

A microscopic image of biological tissue, likely an amphibian, showing various cellular structures and colors (red, blue, green) under a microscope. The image is dark and serves as a background for the text.

Development of the Amphibian Anatomical Ontology

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Community-identified need (ATOL)

- Anatomical ontology vital to amphibian research
 - Common gene expression and embryology models
- Three disparate lexicons
- Lack of terminological standardization limits understanding of phenotype evolution and integrative research on gene expression, embryology, and comparative anatomy

Challenge

Develop an amphibian anatomical ontology that accommodates the diversity of structures present in all amphibians; include definitions, literature references, coding of phylogenetic characters, and images and annotations

...and include the domain expert community

...and maintain interoperability with other ontologies

...and do it in a reasonable amount of time

AmphibAnat approach

Combine existing tools and methodologies with new approaches

1. Semi-automated construction
2. Ontology maintenance
3. Web-based community curation

1. Semi-automated construction

- Challenge requires automated techniques to reduce manual efforts and enhance existing, manually created ontologies by:
 - Enriching the ontology (adding terms to the AAO) and annotating (= character states)
 - Applying metrics to benchmark the semi-automated performance

Semi-automated approach

- Manually construct small subset(s)
 - Started with ZFIN/TAO
- Rigorous community evaluation, augmentation, and modification of subset ontology
- Seed IR software with skeleton of ontology
 - Use to find terms and annotations
- Benchmark, repeat until software is reasonably accurate, then let loose on entire ontology

How does the software work?

- Identify relevant electronic data sources
 - Use topic-specific spider to generate queries for concepts in the ontology
 - Collect potentially relevant documents
- Text mine info from documents
 - Pattern-based extraction methods
 - Statistical natural language processing algorithms that identify and weight most important elements

2. Ontology maintenance

- Our needs required maintenance software that:
 - Allows web-based access and collaboration
 - Ensures consistency and concurrent, authorized access
 - Allows query and update of context and structure
 - Allows import/export of common exchange formats (e.g., OBO, OWL)
 - Allows node-based access and editing privileges

Amphibian Anatomical Ontology

http://www.amphibanat.org/

RDBOM | Relational DataBase Ontology Maintenance

HOME QUERY ontology UPDATE ontology EXPORT ontology VIEW LOG

Query Ontology

best viewed with Firefox
1280x1024 screen resolution

AMPHIBANAT
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0. View Tree

- Find all classes that contain a particular phrase
- Find all references to a particular class
- Find all classes and/or instances that contain a certain phrase in a particular property
- Find all classes and/or instances for which data are known for a certain property
- Find all classes and/or instances for which data are not known for a certain property
- Given a function defined in the ontology and a term, find all such references
- Find all ancestors of a class
- Find all descendants of a class
- Find all relationships between two classes
- Find the closest shared parent of two classes

Concepts <comments>

- anatomical system <comments>
 - digestive system <comments>
 - integument <comments>
 - muscular system <comments>
 - nervous system <comments>
 - respiratory system <comments>
 - skeletal system <comments>
 - appendicular skeleton <comments>
 - axial skeleton <comments>
 - cranial skeleton <comments>
 - braincase and auditory apparatus <comments>
 - braincase and otic capsule opening <comments>
 - braincase and otic capsule skeleton <comments>
 - arcus praeoccipitalis** <comments>
 - basioccipital <comments>
 - basisphenoid <comments>
 - cartilago orbitalis <comments>
 - cartilago prootico-occipitalis <comments>
 - crista parotica <comments>
 - eustachian canal

arcus praeoccipitalis

Concepts

- anatomical system
- skeletal system
- cranial skeleton
- braincase and auditory apparatus
- braincase and otic capsule skeleton
- arcus praeoccipitalis

Definitions:

Skeletal structure that separates the inferior and superior perilymphatic foramina.

Parent Classes:

braincase and otic capsule skeleton

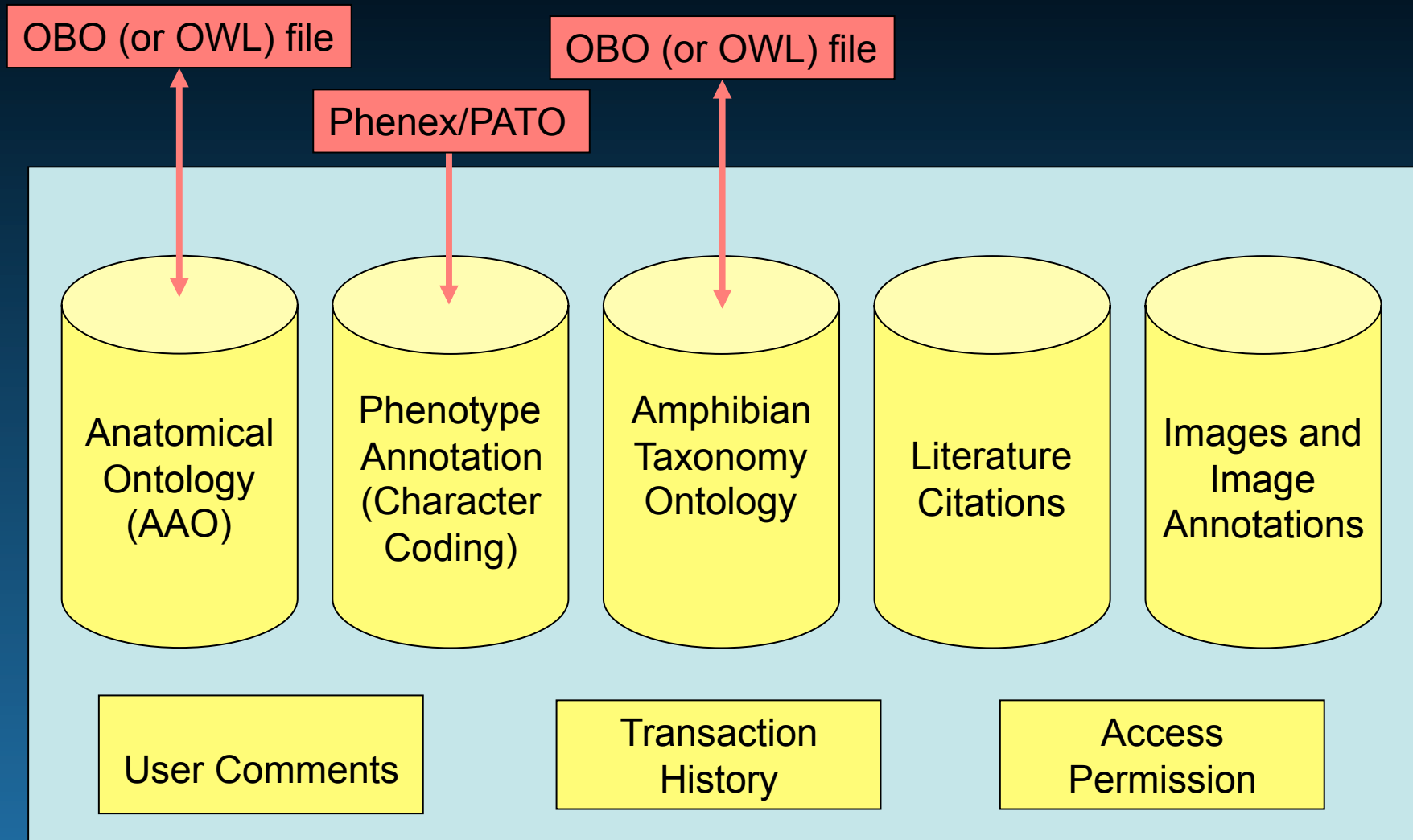
Others:

arcus praeoccipitalis has RDBOM ID [AAO:0000640](#)

RDBOM (*“red-bomb”*)

- Relational Database Ontology Maintenance
- Features:
 - Structural (e.g., ancestors/descendents) and content-based queries (e.g., all concepts with particular phrase)
 - Structural updating (e.g., move/insert/delete nodes)
 - Content-based updating (e.g., change the value)
 - Collaborative commenting
 - Security (node-based per user; multiple users)
 - Version control
 - Web-based access
 - Generic (any ontology)
 - Modularization of data

Modularization



3. Web-based community curation

- Challenge required us to develop a virtual organization of amphibian experts
 - Encourage user commenting by node
 - Allow “super-user” node-based curation
 - Teams and individuals take ownership of particular subsets for which they are the experts

www.amphibanat.org

Amphibian Anatomical Ontology

http://www.amphibanat.org/

Google

HOME ABOUT ONTOLOGY F.A.Q. CONTACT

WELCOME

The Amphibian Anatomical Ontology (AmphibAnat) is a community-based resource for the development of a controlled vocabulary for describing the anatomy of frogs, salamanders, and caecilians.

NEWS & EVENTS

Nov 14, 2007

AmphibAnat Workshop/Board Meeting, University of Texas - Austin, USA, Nov 14-15, 2007

July 11, 2007

2007 Joint Meeting of Ichthyologists and Herpetologists, St Louis, Missouri, USA <Conference Website>

8th International Congress of Vertebrate Morphology, Paris, France <Congress Website>

USER LOGIN

To better serve the AmphibAnat user community, we are now using the RDBOM (Relational DataBase Ontology Maintenance) system to store the ontology.

Please click on the link below to **LOGIN** to the RDBOM system.

Internet Explorer Users: Please note that we do **NOT** support Internet Explorer web browser.

ONTOLOGY

View Ontology

Building the Amphibian Anatomical Ontology

The building of the amphibian anatomical ontology is a threefold process consisting of manual development, semi-automatic construction, and community curation.

Manual construction of the ontology entails experts mining literature sources for semantic concepts and properties. Concepts are given a textual definition, a list of synonyms and alternative terms, and bibliographical references. In the semi-automatic construction phase, subsets of the manually-constructed ontology are used as seeds for a software system we developed that augments the concepts and properties in the ontology by mining electronic media to extract information. The final phase includes enhancement, modification, and acceptance of the ontology by the expert user community via the online collaborative environment.

Throughout all phases of the process, an advisory board comprised of researchers with expertise in amphibian anatomy and systematics, amphibian genomics, ontology building, and Web-based media resources, provide expert opinion on issues inherent to the development of the ontology and the project infrastructure and implementation.

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Challenge

AmphibAnat

Semi-automated construction

Maintenance

Web-based community curation

Summary

Query Ontology

Best viewed with Firefox
1280x1024 screen resolution

1. View Tree

2. Find all classes that contain a particular phrase

3. Find all references to a particular class

4. Find all classes and/or instances that contain a specific phrase/property combination

5. Given a class and property, find all linked classes/instances

6. Find all ancestors of a class

7. Find all descendants of a class

8. Find all relationships between two classes

9. Find the closest shared ancestor of two classes

Concepts <comments>

- 1 amphibian anatomical entity <comments>
 - 1 anatomical space <comments>
 - 1 anatomical structure <comments>
 - 1 anatomical group <comments>
 - 1 anatomical cluster <comments>
 - 1 anatomical system <comments>
 - 1 circulatory system <comments>
 - 1 digestive system <comments>
 - 1 integument <comments>
 - 1 muscular system <comments>
 - 1 nervous system <comments>
 - 1 respiratory system <comments>
 - 1 skeletal system <comments>
 - 1 appendicular skeleton <comments>
 - 1 cranium <comments>
 - 1 braincase and auditory apparatus <comments>
 - 1 braincase and otic capsule opening <comments>
 - 1 basicranial fontanelle <comments>
 - 1 fenestra ovalis <comments>
 - 1 foramen

orbital region

Concepts

- 1 amphibian anatomical entity
 - 1 anatomical structure
 - 1 anatomical group
 - 1 anatomical system
 - 1 skeletal system
 - 1 cranium
 - 1 orbital region

Definitions:

An anatomical cluster that is part of the cranium and structurally supports the eye.

Parent Classes:

[cranium](#)

has_RDBOM_ID:

[orbital region](#) has_RDBOM_ID AAO:0010220

Commenting tool

View / Add Comments: "basale commune"

Hi **Dr. Anne Maglia**, welcome to the View / Add Comments: "basale commune" page. You can view or add comments at this page for "basale commune".

If you want to edit submitted comments for "basale commune", please go to [EDIT MY COMMENTS](#) page.

* Maximum input 2000 characters.

Submit Comments

<u>Node Name</u>	<u>Firstname</u>	<u>Lastname</u>	<u>Comments</u>	<u>DateTime</u>
basale commune	David	Wake	The basale commune is a synapomorphy of living caudata and may ultimately to be a synapomorphy of a deeper node. It evidently evolved from a phylogenetic amalgamation of original distal tarsals 1 and 2. However, there is scant to no evidence that there are two centers during ontogeny, so it is advised to use the term basale commune instead of distal tarsal 1 + 2.	11/9/2008 9:34:32 AM

Privilege assignment

The screenshot shows a web browser window titled "Amphibian Anatomical Ontology" with the URL "http://www.amphibanat.org/". The page features a navigation bar with links: HOME, QUERY ontology, UPDATE ontology, EXPORT ontology, and VIEW LOG. The main content area is titled "RDBOM Home" and includes a welcome message and a user login form. The login form has fields for "Login (E-mail)" and "Password", a "Submit" button, and a "Register Now!" link. The footer of the page contains a navigation bar with links: Home :: Query :: Update :: Export :: View Log.

Amphibian Anatomical Ontology

http://www.amphibanat.org/

RDBOM | Relational DataBase Ontology Maintenance

HOME QUERY ontology UPDATE ontology EXPORT ontology VIEW LOG

RDBOM Home
best viewed with Firefox
1280x1024 screen resolution

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Welcome

Welcome to RDBOM!

We present a functionally comprehensive, generic approach to maintaining an ontology as a relational database. Implemented as a web-based software system called RDBOM (Relational Database Ontology Maintenance), this approach exploits the traditional features of a relational database management system in terms of concurrency control, security, and consistency checking in order to facilitate querying and updating of the ontology.

User Login

Login (E-mail)

Password

Not a registered user?


Register Now!

If you are a registered user of the website, you can update or add comments to the under-development ontology. You can also access the UPDATE ontology page.

Home :: Query :: Update :: Export :: View Log

“Super-user” functions

UPDATE Ontology
best viewed with Firefox
1280x1024 screen resolution

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Concepts <comments>

- 1 amphibian anatomical entity <comments>
 - 1 anatomical space <comments>
 - 1 vertebral column opening <comments>
 - 1 **intervertebral space** <comments>
 - 1 neural canal <comments>
 - 1 spinal foramen <comments>
 - 1 anatomical structure <comments>
 - 1 anatomical group <comments>
 - 1 anatomical cluster <comments>
 - 1 neurocranium <comments>
 - 1 skull <comments>
 - 1 suspensorium(1) <comments>
 - 1 anatomical system <comments>
 - 1 circulatory system <comments>
 - arteriole <comments>
 - artery <comments>
 - 1 aorta <comments>
 - 1 carotid <comments>
 - 1 external carotid <comments>
 - 1 internal carotid <comments>

intervertebral space

Structured Update

- Create Child Node
- Delete Leaf Node
- Move (Cut)

Content-Based Update

- Update Node (Class)
- Link Node to Node
- Delete Node to Node Link

Concepts

- [amphibian anatomical entity](#)
 - [anatomical space](#)
 - [vertebral column opening](#)
 - [intervertebral space](#)

Definitions:

Space formed by the anterior and posterior intervertebral notches. The intervertebral spaces accommodate the spinal nerves as they emerge from the spinal canal. [AAO:LAP]

Parent Classes:

Simple interface

The screenshot shows a web browser window titled "Amphibian Anatomical Ontology" with the URL "http://www.amphibanat.org/". The page features a navigation bar with links: HOME, QUERY ontology, UPDATE ontology, EXPORT ontology, and VIEW LOG. A banner for "UPDATE Ontology" includes the text "best viewed with Firefox 1280x1024 screen resolution" and the "AMPHIBANAT" logo with the website "amphibanat.org".

On the left, a sidebar contains a link: **Concepts** <comments>.

The main content area is titled "Create Child Node for Concepts" and contains the following form fields:

- RDBOM ID: *
- Term Name: *
- Definition:
- Relation Type: *
- Term Type: Class

A "Submit Form" button is located below the form fields. A note at the bottom of the form states: "* Required fields".

Web-based community curation

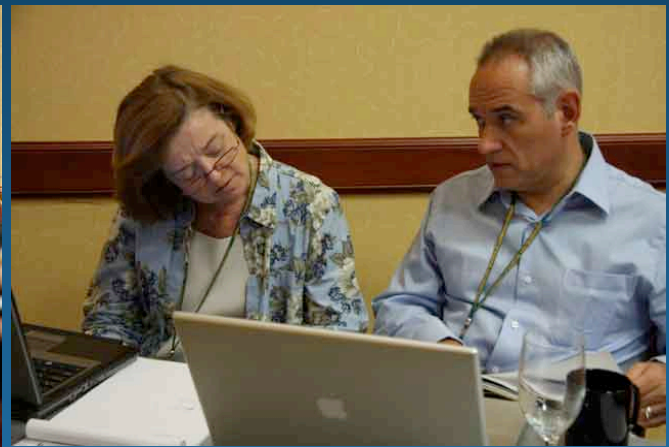
- Facilitates inclusion of area expertise
- Provides forum for argumentation
 - E.g., definitions, homology, preferred terminology
- Allows community ownership (and thus guaranteed use)
- Value-added: unites diverse groups toward common goal

Summary

- Biodiverse group with disparate lexicons required combination of existing tools and novel approaches
- Semi-automated construction should help populate ontology faster, with less manual effort
- Community-based curation allows user ownership, thus mining expert knowledge and facilitating use
- Database maintenance system allows biodiversity data and functionality while allowing interoperability with other groups (e.g., OBO Foundry)

Where are we now?

- Two user workshops
 - 40 domain experts trained in system
- Community helping to build subset ontologies
- Text classification, evaluation, and training tools in final testing phase
- Automated annotation tools in first phase of testing/benchmarking



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