

## BioPortal: Ontologies and Integrated Data Resources at the Click of a Mouse

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BioPortal is a Web portal that provides access to a library of biomedical ontologies and terminologies developed in OWL, RDF(S), OBO format, Protégé frames, and Rich Release Format (<http://bioportal.bioontology.org>). BioPortal functionality, driven by a service-oriented architecture, includes the ability to browse, search and visualize ontologies (Figure 1). The Web interface also facilitates community-based participation in the evaluation and evolution of ontology content. Registered users are able to add mappings between terms, to add comments on individual terms within the ontology, and to provide reviews of ontologies

(Figure 2). This user-generated content provides a critical evaluation and feedback mechanism for ontology developers. BioPortal also enables integrated search of biomedical data resources such as the Gene Expression Omnibus (GEO), ClinicalTrials.gov, and ArrayExpress, through the ontology-based indexing of these resources with ontologies in BioPortal (Figure 3). Thus, BioPortal not only provides investigators, clinicians, and developers a 'one-stop shop' view and programmatically access biomedical ontologies, but also provides support to integrate data from a variety of biomedical resources.

The screenshot displays the BioPortal search interface. At the top, there is a search bar with the text 'melanoma' and a 'Search' button. Below the search bar are options for 'Include attributes in search', 'Help', and radio buttons for 'Contains' and 'Exact Match'. A 'Clear' button is also present. To the right of the search bar are dropdown menus for 'Categories' (set to 'All Categories') and 'Groups' (set to 'All Groups'), along with a 'Filter' input field. Below these are 'Ontologies' with checkboxes for 'ABA Adult Mouse Brain (ABA)', 'Adverse Event Ontology (AEO)', 'African Traditional Medicine (ATMO)', 'AIR (AIR)', 'Amino Acid (amino-acid)', and 'Amphibian gross anatomy (AAO)'. The main section is titled 'Matching Terms' and shows '773 results'. It includes a table with columns: Term Name, Term ID, Ontology, Version ID, Ontology ID, Details, and Visualize. The table lists several 'Melanoma' terms from various ontologies like Galen, Cell line ontology, NCI Thesaurus, etc. Each row has a 'Details' icon and a 'Visualize' icon.

Term Name	Term ID	Ontology	Version ID	Ontology ID	Details	Visualize
Melanoma	Melanoma	Galen	4525	1055		
Melanoma	DOID:1909	Cell line ontology	39927	1245		
Melanoma	Melanoma	NCI Thesaurus	42693	1032		
Melanoma	D008545	Descriptores en Ciencias de la Salud (Spanish M...	42236	1420		
melanoma	11223:68	Health Level Seven	42545	1343		
Melanoma	10053571	MedDRA	42280	1422		
Melanoma	T321	MedlinePlus Health Topics	40397	1347		
Melanoma	C4116	National Drug File	40402	1352		

**Figure 1.** The BioPortal Search interface. The Search tab allows users to limit their search to “Contains” or “Exact Match” (a) and the ontology content can be limited by “Categories”, “Groups”, or to a specific ontology (b). Search results (c) display the “Term Name”, “Identifier”, and “Ontology Name”. Additional term details are displayed in the term “Details” pop-up and the ontology structure can be viewed in the “Visualize” pop-up.

**Notes**

Show  entries

Filtering Options -  Hide Archived

Search:

SUBJECT	AUTHOR	TYPE	TARGET	CREATED
<a href="#">New Term Proposal: Exercise Study Facility</a> archived	Mette	New Term Proposal	Physiology Facility (Class)	06/15/2010
<a href="#">New Term Proposal: Sleep Study Facility</a> archived	Mette	New Term Proposal		
<a href="#">Deprecate</a>	whetzel	Comment		
<a href="#">Move in hierarchy</a>	whetzel	Comment		
<a href="#">re-activate this term</a>	whetzel	Comment		
<a href="#">Proposal</a>	whetzel	Comment		
<a href="#">Add Education Service as a Synonym</a>	whetzel	Comment		
<a href="#">Synonym proposal</a>	whetzel	Comment		
<a href="#">Add Image to Data_Resource branch</a>	whetzel	Comment		
<a href="#">Clarify action item</a>	whetzel	Comment		
<a href="#">Clarify action item</a>	whetzel	Comment		

Biomedical Resource Ontology Version 3.1

Physiology Facility | [Link Here](#) | [Subscribe](#)

View Ontology Summary

Jump To:  (Go)

Legend

- Activity
- Area of Research
- Biositemaps Information Model
- core:Collection
- core:Concept
- core:ConceptScheme
- Deprecated Activity
- Deprecated Area of Research
- Deprecated Resource
- Resource
  - Funding Resource
  - Information Resource
  - Material Resource
    - Assessment Material Resource
    - Biomaterial Supply Resource
    - Biomedical Supply Resource
  - Facility Core
    - Biosafety Level Facility
    - Cell Biology Facility
    - Fabrication Facility
    - Imaging Facility
    - Molecular Biology Facility
    - Physiology Facility
    - Research Animals Facility
    - Tissue Organ Facility
- Instrument
  - Laboratory Supply Resource
- Medical Device
- Reagent Resource
- People Resource
- Service Resource
- Software
- Training Resource

Physiology Facility | Link Here | Subscribe

View Ontology Summary

Details Visualization Notes (3) Mappings (0) Resource Index

Jump To:  (Go)

Legend

Show  entries

Search:

SUBJECT	AUTHOR	TYPE	CREATED
<a href="#">New Term Proposal: Exercise Study Facility</a>	Mette	New Term Proposal	06/15/2010

**New Term Proposal: Exercise Study Facility**

New Term Proposal submitted by Mette 3 months ago on Physiology Facility in Biomedical Resource Ontology

PREFERRED NAME: Exercise Study Facility

PROPOSED ID: [blank]

PARENT: [http://biontology.org/ontologies/BiomedicalResourceOntology.owl#Physiology\\_Facility](http://biontology.org/ontologies/BiomedicalResourceOntology.owl#Physiology_Facility)

REASON FOR CHANGE: Physiology Facility

STATUS: [blank]

CONTACT INFO: [blank]

SYNONYMS: [blank]

DEFINITION: A facility or core devoted to exercise studies

Responses [hide all](#) | [show all](#)

RE: New Term Proposal: Exercise Study Facility by whetzel 3 months ago

Can you expand on what an exercise study is?

[reply](#)

Exercise study facility definition by Mette 3 months ago

A facility or core that provides services and equipment related to exercise physiology

[reply](#)

[Add Reply](#)

Figure 2. The “Notes” page displays a summary of all Notes posted to an ontology and can be sorted by author, type, term name, and date.

Denosumab (preferred name) from: NCI Thesaurus x

[Search](#)

[Clear](#)

To begin, type in text and select a matching term.  
Examples: melanoma, lupus, breast cancer, ...  
Click search and select a repository.

**Ontology filters**

- ARRS GoldMiner
- ArrayExpress
- 37 ClinicalTrials.gov
- Database of Genotypes and Phenotypes
- Gene Expression Omnibus DataSets
- Online Mendelian Inheritance in Man
- PharmGKB [Disease]
- PharmGKB [Gene]
- 38 PubMed
- ResearchCrossroads
- UniProt KB
- caNanoLab
- 12 Adverse Event Reporting System Data
- Biositemaps
- Conserved Domain Database (CDD)
- DrugBank
- MICAD
- Pathway Commons
- PharmGKB [Drug]
- PubChem
- Reactome
- Stanford Microarray Database
- WikiPathways

Figure 3. The “All Resources” tab allows users to search for data records tagged with ontology terms of interest and to find related records in other resources via shared ontology annotations.