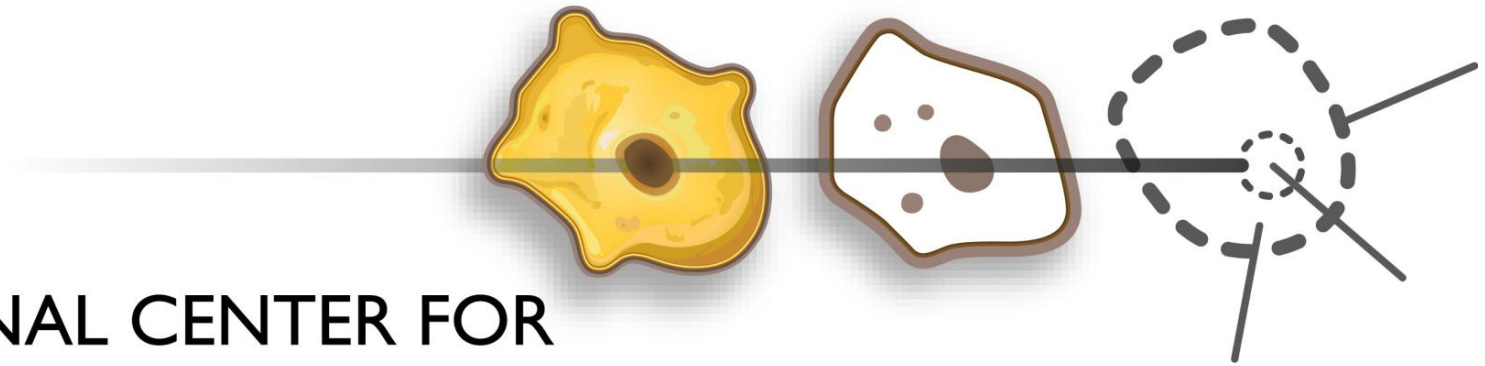
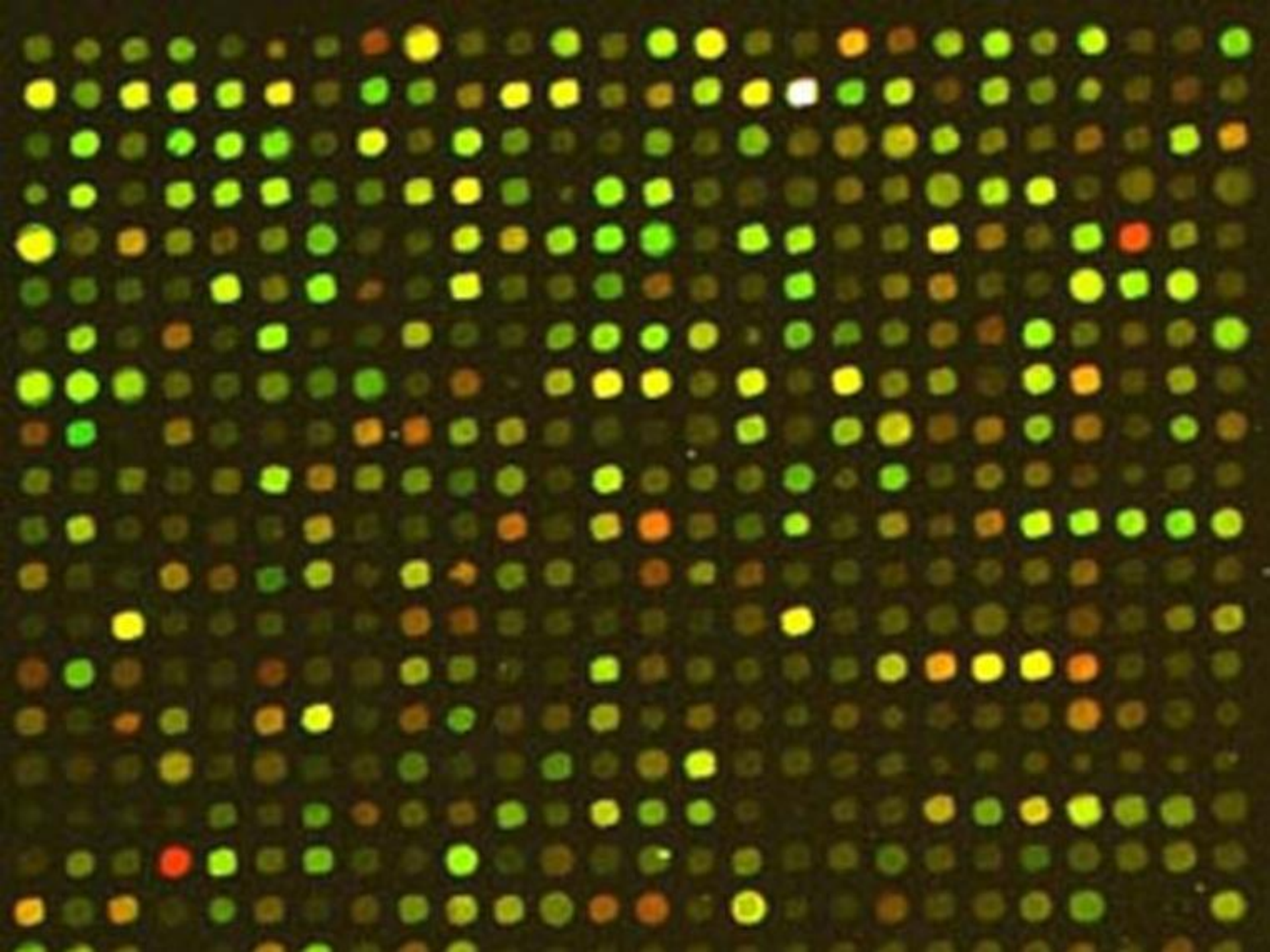


NATIONAL CENTER FOR

BIOMEDICAL ONTOLOGY

Mark Musen and the NCBO team
Stanford University

Big Data Needs Big Ontology!



the Gene Ontology

AmiGO

Search | Browse | BLAST | Homolog Annotations | Tools & Resources | Help

Search GO [ ] terms genes or proteins exact match Submit

Tree Browser

Filter tree view

Filter by ontology
Ontology: All | biological process | cellular component | molecular function

Filter Gene Product Counts
Data source: All | ASAP | AspGD | CGD
Species: All | Arabidopsis thaliana | Aspergillus fumig... | Aspergillus niger

View Options
Tree view: Full Compact

Set filters | Remove all filters

- all : all [582472 gene products]
  - **GO:0008150 : biological_process [442277 gene products]**
    - GO:0022610 : biological adhesion [7784 gene products]
    - GO:0065007 : biological regulation [106873 gene products]
    - GO:0009758 : carbohydrate utilization [35 gene products]
    - GO:0015976 : carbon utilization [251 gene products]
    - GO:0001906 : cell killing [1176 gene products]
    - GO:0008283 : cell proliferation [9942 gene products]
    - GO:0071840 : cellular component organization or biogenesis [55517 gene products]
    - GO:0009987 : cellular process [266466 gene products]
    - GO:0016265 : death [12861 gene products]
    - GO:0032502 : developmental process [49009 gene products]
    - GO:0051234 : establishment of localization [55604 gene products]
    - GO:0040007 : growth [13918 gene products]
    - GO:0002376 : immune system process [12542 gene products]

Actions...
Last action: Opened
GO:0008150
Graphical View
Permalink
Download...
OBO
RDF-XML
GraphViz dot

NCI Thesaurus

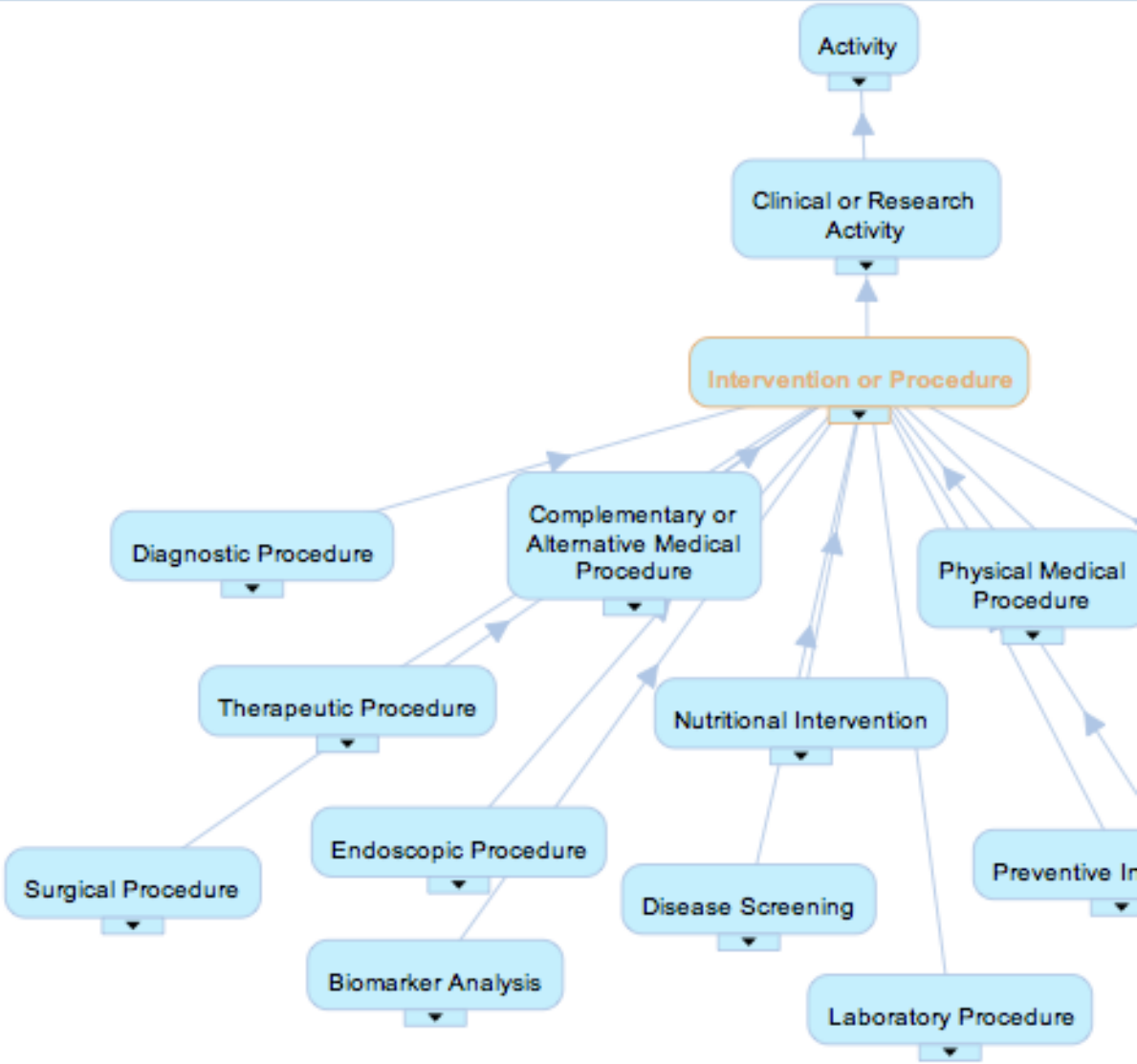
Terms

Jump To:

- Abnormal Cell
- Activity
  - Action
  - Administrative Activity
  - Behavior
  - Clinical or Research Activity
    - Healthcare Activity
    - Intervention or Procedure
      - Behavioral, Psychological or Informational Intervention
      - Biomarker Analysis
      - Cancer Diagnostic or Therapeutic Procedure
      - Complementary or Alternative Medical Procedure
      - Diagnostic Procedure
      - Disease Screening
      - Endoscopic Procedure
      - Laboratory Procedure
      - Nutritional Intervention
      - Pediatric Intervention or Procedure
      - Physical Medical Procedure
      - Preventive Intervention
      - Surgical Procedure
      - Therapeutic Procedure
    - Research Activity
    - Study Activity
  - Educational Activity
  - Physical Activity
  - Technique
    - Birth Method of Delivery
    - Catheterization
    - Computational Technique
    - Modeling
    - Radiation Dosimetry
    - Research Technique
    - Statistical Technique

Details | Visualization | Notes (0) | Term Mappings (30) | Term Resources

path to root



SNOMED Clinical Terms

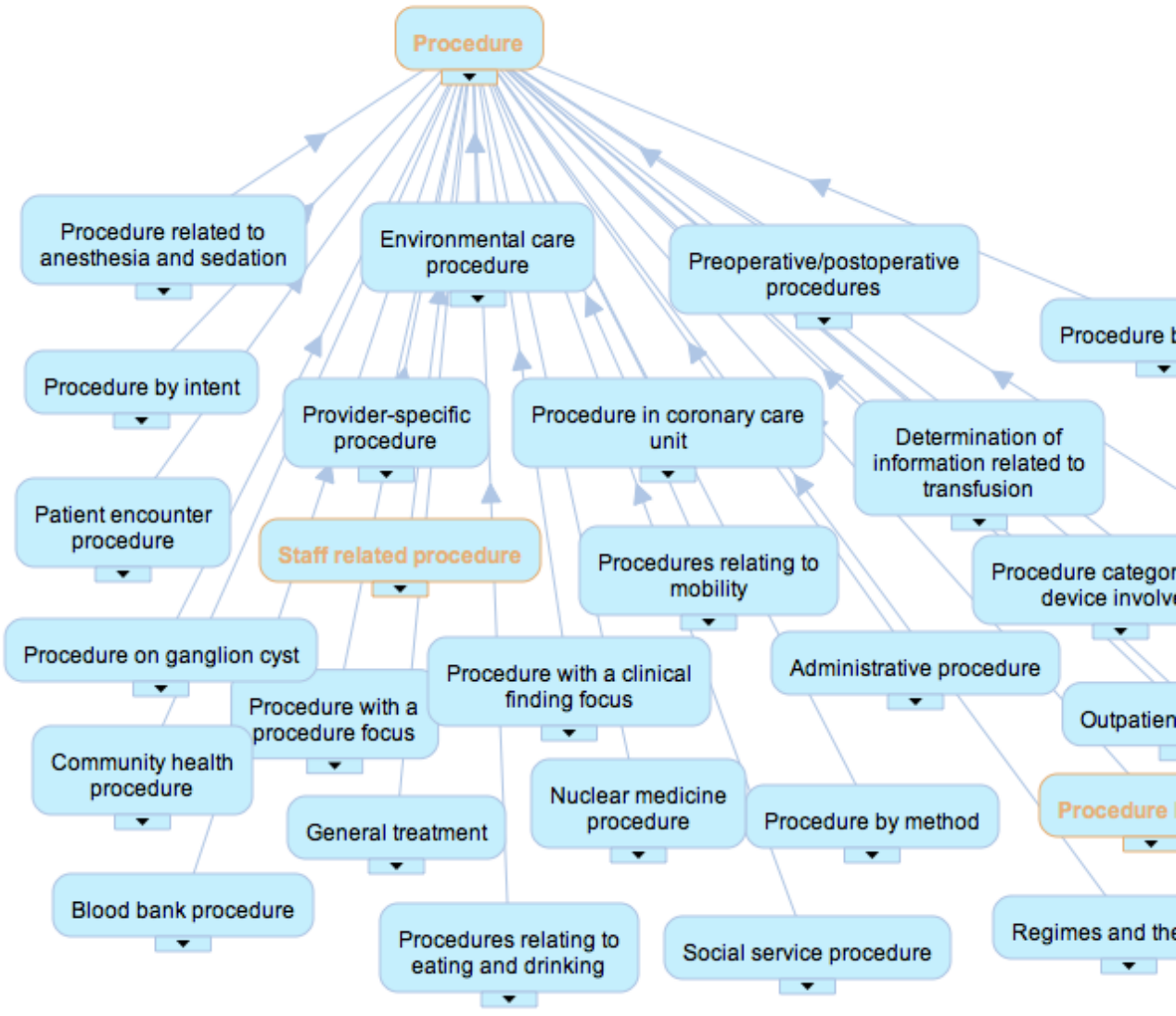
Terms

Jump To:

- Body structure
- Clinical finding
- Environment or geographical location
- Event
- Linkage concept
- Observable entity
- Organism
- Pharmaceutical / biologic product
- Physical force
- Physical object
- **Procedure**
  - Administrative procedure
  - Blood bank procedure
  - Community health procedure
  - Determination of information related to transfusion
  - Environmental care procedure
  - General treatment
  - Laboratory procedure
  - Nuclear medicine procedure
  - Obstetric procedure
  - Outpatient procedure
  - Patient encounter procedure
  - Preoperative/postoperative procedures
  - Procedure by intent
  - Procedure by method
  - Procedure by priority
  - Procedure by site
  - Procedure categorized by device involved
  - Procedure in coronary care unit
  - Procedure on ganglion cyst
  - Procedure related to anesthesia and sedation
  - Procedure related to breastfeeding
  - Procedure with a clinical finding focus

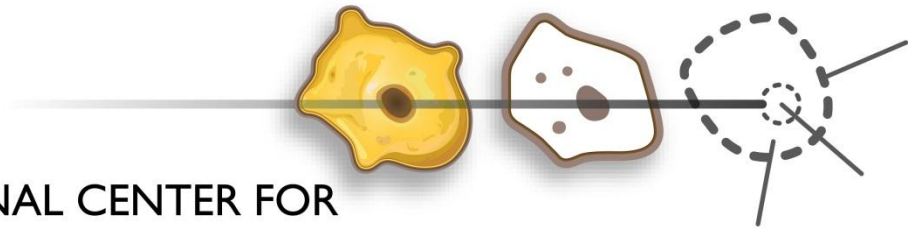
Details | Visualization | Notes (0) | Term Mappings (31) | Term Resources

path to root



The National Center for Biomedical Ontology

- We **create and maintain a library** of biomedical ontologies and terminologies.
- We **build tools and Web services** to enable the use of ontologies and terminologies.
- We **collaborate with scientific communities** that develop and use ontologies and terminologies in biomedicine.



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- **Recent Release**: BioPortal 3.10 (July 2012)
- **NCBO Webinar Announcements - Subscribe**
- **NCBO Software Support - Mailing List Archive**
- **More News & Events**

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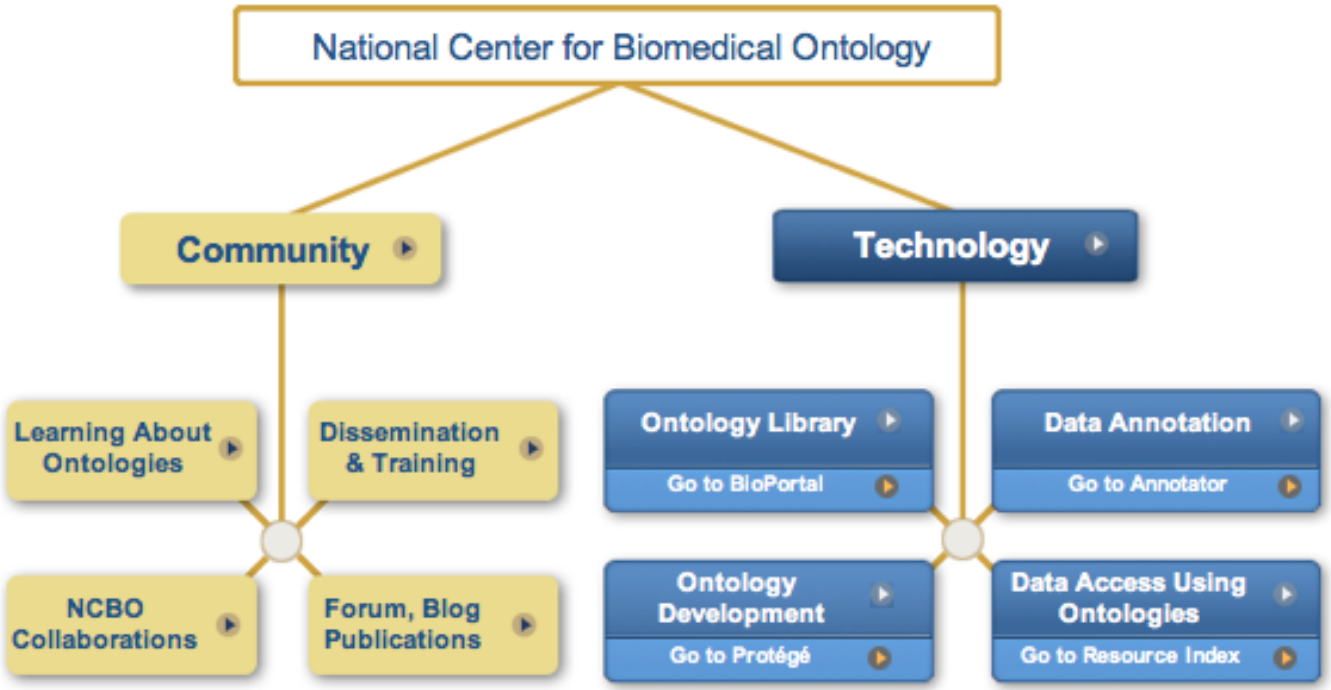


NCBO User Profile

Jin-Dong Kim
Database Center for Life Science

More >

Other profiles >

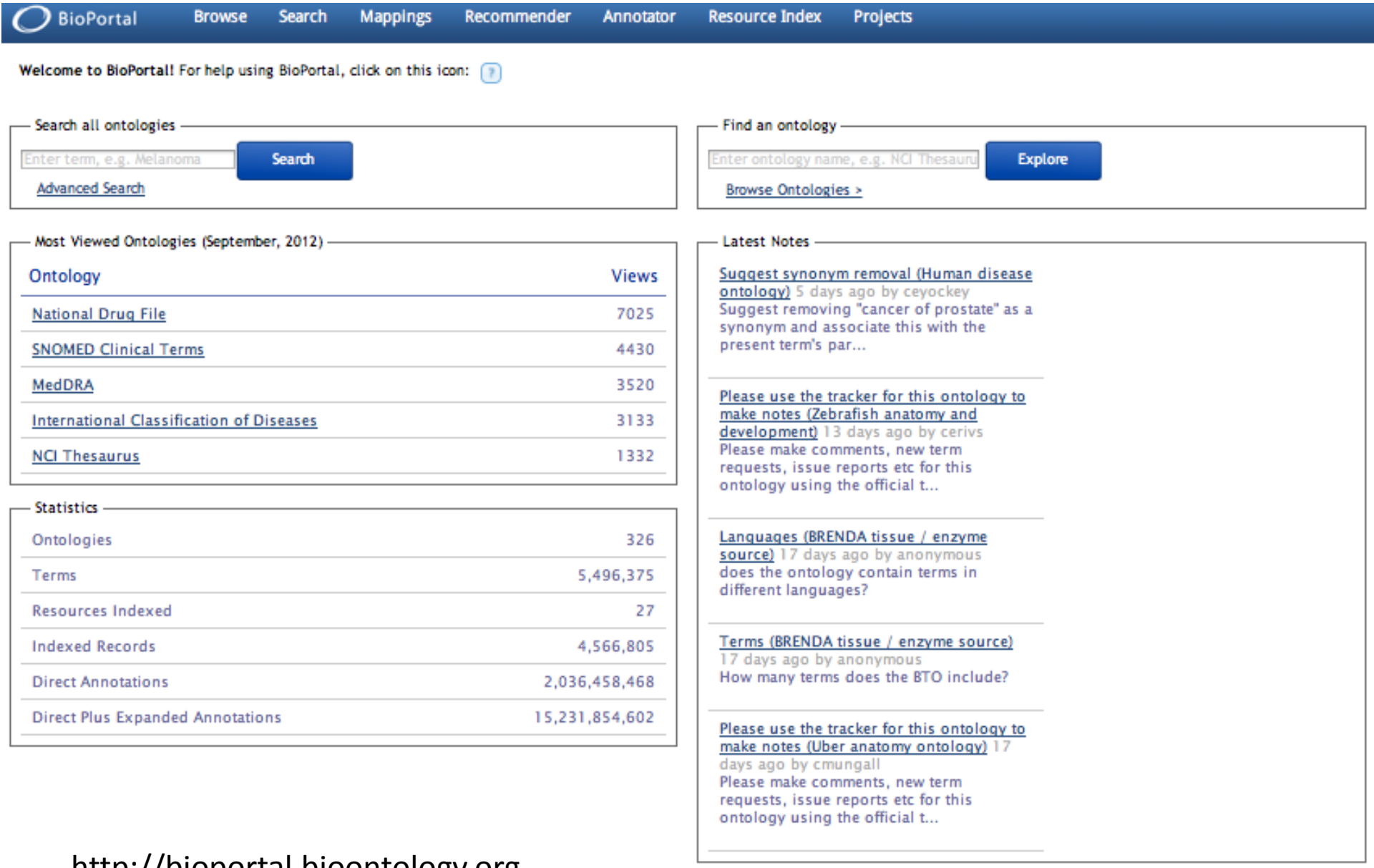
Video

Learn about Biomedical Ontologies. Watch a series of introductory videos.

Browse ontologies in BioPortal!

BioPortal allows users to browse, search and visualize ontologies.

BioPortal Ontology Repository



http://bioportal.bioontology.org

Browse

Browse the library of ontologies

New: Configure which ontologies you see in BioPortal

FILTER BY CATEGORY: All Categories

FILTER BY GROUP: All Groups

FILTER BY TEXT:

Submit New Ontology

Subscribe to all updates

ONTOLOGY NAME	VISIBILITY	TERMS	NOTES	REVIEWS	PROJECTS	UPLOADED	CONTACT
ABA Adult Mouse Brain (ABA)	Public	913	0	0	7	08/08/2009	Allen Institute for Brain Science
Adverse Event Reporting ontology (AERO)	Public	374	1	0	3	11/13/2012	Melanie Courtot
African Traditional Medicine (ATMO)	Public	223	2	2	4	06/28/2009	Ghislain Atemezing
AI/RHEUM (AIR)	Public	681	0	0	2	02/05/2010	May Cheh
Amino Acid (amino-acid)	Public	46	0	0	5	07/02/2010	Nick Drummond, Georgina Moulton, Robert Stevens, Phil Lord
Amphibian gross anatomy (AAO)	Public	1,603	0	0	5	07/22/2011	David Blackburn
Amphibian taxonomy (ATO)	Public	6,135	0	0	3	11/02/2009	AmphiAnat list
Anatomical Entity Ontology (AEO)	Public	250	0	0	3	06/01/2012	EMAP Administrators
Animal natural history and life history (ADW)	Public	360	0	0	2	08/31/2010	Animal Diversity Web technical staff
apollo-akesios (apollo)	Public	3	0	0	1	09/30/2010	Jeremy Espino
Ascomycete phenotype ontology (APO)	Public	328	0	0	4	03/01/2012	SGD curators
Basic Formal Ontology (BFO)	Public	39	0	1	21	07/24/2009	Holger Stenzhorn
Basic Vertebrate Anatomy (basic-vertebrate-gross-anatomy)	Public	99	0	0	4	01/16/2007	
Bilateria anatomy (BILA)	Public	114	0	0	4	03/03/2010	Thorsten Heinrich
Bio-health ontological knowledge base- cystic fibrosis (OntoKBCF)	Public	405	0	0	3	09/18/2012	Xia Jing
BioAssay Ontology (BAO)	Public	1,292	0	0	7	04/12/2012	Stephan Schurer
Bioinformatics operations, types of data, data formats and topics (EDAM)	Public	2,719	0	2	6	07/05/2012	Jon Ison
Bioinformatics Web Service Ontology (OBIws)	Public	195	0	0	1	07/17/2012	jie zheng
Biological imaging methods (FBbi)	Public	624	0	0	6	06/09/2011	Chris Woodcock
Biomedical Resource Ontology (BRO)	Public	486	73	1	8	08/31/2010	Trish Whetzel, Csongor Nyulas, Natasha

Gene Ontology

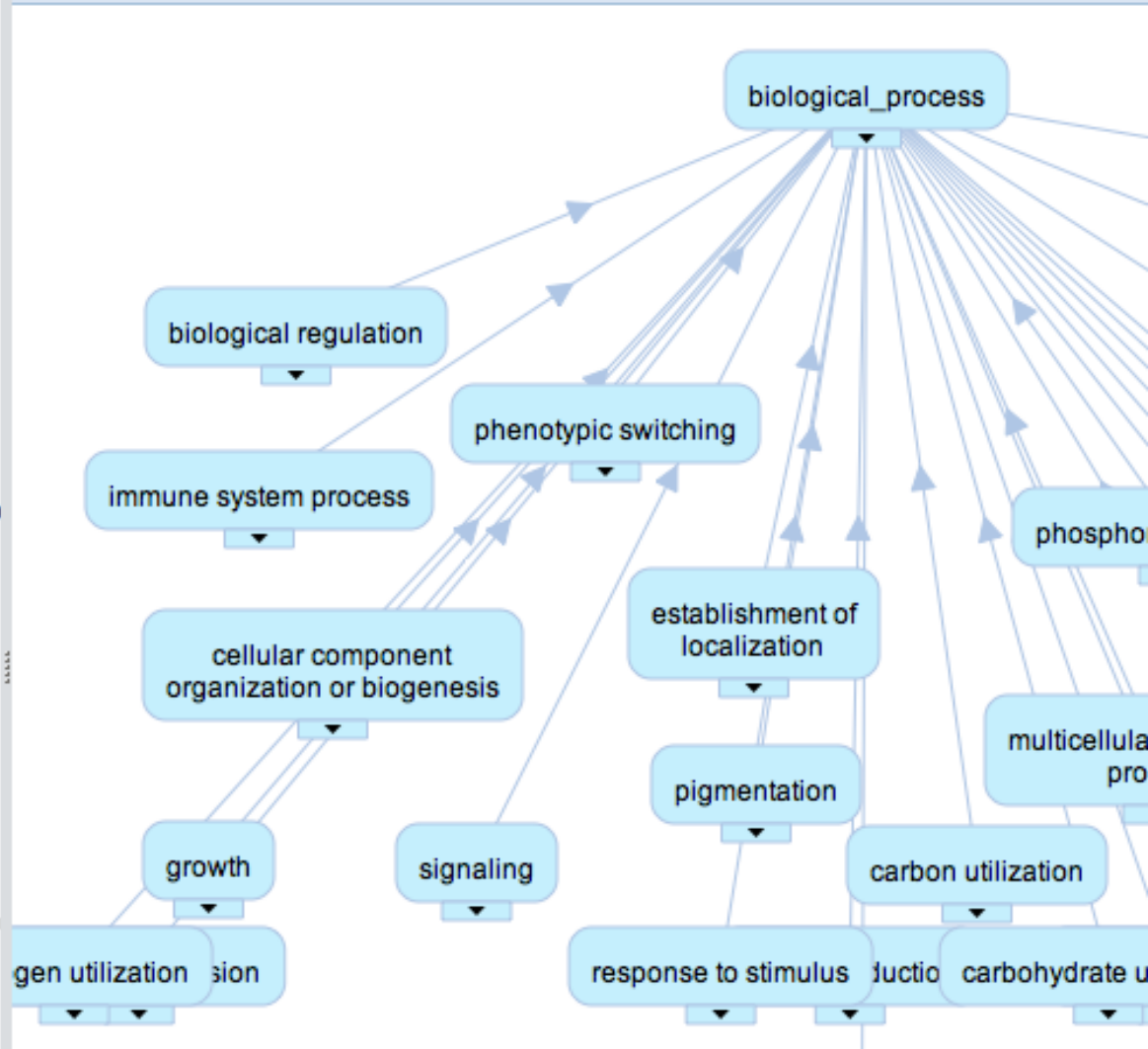
Terms

Jump To:

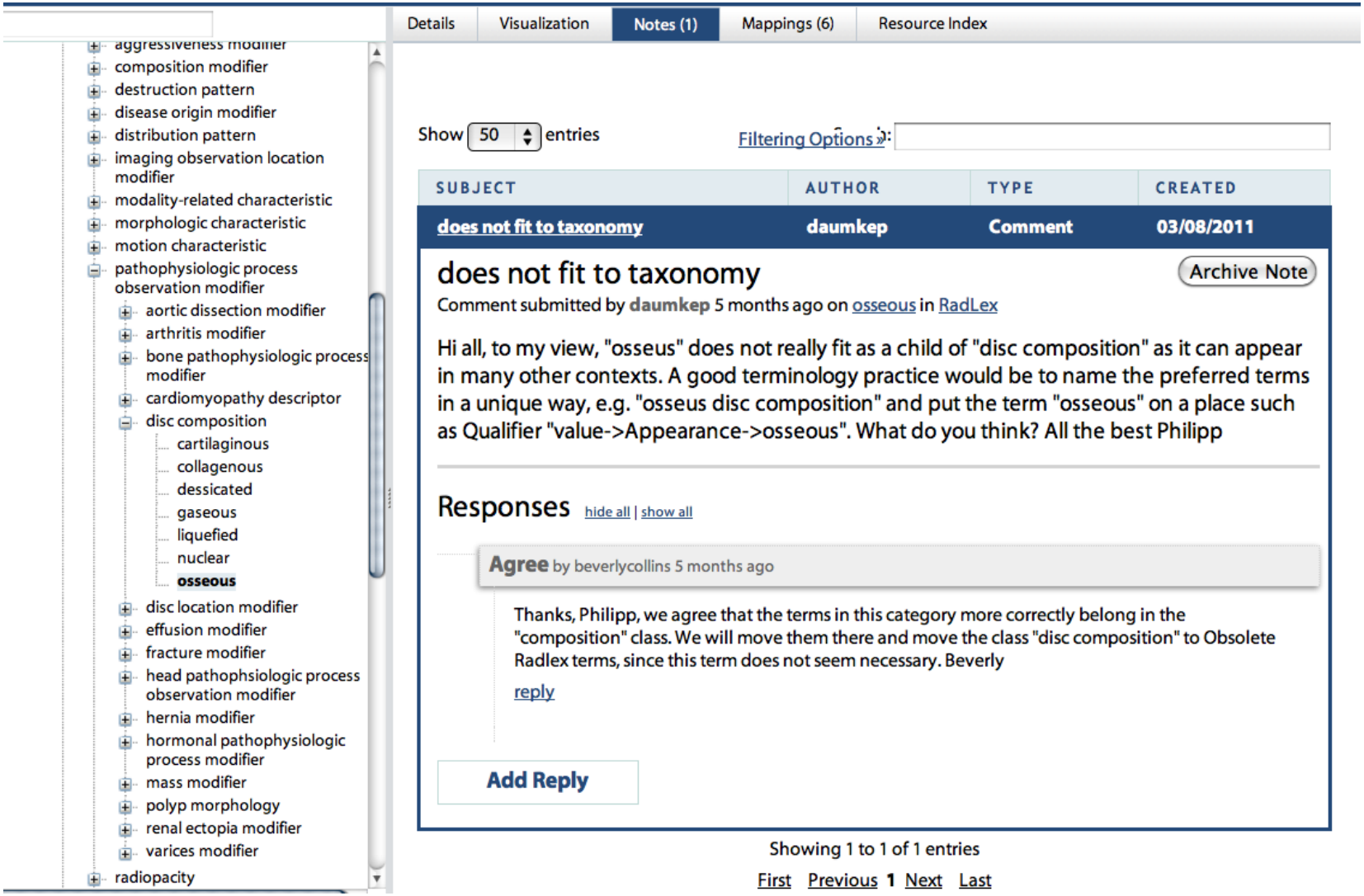
- biological_process
- cellular_component
- molecular_function
  - antioxidant activity
  - binding
  - catalytic activity
  - channel regulator activity
  - chemoattractant activity
  - chemorepellent activity
  - electron carrier activity
  - enzyme regulator activity
  - metallochaperone activity
  - molecular transducer activity
  - morphogen activity
  - nucleic acid binding transcription facto activity
  - nutrient reservoir activity
  - protein binding transcription factor activity
  - protein tag
  - receptor activity
  - receptor regulator activity
  - structural molecule activity
  - translation regulator activity
  - transporter activity

Details | Visualization | Notes (0) | Term Mappings (31) | Term Resources

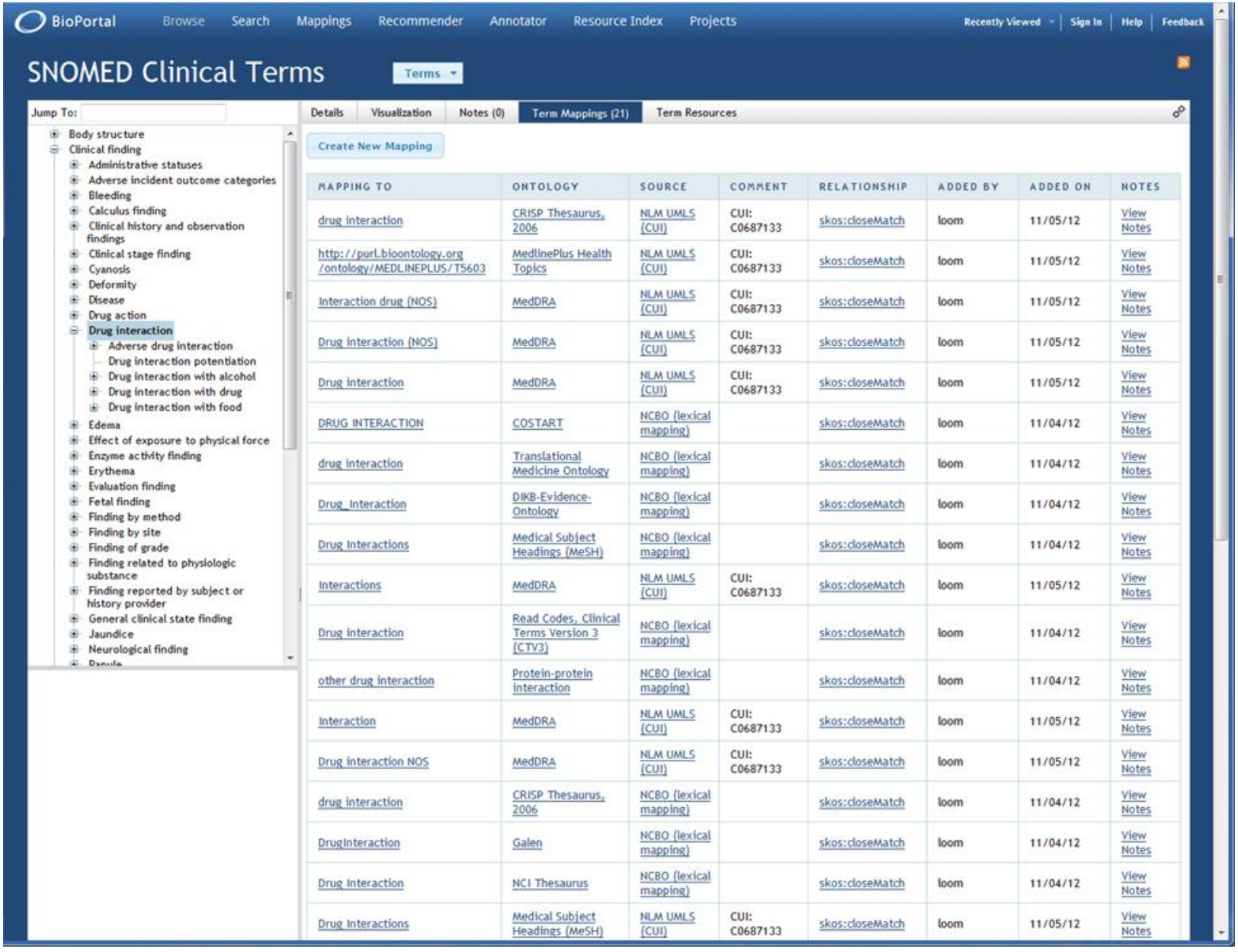
path to root



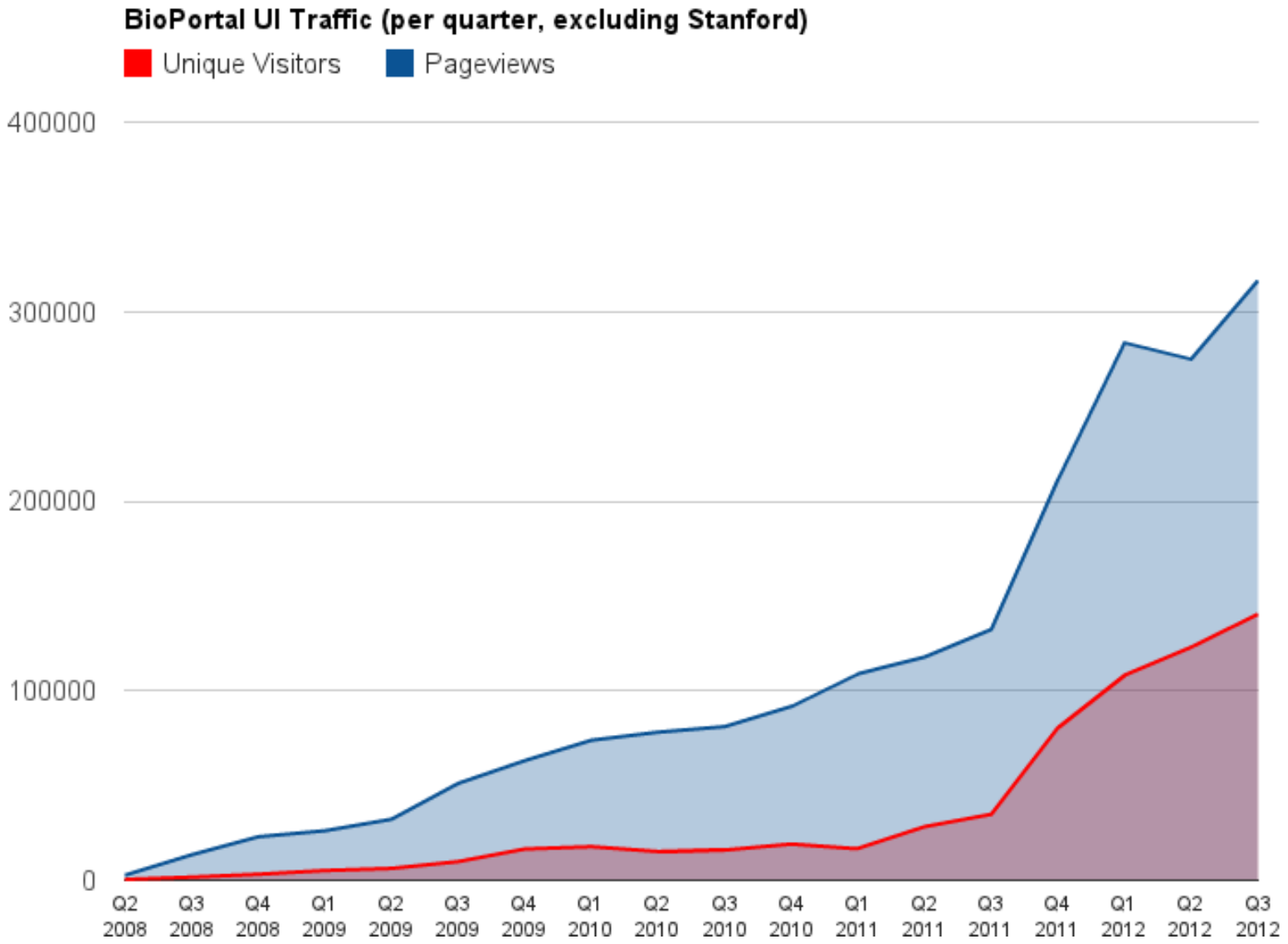
Community Comments in BioPortal



Users can view and create mappings



BioPortal Traffic – Volume



BioPortal UI Traffic – Top Users

Thomson Financial

Japan Network Information Center

Department of Veterans Affairs

National Health Service (UK)

University of British Columbia

University of Florida

MRC Human Genome Mapping Project Resource Centre

University of California, San Diego

Mayo Foundation for Medical Education and Research

University of California, Davis

University of Pennsylvania

BioPortal is building an online community of users who

- Develop, upload, and apply ontologies
- Map ontologies to one another
- Comment on ontologies via “notes” to give feedback
  - To the ontology developers
  - To one another
- Make proposals for specific changes to ontologies
- Stay informed about ontology changes and proposed changes via “push” technology
- Incorporate BioPortal services into their own technologies

Annotator

Get annotations for biomedical text with terms from the ontologies ?

insert sample text

Cyclic nucleotide phosphodiesterases (PDEs) are enzymes that regulate the cellular levels of the second messengers, cAMP and cGMP, by controlling their rates of degradation. There are 11 different PDE families, with each family typically having several different isoforms and splice variants. These unique PDEs differ in their three-dimensional structure, kinetic properties, modes of regulation, cellular expression, and inhibitor sensitivities. Current data suggest that individual isozymes modulate distinct regulatory pathways in the cell.

Select Ontologies

GO ×

clear selection select from list

Select UMLS Semantic Types

Type here to select UMLS semantic types

Include Mappings: ☑ Automatic ☐ Manual

Include Ancestors Up To Level: All

Get Annotations

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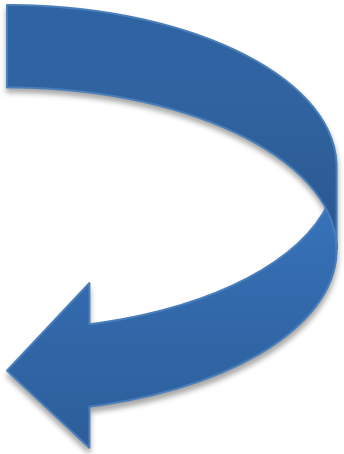

Get Annotations

Annotations

total results 5 (direct 2 / ancestor 3

TERM filter	ONTOLOGY filter	TYPE filter	CONTEXT	MATCHED TERM filter	MATCHED ONTOLOG
cell	Gene Ontology	direct	regulatory pathways in the **cell**	cell	Gene Ontology
metabolic process	Gene Ontology	ancestor	controlling their rates of **degradation**. There are 11 different	catabolic process	Gene Ontology
cellular_component	Gene Ontology	ancestor	regulatory pathways in the **cell**	cell	Gene Ontology
catabolic process	Gene Ontology	direct	controlling their rates of **degradation**. There are 11 different	catabolic process	Gene Ontology
biological_process	Gene Ontology	ancestor	controlling their rates of **degradation**. There are 11 different	catabolic process	Gene Ontology

NCBO Annotator

- Typically called as Web service by client programs
- Takes as input some text; generates as output links between the text and terms in any or all NCBO ontologies
- Enables high-throughput
  - Annotation of textual metadata
  - Text mining of electronic medical records
  - Concept-based indexing and retrieval of online data sets

Search Resource Index

Search biomedical resources

Start typing to find terms to search the index with

Search Resource Index

select ontologies to search

Available Resources

RESOURCE	DESCRIPTION
AgingGenesDB (via NIF)	This database provides a searchable and browsable list of aging related genes and their effects ... [more]
ArrayExpress	ArrayExpress is a public repository for microarray data, which is aimed at storing MIAME-compli ... [more]
ARRS GoldMiner	ARRS GoldMiner provides instant access to images published in selected peer-reviewed radiology ... [more]
Biositemaps	Biositemaps represent a mechanism for computational biologists and bio-informaticians to openly ... [more]
caNanoLab	caNanoLab is a data sharing portal designed to facilitate information sharing in the biomedical ... [more]
Cell Centered Database (via NIF)	The Cell Centered Database is a publicly accessible resource for high resolution 2D, 3D and 4D ... [more]
ClinicalTrials.gov	ClinicalTrials.gov provides regularly updated information about federally and privately support ... [more]
Conserved Domain Database (CDD)	The Conserved Domain Database (CDD) contains protein domain models imported from outside source ... [more
Database of Genotypes and Phenotypes	The database of Genotypes and Phenotypes (dbGaP) was developed to archive and distribute the re ... [more]
DrugBank	DrugBank is offered to the public as a freely available resource. Use and re-distribution of th ... [more]
Gene Expression Omnibus DataSets	A gene expression/molecular abundance repository supporting MIAME compliant data submissions, ... [more]
MICAD	Molecular Imaging and Contrast Agent Database
ModelDB (via NIF)	ModelDB provides an accessible location for storing and efficiently retrieving computational ne ... [more]
Online Mendelian Inheritance in Man	OMIM is a comprehensive, authoritative, and timely compendium of human genes and genetic phenot ... [more]
Pathway Commons	Pathway Commons is a convenient point of access to biological pathway information collected fro ... [more]

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- **NCBO Software Support - Mailing List Archive**
- **More News & Events**

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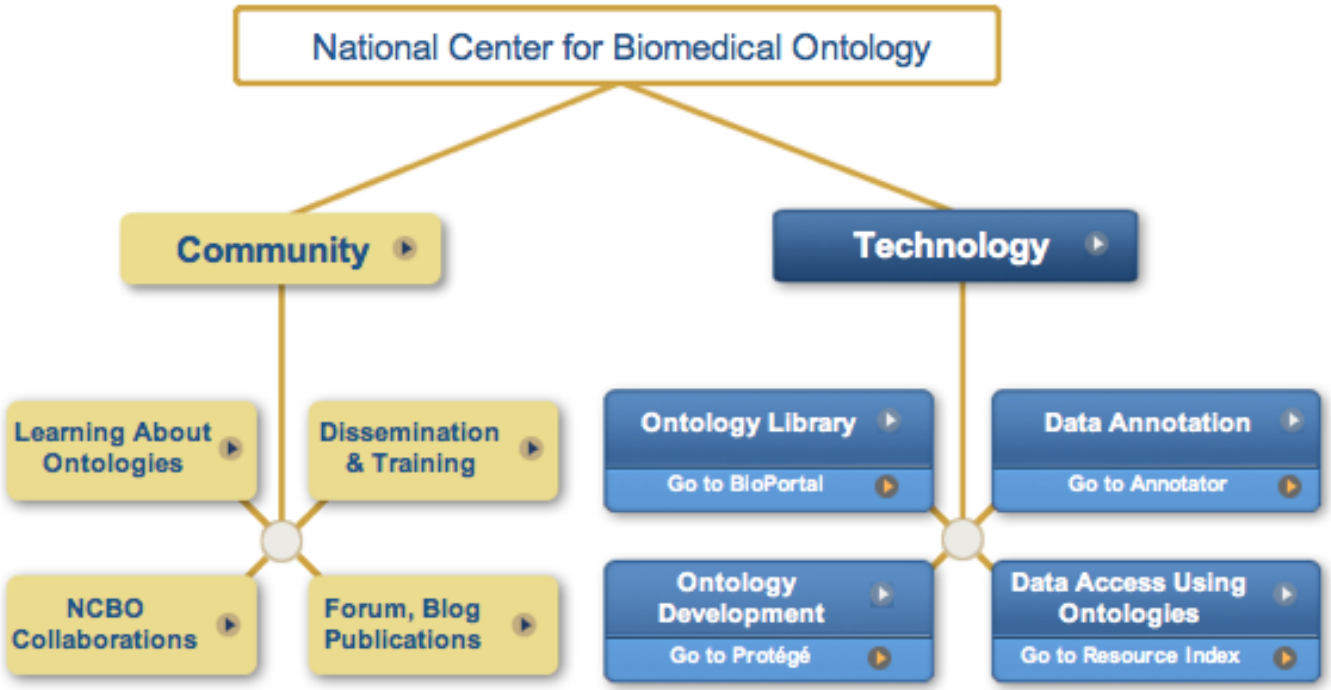

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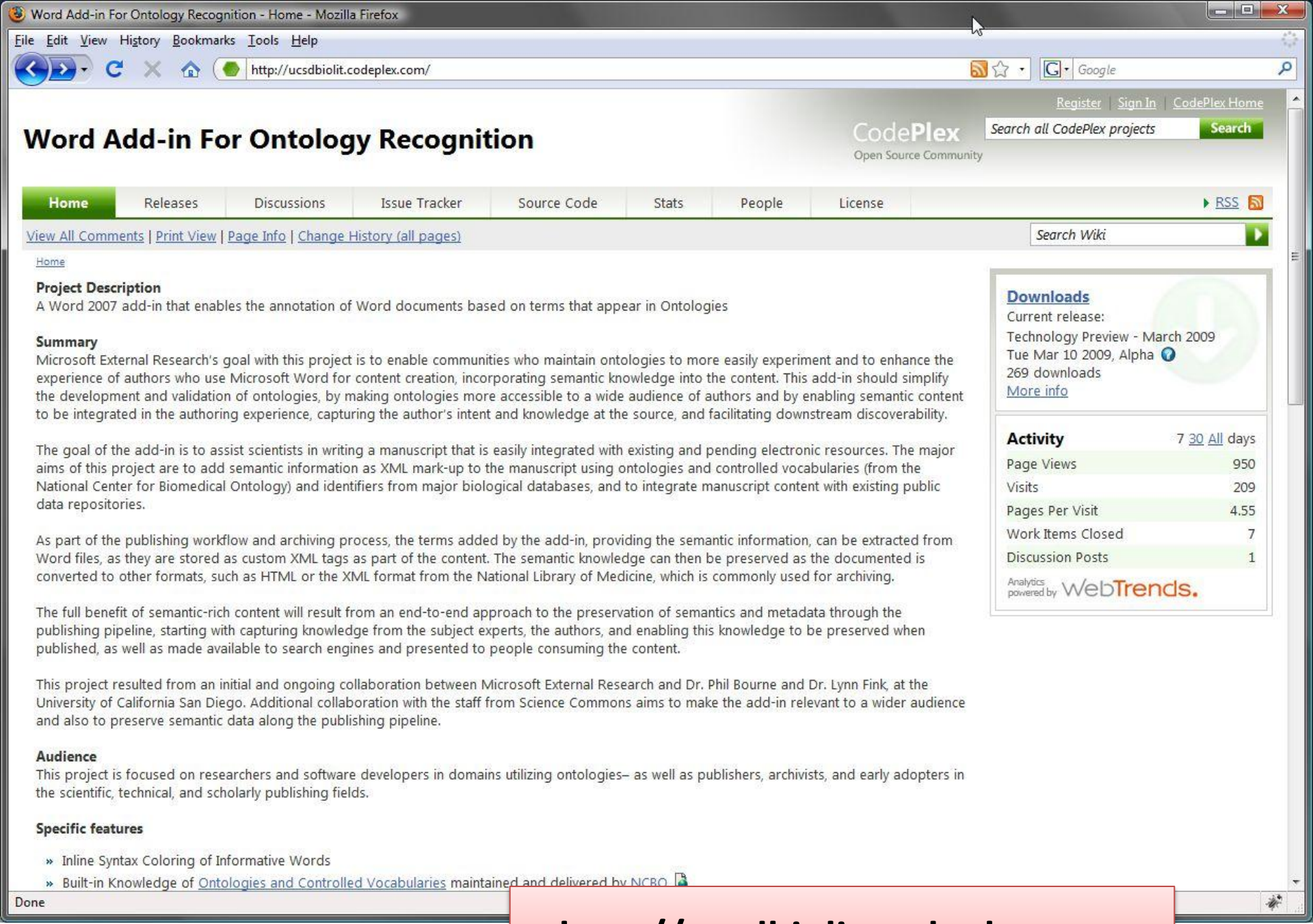
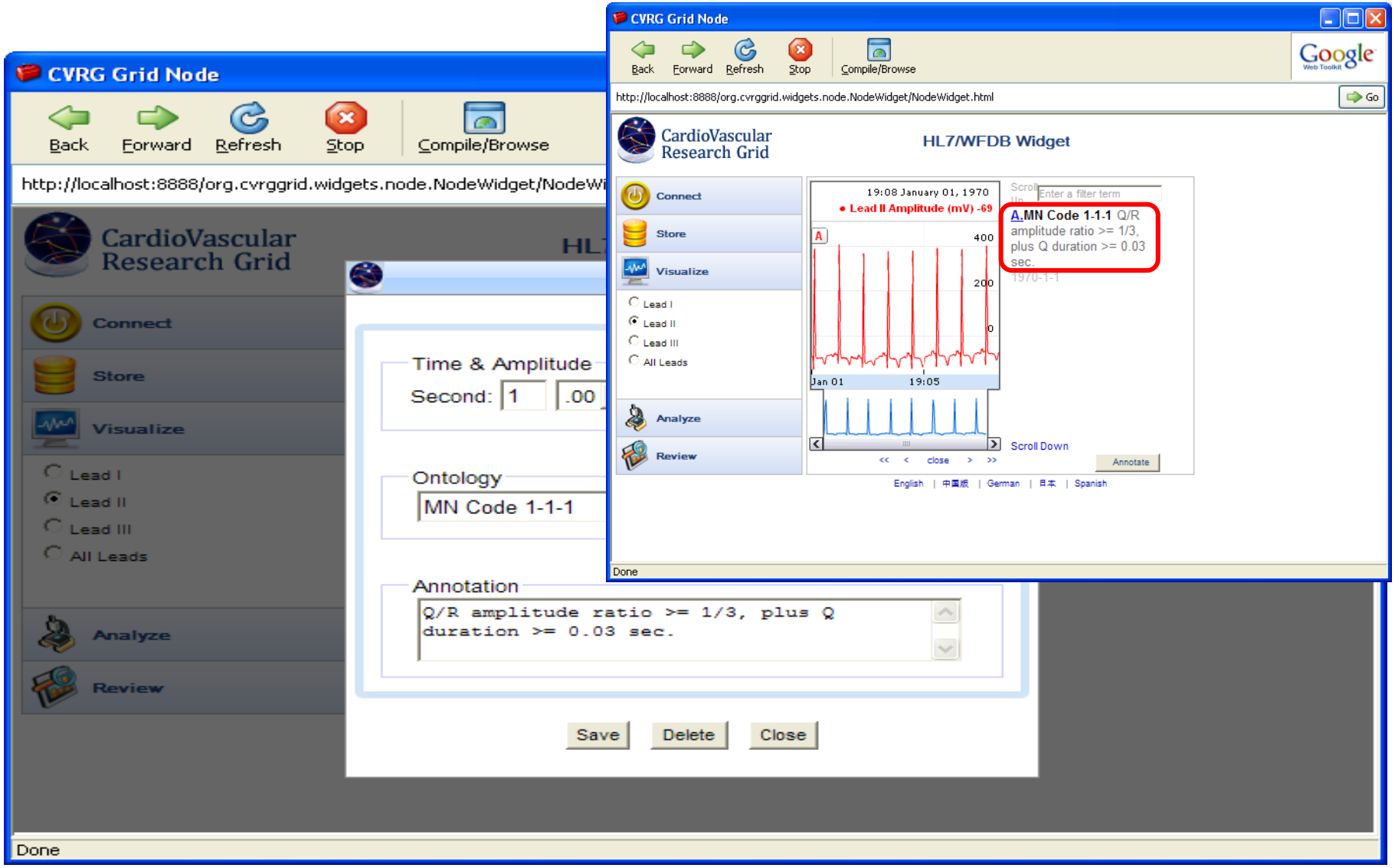
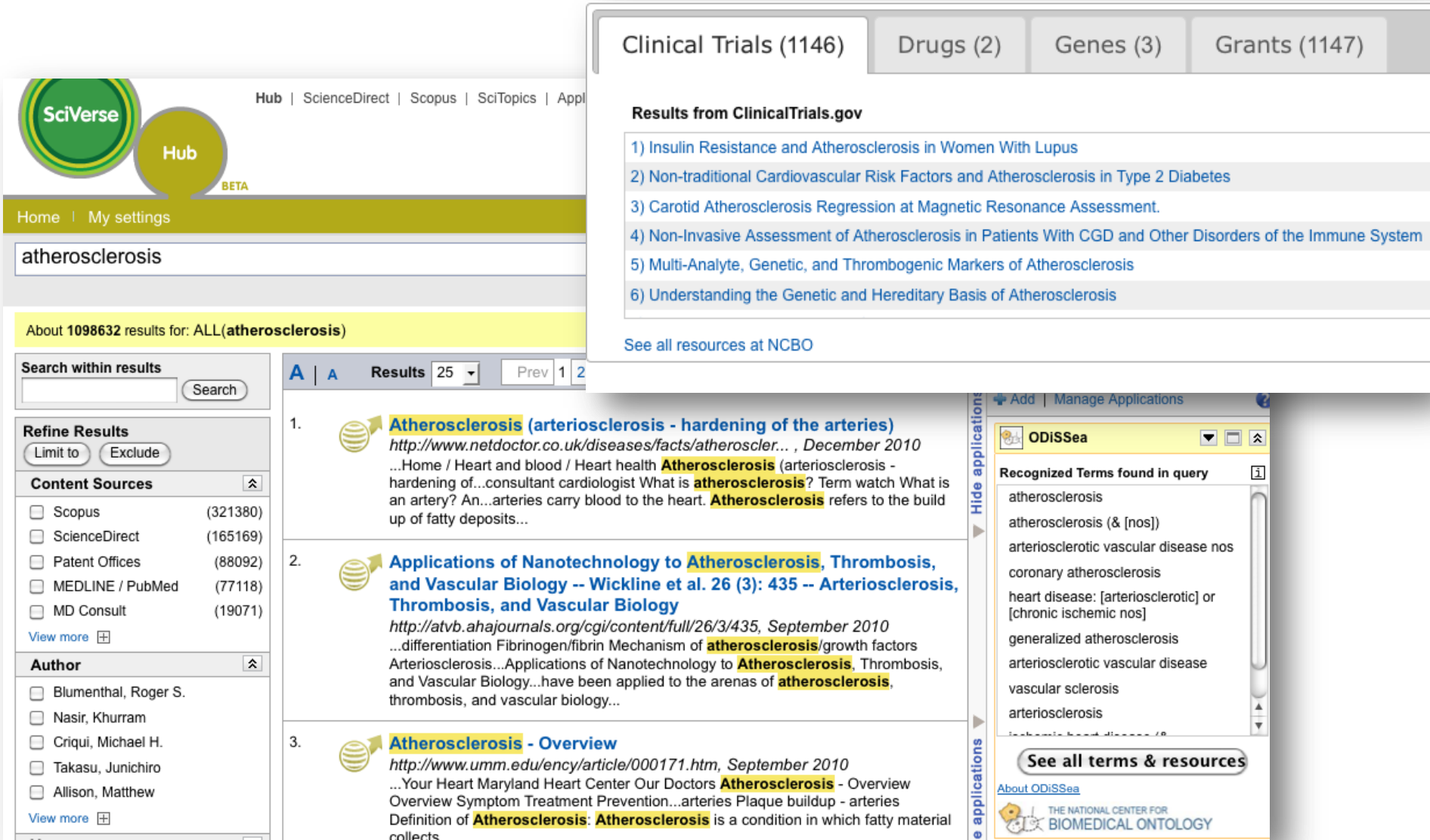


http://ucsdbiolit.codeplex.com

ECG Gadget uses NCBO services



Elsevier SciVerse uses NCBO technology for ontology-based IR



Simbios uses NCBO Ontology Web Widgets

7. Classify your project (required)

a) Choose one or more terms from the Biological Resource Ontology that most closely describe your project. These will be used in searches so others can more easily find your work.

1) Search for a term by starting to enter it in the box below - all terms that contain what you entered will be shown below the box. Select one of these, *or*. . .

2) Alternatively, you can try browsing the Biological Resource Ontology. Only terms under BRO:Resource are allowed. You are most likely to find suitable terms under BRO:Resource → BRO:Software → BRO:Modeling_and_Simulation. Enter the term or any part of it in the box below *without* the BRO prefix and continue as in 1).

Restriction: only terms from the BRO:Resource branch of the Biological Resource Ontology allowed.

Samples: Neuromuscular_Model, Molecular_Dynamics

Ontology terms:

Computational_Model	Remove
Protein_Model	Remove
Standalone_Application	Remove
Structure-Based_Protein_Classification	Remove

Add (click after choosing a term)

b) Please also choose one or more keywords for your project. These will also be used in searches so others can more easily find your project.

Keywords: (required)

allosteric communication	Remove
allostery	Remove

Add (one at a time)

To save changes, click Save Project Info **here or at the bottom of the page.**

8. Short Purpose/Synopsis (required)

Please provide a synopsis of your project. This will be displayed in the search results.

Restriction: 255 characters

Samples:

1) Provide an easy-to-use application for manipulating RNA structures

2) Provides the code base for creating, simulating, and visualizing three-dimensional finite-element models of skeletal muscle.

3) Geometric models in VTK/XML PolyData format for download, for use in cardiovascular applications.

Collaborations with other NCBCs

- **Simbios** uses NCBO Web widgets for accessing ontology-derived value sets
- **I2b2** uses NCBO ontology repository to build its ontology “hive”
- NCBO Annotator uses *mgrep* named-entity recognizer from **NCIBI**
- **NA-MIC** Slicer system uses NCBO for semantic annotation of images
- NCBO has collaborated with **CCB** and **NCIBI** to develop BioSitemaps

“Collaborating R01” Program

- Nine NIH-funded collaborations with NCBO to date
- Collaborators have benefitted from
  - Early access to NCBO technology to enable their research
  - Opportunity to shape some of our work
- NCBO has benefitted from
  - Continuous feedback on our work
  - Actual code that we have incorporated into our technology (e.g., support for ontology “views”)

Driving Biological Projects (DBPs)

- Nine DBPs supported by NCBO to date
- DBPs allow NCBO to target “applications pull”
- Lots of important contributions
  - Structural visualization of clinical-trial results
  - Tool for annotating electrophysiological signals
  - Concept-based search of data regarding therapeutic nanoparticles in caNanoLab
  - Annotation of microarray data in Array Express
  - General-purpose tool for ontology-based enrichment analysis

Our initial proposal did not predict …

- The exponential increase in the use of semantic technology in biomedicine
- The huge user community that NCBO would attract
- The time that it would take for our technology to become sufficiently robust for other investigators to stake their success on us
- All the applications that investigators would find for our technology
- That people would take us for granted

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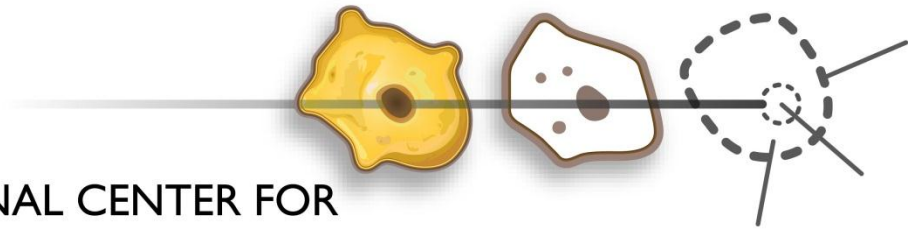

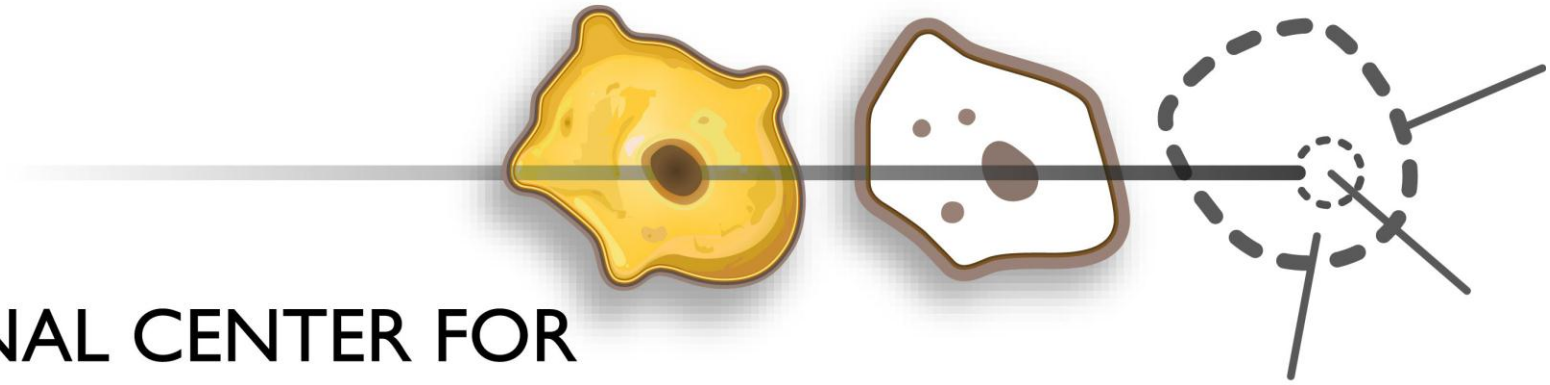

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