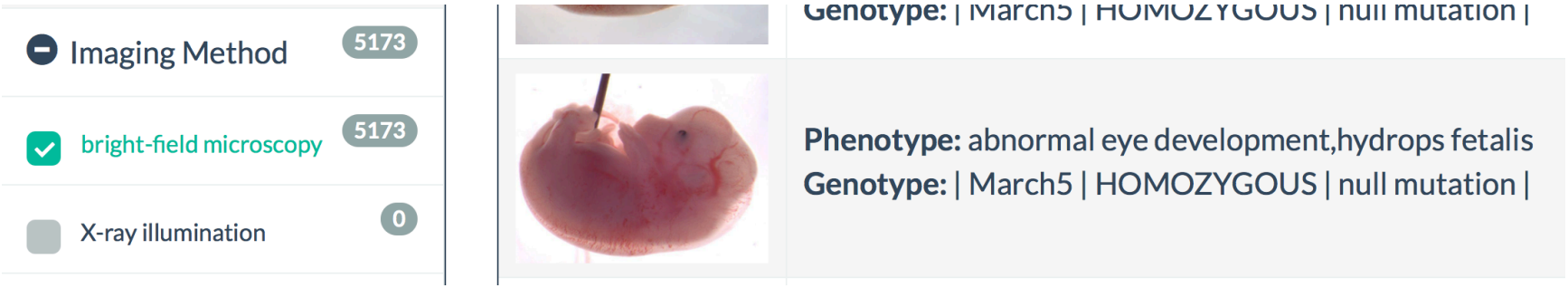
PhenoImageShare organizes image metadata

- Genotype information – e.g. Gene | type (knockouts, mutants, etc)



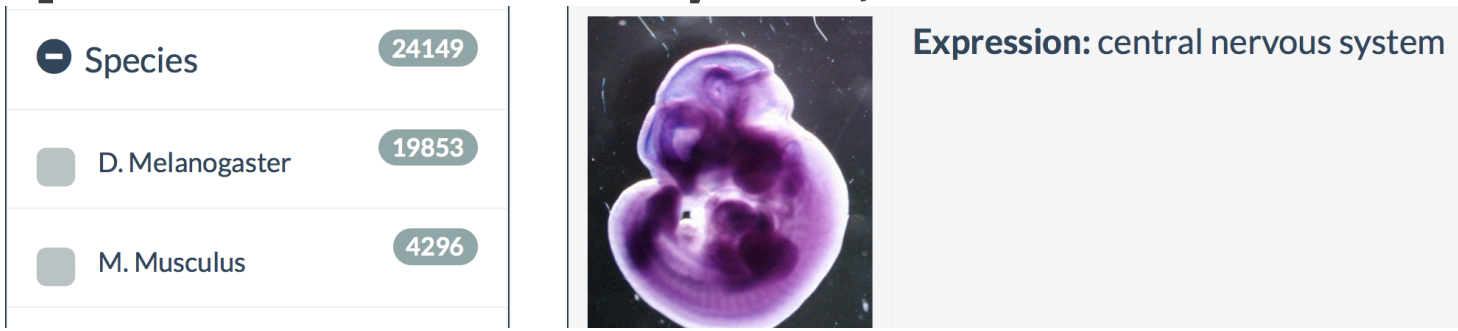
- Sample & Image types – Mutants/Wildtype; Phenotype/Expression

- Imaging Methods: X-Ray, macroscopy, microscopy, etc

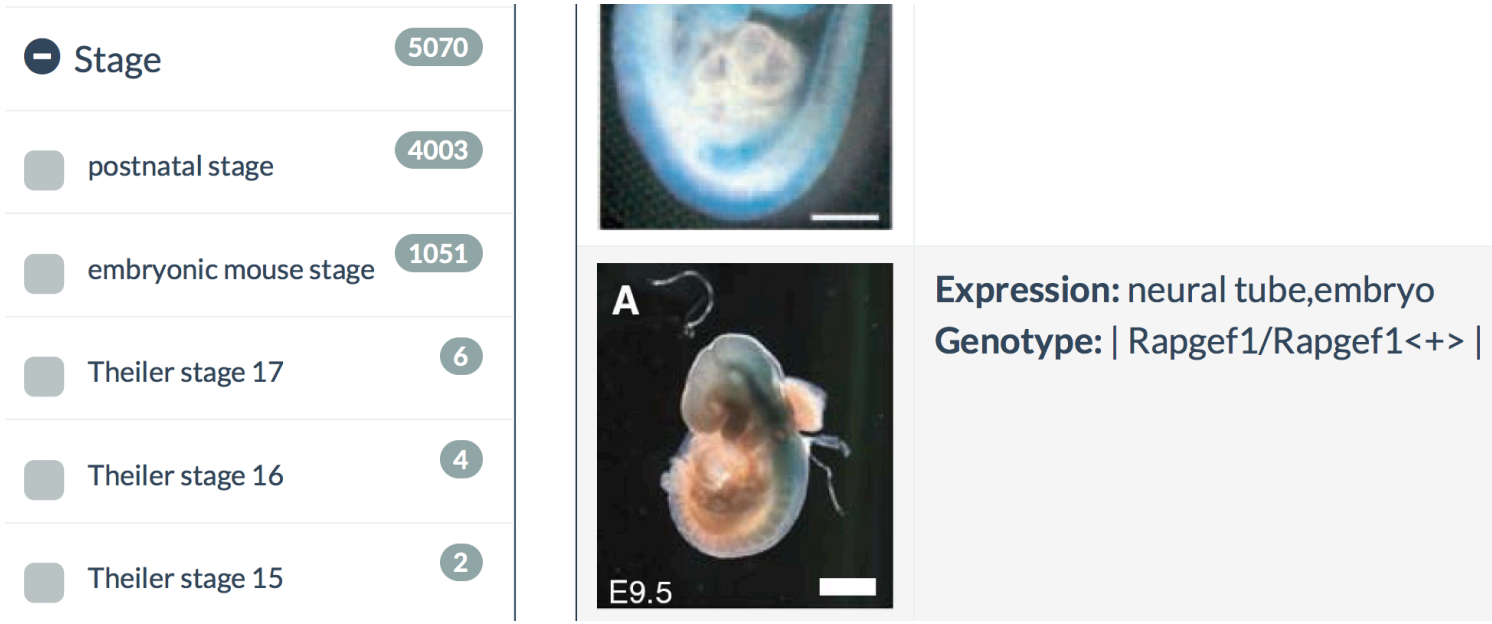


PhenoImageShare organizes image metadata

- Species – **mouse**, **virtual flybrain,** zebrafish, human, etc



- Development stages – adult, embryonic, postnatal, TS XY, etc



Answering some competency questions

Usage Examples

Search for: “liver” anatomy

Search for: “corneal opacity” phenotype

Annotate image: associated with “ntxk2-5” gene

Discover/Search image:”ts14”

UX Session: Setup & Feedback

Setup

- Search & details page tested May, 2015
- Participants: 4 users, unfamiliar with the application
- Aim: To test all major features of web tool
- Developers observed without interfering
- 1.5h sessions:
  - 1h for exercise, discussion & margin
  - 0.5h for developer discussion

Feedback

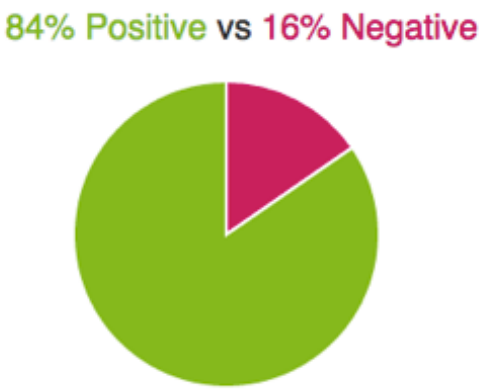
Pros	Cons
Website fast & responsive	Some missing information
Good & intuitive browsing	Terms were sometimes confusing
Liked search box & quick autosuggest	Some minor bugs
Liked facets & filters on search page	Download incomplete

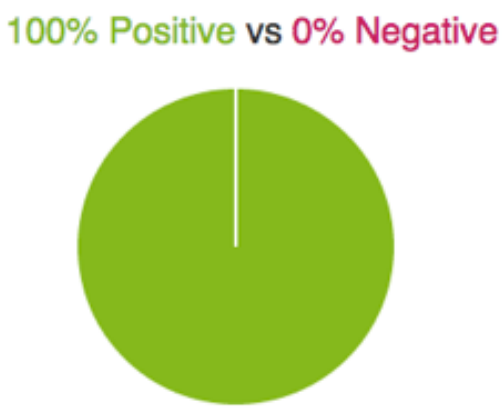
UX Session: Feedback & Feature Requests

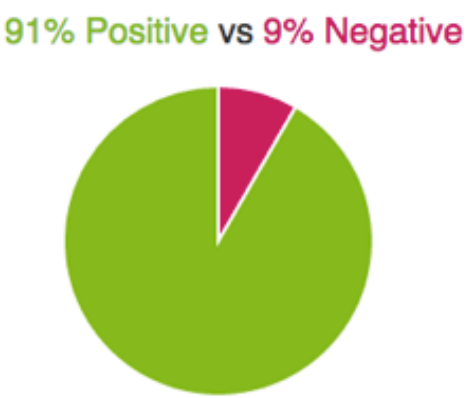
- Present search results summaries, i.e. list of genes for a phenotype term search

- Place control & mutant images side by side

- Ability to navigate to similar images







Technologies used on the project

Challenges

- Integration with existing image tools & resources
  - 3D Image service
  - OMERO Server
- Data validation: annotations: free-text & ontology terms
- Spatial reasoning: algorithms & database representation
- Ontology management (versioning, etc.)

Future Work & Planned Activities

- Next steps…
  - Implementation of submission service
  - Implementation of Grid-style gallery view
  - Annotation of 3D images (DMDD)
  - Implementation of user management
- OMERO server integration
  - supports existing standards upon which PHIS builds
- Export annotations & metadata in RDF format
- Production release: August 2015
  - Discovery + Query + Annotation interfaces

Acknowledgement

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BBSRC
bioscience for the future

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