

# Expanding the Plant Ontology to include non-vascular plants:



## Linking anatomical structures to *Physcomitrella patens* gene annotations

### Plant Ontology Consortium Members and Curators\*:

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**Maria A. Gandolfo**: Department of Plant Biology, Cornell University, Ithaca, NY

### Ontology Consultants:

**Chris Mungall**: **Gene Ontology**, Lawrence Berkeley National Lab, Berkeley, CA

**Barry Smith**: **OBO Foundry**, Department of Philosophy, University at Buffalo, NY

[www.plantontology.org](http://www.plantontology.org)

# Agenda and Goals:

- Overview of the Plant Ontology and its principles (Laurel)
- How to navigate the PO site, download the ontology, request new terms and use editing software- (Ramona)
- Demonstrate new terms and changes that have been made to accommodate mosses- (Ramona)
- Illustrate the annotations and demonstrate the utility of linking to the PO terms (Laurel)
- Encourage continued cooperation and collaboration between our groups (All)

# The Plant Ontology

## What is the Plant Ontology?

- A controlled vocabulary (ontology) that describes plant anatomical and morphological structures and growth and developmental stages for all plants.
- The goal of the PO is to establish a framework for meaningful cross-species queries across gene expression and phenotype datasets from plant genomics and genetics experiments.

## Plant Anatomy Ontology (PAO):

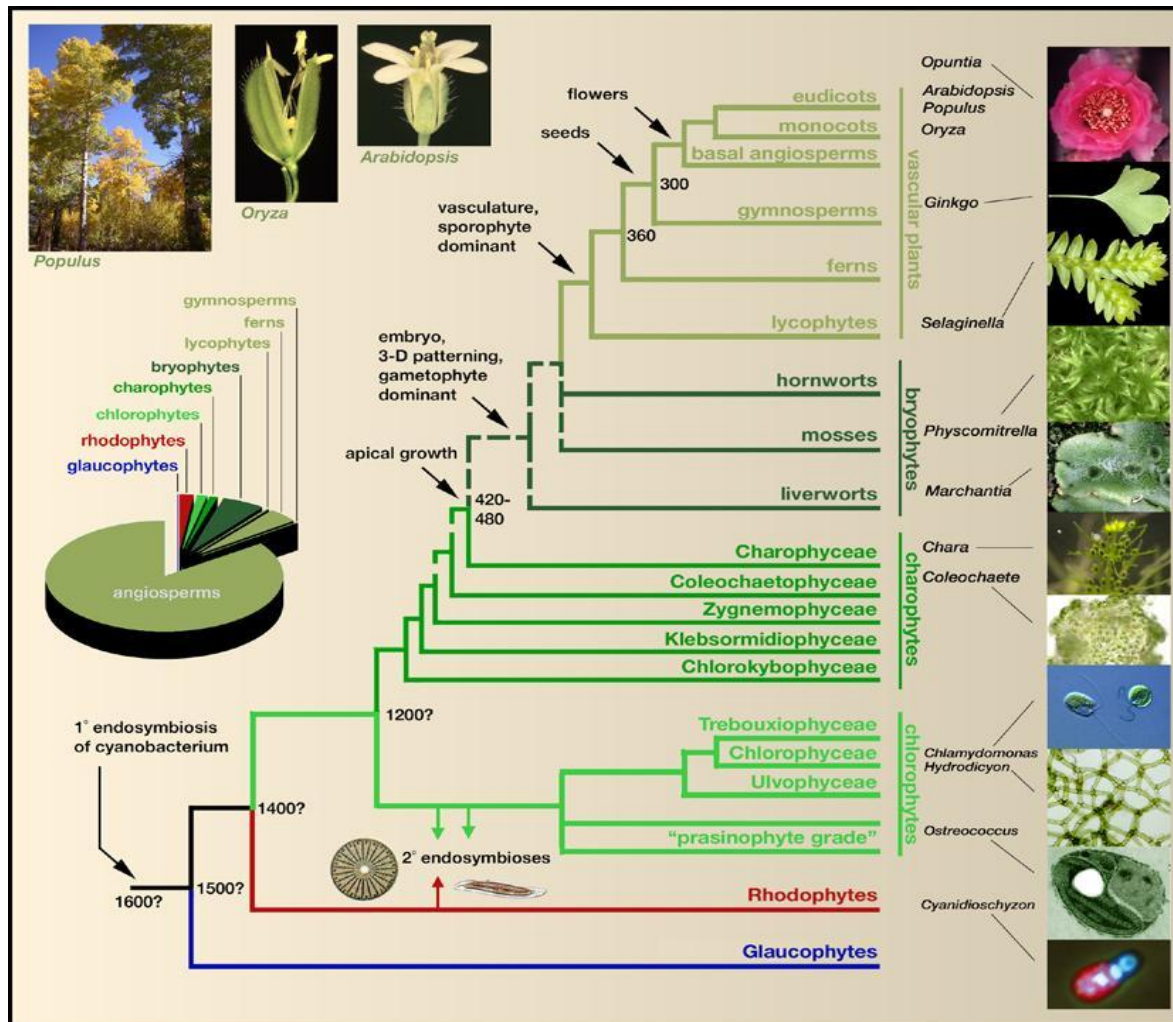
- Botanical terms describing plant structures and other anatomical entities and the relationships between them
- eg. plant organ, plant cell, whole plant, portion of plant tissue, vascular system, etc.

## Plant Growth and Developmental Stage Ontology (PGDSO):

- Terms describe (i) whole plant growth stages and (ii) plant structure developmental stages
- eg. seedling growth, rosette growth, leaf development stages, embryo development stages, flower development stages, etc.

# Challenges in expanding the Plant Ontology to covers all plants:

Diversity in anatomy, morphology, life cycles, growth patterns



**Seed plants**  
(Angiosperms and Gymnosperms)

**Pteridophytes**  
(Ferns and Lycopods)

**Bryophytes**  
(Mosses, Hornworts and Liverworts)

**Algae**

## How to:

- Navigate the PO site
- Download ontology files
- Request new terms
- View the OBO file

# Navigation

The screenshot shows the Plant Ontology Consortium website. At the top, a browser window displays the URL <http://www.plantontology.org>. Below the browser window is a green header bar with the Plant Ontology Consortium logo on the left and the text "Plant Ontology Consortium" in yellow. Underneath the header is a navigation toolbar with links: Home, Search/Browse Plant Ontologies, Download Ontologies, Request PO terms, Documentation, Tutorials, Mail Archives, Site Map, and Feedback. The main content area is titled "Search or Browse the Plant Ontology Data". It features a search form with a text input field, a "Submit" button, and radio buttons for "PO terms", "Annotations", and "exact match". Below the search form are links for "Browse PO", "Advanced Search", and "Help". A yellow callout box with a black border and a black triangle pointing to the navigation toolbar contains the text: "The toolbar is used to navigate within the website". On the right side of the page, there is a "What's New...!" section with a Facebook icon. It contains text about the latest release (Version #15) of the Plant Ontology, which is now available on the "Ontology Browser". It also mentions that this release contains more than 80 new terms to accommodate pteridophytes and bryophytes, and that many existing terms have been modified. A link to "Summary of Changes" is provided. At the bottom of the "What's New...!" section, it says "The Plant Ontology is now on FaceBook!".

Plant Ontology Consortium web site at <http://www.plantontology.org>

<http://www.plantontology.org/> Google

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology Consortium University of California, Berkeley

**Plant Ontology Consortium**

[Home](#) [Search/Browse Plant Ontologies](#) [Download Ontologies](#) [Request PO terms](#) [Documentation](#) [Tutorials](#) [Mail Archives](#) [Site Map](#) [Feedback](#)

## Search or Browse the Plant Ontology Data

Example Searches:

type: endospore  
type: CONSTANS

☒ PO terms ☐ Annotations ☐ exact match

More options: [Browse PO](#), [Advanced Search](#) and [Help](#).

## About Plant Ontology (PO)

The Plant Ontology Consortium (POC) is developing a controlled vocabulary (ontology) that describes plant anatomical and morphological structures and growth and developmental stages for all plants. The goal of the POC is to establish a semantic framework for meaningful cross-species queries across gene expression and phenotype datasets from plant genomics and genetics experiments.

- **Plant Anatomy**

A controlled vocabulary of botanical terms describing plant structures and other

## What's New...!

[Archive...](#)

, 2011

Latest release (Version #15) of the Plant Ontology is now available on our [Ontology Browser](#).

This release contains more than 80 new terms to accommodate pteridophytes and bryophytes. In addition, many existing terms have been modified to make them applicable to all plants.

For more details on the changes made to the ontology, please visit: [Summary of Changes](#).

**The Plant Ontology is now on FaceBook!**



# Browse or search the PO web site for ontology terms or annotations



## Search or Browse the Plant Ontology Database

Example Searches:

type: endosperm or PO:0009089 and select 'PO terms'  
type: CONSTANS or AT5G15850 and select 'Annotations'

☒ PO terms ☐ Annotations ☐ exact match

More options: [Browse PO](#), [Advanced Search](#) and [Help](#).

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[News Archive...](#)

**May 27, 2011**

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**The Plant Ontology is now on FaceBook!**

Or do a quick search from the home page

# Term search

Advanced Search

Browse

Help

Request PO Term

Home

Search PO

☒ Ontology

☐ Annotations

☐ Exact Match

Type "endosperm"

## Term Search Results

15 results for **endosperm** in field(s) term name, synonyms

Filter search results ?


Ontology

All  
Plant Growth Stage  
Plant Structure

Term	Ontology
basal <b>endosperm</b> transfer cell ; PO:0009018 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
basal <b>endosperm</b> transfer layer ; PO:0009019 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
cellular <b>endosperm</b> ; PO:0009018 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>endosperm</b> ; PO:0009089 <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
central <b>endosperm</b>	
chalazal cyst ; Nutritive tissue in a seed, in angiosperms usually triploid and formed after fertilization by the fusion of one gamete with the polar nucleus, sometimes diploid or polyploid.	
Query matches synonym chalazal <b>endosperm</b> cyst	
<b>endosperm</b> ; PO:0009089 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>endosperm</b> development stages ; PO:0007633 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant growth and development stage</a>



# Browsing the ontologies



## Plant Ontology™ Consortium

[Advanced Search](#) [Browse](#) [Help](#) [Request PO Term](#) [Home](#)

Search PO  ☒ Ontology ☐ Annotations ☐ Exact Match

### Filter tree view ?

Filter by ontology

Ontology

- All
- Plant Growth Stage
- Plant Structure

Filter Annotation Objects Counts

Data source


- All
- Gramene Genes
- Gramene QTL
- MaizeGDB


all : all [45015]

- PO:0009012 : plant growth and development stages [32296]
- PO:0009011 : plant structure [44765]


[Graphical View](#)  
[Permalink](#)  
[Download as XML](#)  
[Download as flat file](#)


#### Legend


 Click to expand

 Click to get annotations distribution

#### Relationship Types

 is a

 part of

 develops from

# Expanding nodes

Plant Ontology™ Consortium

Advanced Search Browse Help Request PO Term Home

Search PO  ☒ Ontology ☐ Annotations ☐ Exact Match

## Filter tree view ?

Filter by ontology

Ontology

All  
Plant Growth Stage  
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Filter Annotation Objects Counts

Data source

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MaizeGDB

☐ all : all [45015] 🌈

- ☐ ⓘ PO:0009012 : plant growth and development stages [32296]
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Graphical View  
Permalink  
Download as XML  
Download as flat file

### Legend

- ☐ Click to expand
- 🌈 Click to get annotations distribution

### Relationship Types

- ⓘ is a
- Ⓟ part of
- Ⓢ develops from

To expand a node,  
Click on the [+] sign  
Next to the node/term

# Relationship types

The screenshot shows a web browser window with the URL [http://plantontology.org/amigo/go.cgi?action=plus\\_node&depth=1&search\\_constraint=terms&query=](http://plantontology.org/amigo/go.cgi?action=plus_node&depth=1&search_constraint=terms&query=). The browser's address bar and tabs are visible at the top. The main content area displays a hierarchical tree of plant ontology terms. The tree starts with a collapsed node **PO:0025131 : plant anatomical entity [46280]**, which is expanded to show several sub-terms, including **PO:0009011 : plant structure [46280]** and **PO:0009002 : plant cell [21323]**. The **PO:0009002 : plant cell [21323]** node is also expanded, showing a list of specific cell types such as **PO:0030057 : alar cell [0]**, **PO:0030052 : antheridium jacket layer cell [0]**, and **PO:0030065 : archegonium neck canal cell [0]**. To the right of the tree, there is a sidebar with a 'Legend' section. The 'Legend' section contains a 'Relationship Types' list with icons and labels: 'is a', 'part of', 'develops from', 'has part', 'participates in', and 'adjacent to'. A yellow callout bubble points to this legend, containing the text 'The relation type icons used in the tree browser'. The browser's status bar at the bottom shows the Zotero logo.

**PO:0025131 : plant anatomical entity [46280]**

- PO:0025117 : plant anatomical space [4]**
- PO:0009011 : plant structure [46280]**
  - PO:0025001 : cardinal organ part [16309]**
  - PO:0025269 : collective organ part structure [6]**
  - PO:0025007 : collective plant structure [40365]**
  - PO:0025099 : embryo plant structure [101]**
  - PO:0000004 : in vitro plant structure [3404]**
  - PO:0009072 : ovary [303]**
- PO:0009002 : plant cell [21323]**
  - PO:0030057 : alar cell [0]**
  - PO:0030052 : antheridium jacket layer cell [0]**
  - PO:0030065 : archegonium neck canal cell [0]**
  - PO:0030056 : archesporial cell [55]**
  - PO:0000081 : axial cell [17]**
  - PO:0030058 : brachycyte [0]**
  - PO:0000005 : cultured plant cell [3404]**
  - PO:0002002 : embryo basal cell [12]**
  - PO:0020109 : embryo hypophysis [4]**
  - PO:0025028 : embryo plant cell [13]**
  - PO:0004013 : epidermal cell [1973]**
  - PO:0025006 : gamete [5535]**
  - PO:0020097 : generative cell [5412]**

**Legend**

Click to expand  
Click to get annotations distribution

**Relationship Types**

- is a
- part of
- develops from
- has part
- participates in
- adjacent to

The relation type icons used in the tree browser

# Term detail view

[Advanced Search](#) [Browse](#) [Help](#) [Request PO Term](#) [Home](#)

Search PO  ☒ Ontology ☐ Annotations ☐ Exact Match

## Term Search Results

15 results for **endosperm** in field(s) **term name, synonyms**

Filter search results ?

Ontology

All  
Plant Growth Stage  
Plant Structure

Term	Ontology
<b>basal endosperm</b> transfer cell ; PO:0009018 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>basal endosperm</b> transfer layer ; PO:0009019 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>cellular endosperm</b> ; PO:0000199 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>central endosperm</b> ; PO:0006220 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>chalazal cyst</b> ; PO:0000201 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
Query matches synonym: chalazal endosperm cyst	
<b>endosperm</b> ; PO:0009089 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant structure</a>
<b>endosperm</b> development stages ; PO:0007633 <a href="#">[show def]</a> <a href="#">[view annotations]</a>	<a href="#">plant growth and development stage</a>

Click to display the detail view



# Term detail view

## endosperm

[Term information](#) [Term lineage](#) [External references](#) [Term annotations](#)

### Term Information

<b>Accession</b>	PO:0009089
<b>Ontology</b>	plant structure
<b>Synonyms</b>	None
<b>Definition</b>	Nutritive tissue in a seed, in angiosperms usually triploid and formed after fertilization by the fusion of one gamete with the polar nucleus, sometimes diploid or polyploid. [source: APWeb:Glossary, GR:pj]
<b>Comment</b>	None

[Back to top](#)

### Term Lineage

#### Filter tree view ?

Filter Annotation Objects Counts

Data source

- All
- Gramene Genes
- Gramene QTL
- Maize GDB

Term View Options

- ☒ Term ancestors ☐ Term parents, siblings and children

[Set filters](#)

[Remove all filters](#)

all : all [45015]

- PO:0009011 : plant structure [44765]
  - PO:0009003 : sporophyte [39836]
    - PO:0006342 : infructescence [23763]
      - PO:0009001 : fruit [23762]
        - PO:0009010 : seed [21059]
          - PO:0009089 : endosperm [1732]**
  - PO:0009010 : seed [21059]
    - PO:0009089 : endosperm [1732]**
  - PO:0009007 : tissue [17491]
    - PO:0009089 : endosperm [1732]**

[Graphical View](#)  
[View in tree browser](#)

#### Legend

- Click to expand
- Click to get annotations distribution

#### Relationship Types

- is a
- part of
- develops from

To view the term lineage in a graphical format click on the Graphical View link



# Graphical view

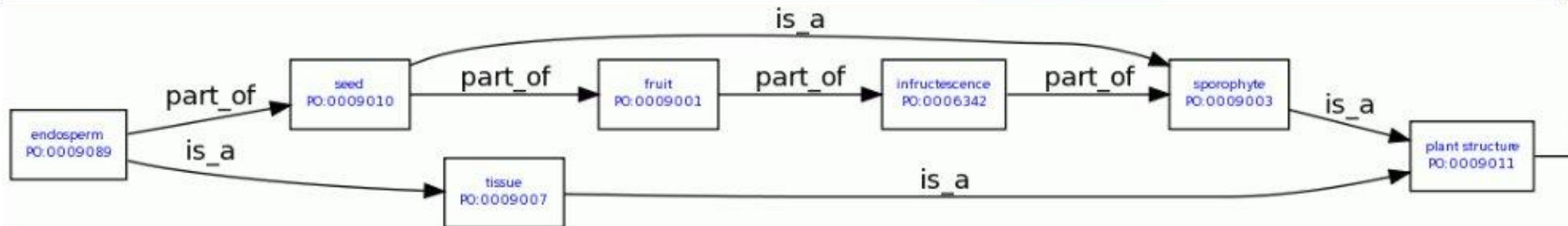
Advanced Search   Browse   Help   Request PO Term   Home

Search PO    ☒ Ontology   ☐ Annotations   ☐ Exact Match  

## endosperm Graphical View

Graph View Options

Layout    Box Color    Text Color    Format   



Last updated 2009-07-01  
How can we improve the PO? [Send us your suggestions](#) OR [Contact the Plant Ontology Consortium](#)  
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Layout can be changed to horizontal  
or colors can be changed

# Use advanced search to find terms used for mosses

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology Plant Ontology.org University Link University Google

Search PO  ☐ Ontology ☐ Annotations ☐ Exact Match

## Advanced Search

### Search the Plant Ontology database

#### Enter your query [?](#)

To search for more than one term or annotation, separate your queries with a line break.

bryophytes

OR upload a text file of queries:  file selected

☐ Exact match

#### Search type [?](#)

☒ Terms

Search field

- ☐ Term name
- ☐ Synonyms
- ☐ Definition
- ☐ Comment
- ☐ Database cross-references
- ☒ All fields

☐ Annotations

Search field

- ☒ Gene or protein name(s)
- ☒ Gene symbol
- ☒ Synonyms
- ☐ Accession or database ID
- ☐ Sequence accession

Searching for keyword  
"bryophyte" in all  
fields returns  
152 terms

#### Filter results [?](#)

The evidence code, species and database filters only apply to the annotation search.

Ontology

All  
Plant Anatomy  
Plant Growth Stage

Species

S. lycopersicum  
S. melongena  
S. tuberosum  
Z. mays

Data source

All  
Gramene Genes  
Gramene QTL  
Gramene Ensembl

Evidence Code

All Curator Approved  
IC  
IDA  
IEP

# Downloading the Ontology File

ne	<a href="#">Search/Browse Plant Ontologies</a>	<a href="#">Download Ontologies</a>	<a href="#">Request PO terms</a>	<a href="#">Documentation</a>	<a href="#">Tutorials</a>	<a href="#">Mail Archives</a>	<a href="#">Site Map</a>	<a href="#">Feedba</a>
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[SVN Access and Download Instructions](#)

## Plant Ontologies

Plant ontology is not an extensive collection of terms that describe structure and developmental stages of a plant. However they are arranged in a structured order/network based on the biological concept describing the term's relationship in an ontology tree. Learn more about the [ontology concepts and how they are organized](#). One of our objective is to integrate species-specific vocabulary terms into unified flowering-plant ontologies for rice, maize, Arabidopsis and other Angiosperms. Species specific ontologies are also listed in the following sections.

Click here to download the most recent versions of the Plant Ontology in [OBO format](#).

Click here to download the most recent versions of the Plant Ontology in [OWL format](#).

Beginning with Version #14 (January 2011), the Plant Ontology has been merged from two separate files (po\_anatomy.obo and po\_temporal.obo) into a single file called [plant\\_ontology.obo](#). We recommend that all users switch to the single, merged file. If you need current versions of the po\_anatomy.obo and po\_temporal.obo, please contact us.

## Previously used ontology files from the POC and collaborators

The ontologies are:

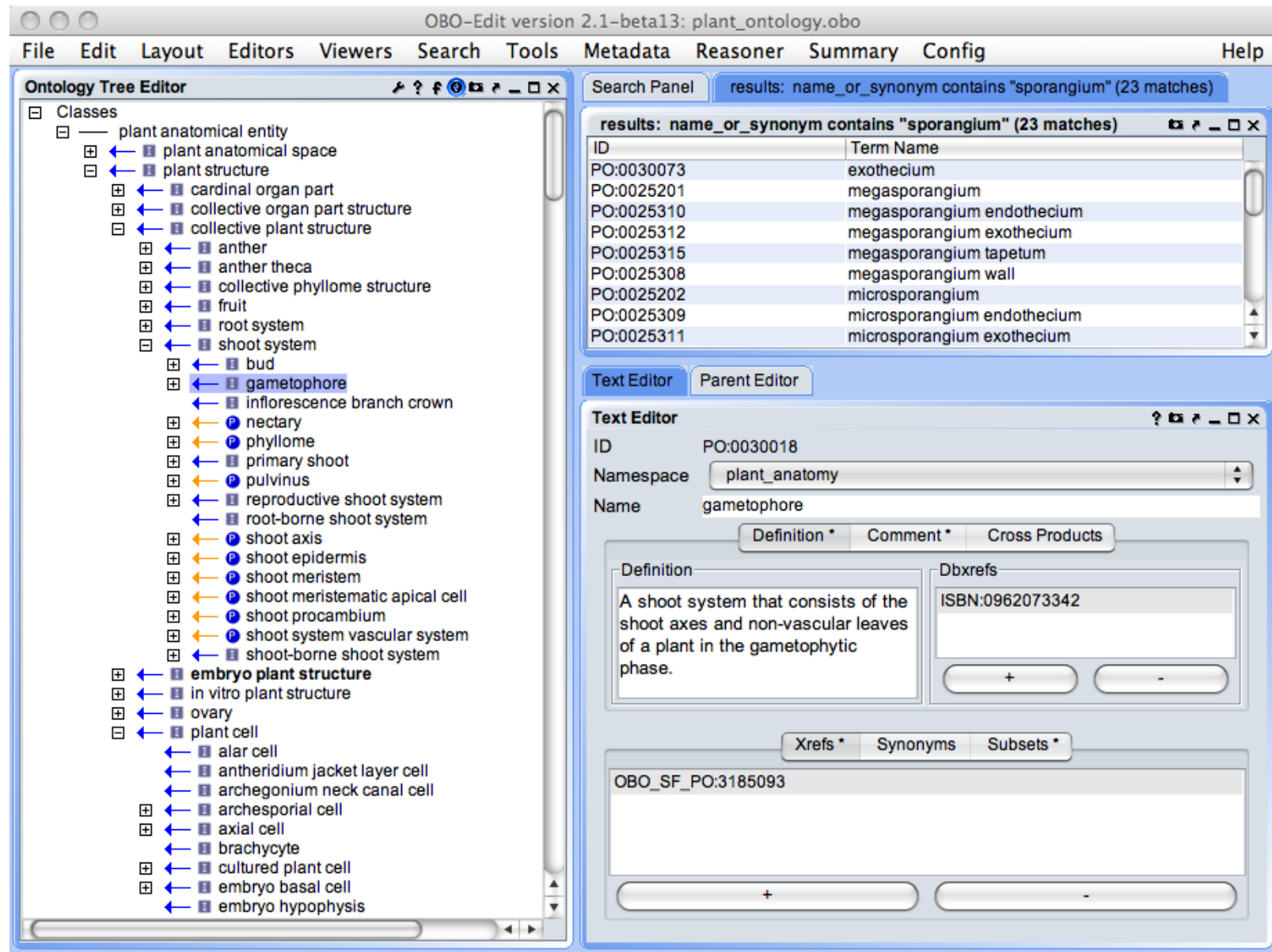
## Plant Structure

A controlled vocabulary of plant's morphological and anatomical structures representing organs, tissues, cell types and their biological relationships based on spatial and developmental organization. *Examples are stamen, gynoecium, petal, parenchyma, guard cell, etc.*

Species	Sources	Browse at source site	OBO format file Includes ontology and definitions.	Ontology flat files	Definition flat files	Term List files
Flowering plants	<a href="#">POC</a>	<a href="#">Browse</a>	<a href="#">Download</a>	--	--	<a href="#">Download</a>

[http://palea.cgrb.oregonstate.edu/viewsvn/Poc/tags/live/plant\\_ontology.obo?view=co](http://palea.cgrb.oregonstate.edu/viewsvn/Poc/tags/live/plant_ontology.obo?view=co)

# Ontology (.obo) files can be viewed using OBO-Edit or other software



download at <http://wiki.geneontology.org/index.php/OBO-Edit>

prickle  
leaf sheath  
stomatal complex  
from leaf-derived cultured plant  
non-vascular leaf  
alar cell  
costa  
non-vascular leaf meristematic apical  
transition leaf  
vascular leaf  
auricle  
bundle sheath  
cauline leaf  
cigar leaf  
compound leaf  
cotyledon  
embryo leaf  
leaf abscission zone  
leaf collar  
leaf end  
leaf spine  
leaf vascular  
ligule  
petiole  
rosette leaf  
simple leaf  
stipule  
vascular leaf meristematic apical  
sepal  
stamen  
tepala  
apical  
base

subset contains "Bryophytes"



Indicate if selected term matches filter



Search

Text Editor

Parent Editor

Text Editor

ID PO:0025075

Namespace plant\_anatomy

Name non-vascular leaf

Definition \*

Comment \*

Cross Products

Comment

Include moss and liverwort leaves. Occurs in the gametophytic phase of a plant life cycle.

Xrefs

Synonyms \*

Subsets \*

Term used for ferns and allies (Ferns...)

Term used for grasses (Poaceae)

Term used for gymnosperms (Gymno...)

Term used for maize (Maize)

Term used for mosses, liverworts, and...

Term used for potato (Potato)

Term used for rice (Rice)

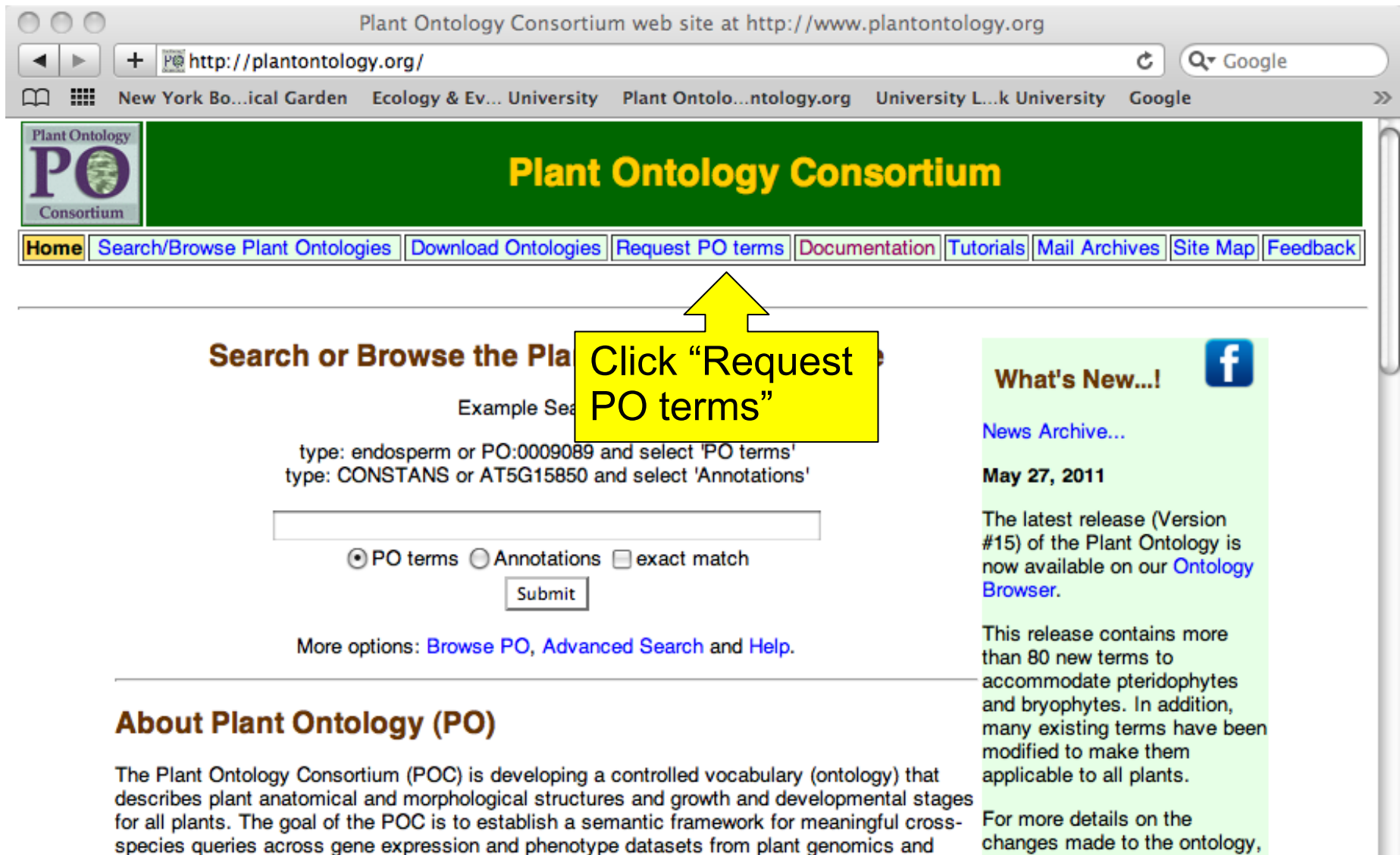


Comments  
describe which  
taxa a structure  
occurs in

New subset for  
bryophytes



# Requesting new term: link from PO home page



Plant Ontology Consortium web site at <http://www.plantontology.org>

[http://plantontology.org/](#)

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology Consortium University of California, Berkeley Google

**Plant Ontology Consortium**

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**Search or Browse the Plant Ontology**

Example Search: type: endosperm or PO:0009089 and select 'PO terms'  
type: CONSTANS or AT5G15850 and select 'Annotations'


☒ PO terms ☐ Annotations ☐ exact match

More options: [Browse PO](#), [Advanced Search](#) and [Help](#).

---

**About Plant Ontology (PO)**

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**What's New...!** 

[News Archive...](#)

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Takes you to SourceForge Tracker Page:  
[http://sourceforge.net/tracker/?group\\_id=76834&atid=835555](http://sourceforge.net/tracker/?group_id=76834&atid=835555)

SourceForge.net: Open Biomedical Ontologies: Plant Ontology (PO) TERM requests

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SourceForge.net > Projects > Open Biomedical Ontologies > Tracker > Plant Ontology (PO) TERM requests > Browse Tracker Items

## Open Biomedical Ontologies

Summary Files Reviews Support Develop Tracker Mailing Lists Forums Code

Add new Browse

### Plant Ontology (PO) TERM requests

Search Advanced Options RSS

Page: Page 1 Next → 1 - 25 of 370 Results - Display 25

ID	Summary	Status	Opened	Assignee	Submitter	Resolution	Priority
3314766	replaced_by relations for old obsolete terms	Open	2011-06-10	rwalls	rwalls	None	5
3314764	fascicular and interfascicular cambium	Open	2011-06-10	rwalls	rwalls	None	5

Assignee: Any Status: Any Category: Any Group: Any Submitter:

Keyword:  Artifact ID:  Filter Reset Permalink

SOURCEFORGE

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## Open Biomedical Ontologies

[Share](#)[Monitor](#)[Watch](#)[Summary](#) [Files](#) [Reviews](#) [Support](#) [Develop](#) [Tracker](#) [Mailing Lists](#) [Forums](#) [Code](#)[Add new](#) [Browse](#) [Reporting](#)**Tracker: Plant Ontology (PO) TERM requests**

### Add Artifact

Use this option to submit new requests (PO) term/definition/parentage modification, etc. For browsing the project website [www.plantontology.org](http://www.plantontology.org)

**Choose a category****Choose a group**

Project: Open Biomedical Ontologies

Private: ☐

Category: Request: New ontology term (admin)

Group: plant anatomy (admin)

Assigned To: None (admin)

Priority: 5 - Medium

Summary:

Description:

**Provide a detailed description, including suggestions for parent term, definition, and references.****Upload a file attachment**

# Review of changes that have been made to accommodate mosses

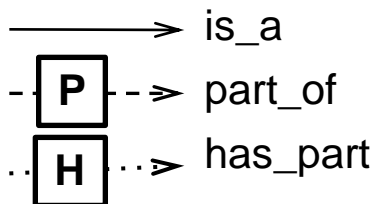
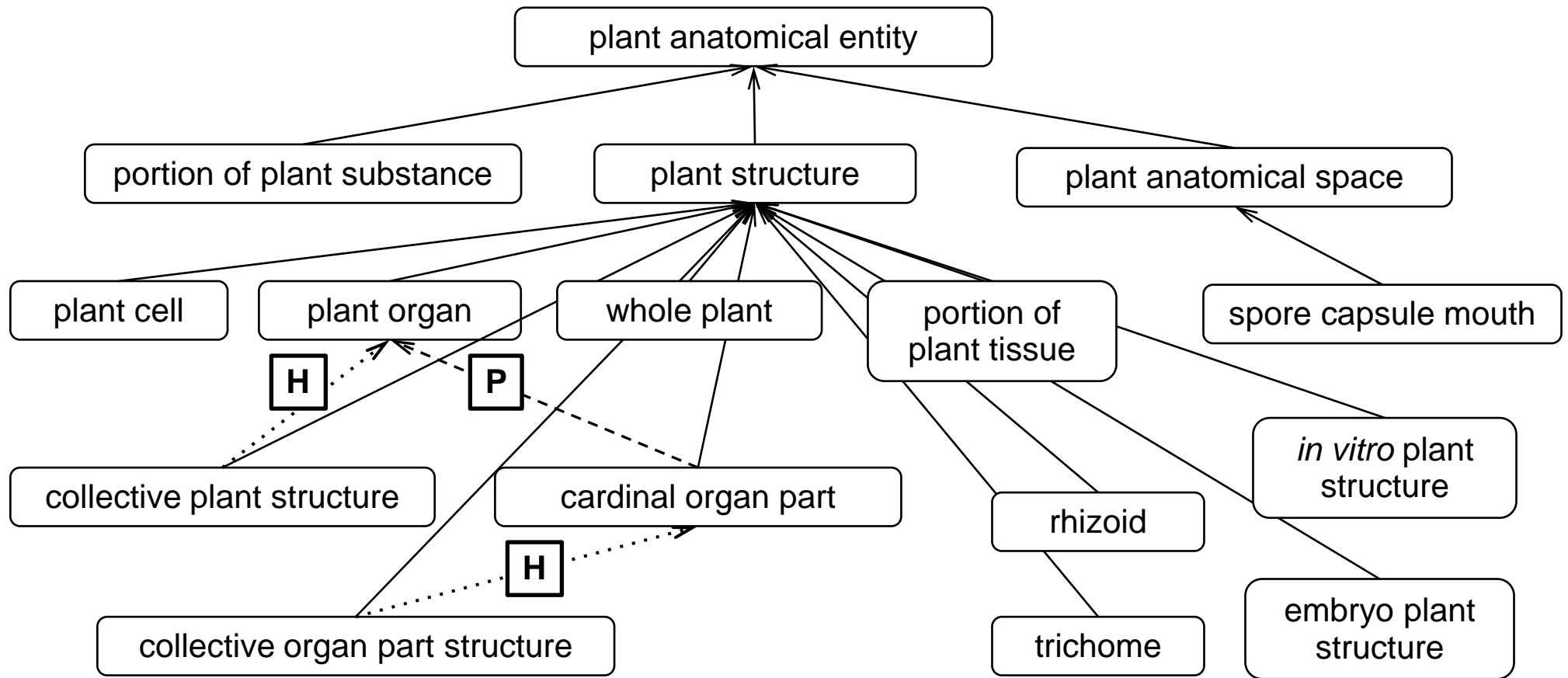
- More than 80 new terms were added to accommodate pteridophytes and bryophytes
- Review of new terms- Any questions?
- Plant life cycle phases: gametophyte phase and sporophyte phase were added to the PGDSO (during an earlier release).
- Also added protonema phase, for bryophytes and pteridophytes

# Any questions about new terms or definitions?

adult leaf	PO:0006340	gametophore axillary hair	PO:0030060	plant gametangium	PO:0025124
alar cell	PO:0030057	gametophore axillary hair basal cell	PO:0030064	plant protoplast	PO:0000006
antheridial sperm cell	PO:0025120	gametophore axillary hair base	PO:0030063	protonema	PO:0030003
antheridium	PO:0025125	gametophore axillary hair terminal cell	PO:0030062	protonema side branch initial	PO:0030067
antheridium jacket layer	PO:0030053	gametophore axis	PO:0030020	rhizoid	PO:0030078
antheridium jacket layer cell	PO:0030052	gametophore axis apical cell	PO:0030023	seta	PO:0030032
archegonial egg cell	PO:0025122	gametophore bud	PO:0030026	sporangium	PO:0025094/ PO:0025232
archegonium	PO:0025126	gametophyte perianth	PO:0030031	sporangium base	PO:0030040
archegonium neck canal cell	PO:0030065	gametophyte phase	PO:0028003	sporangium theca	PO:0030041
archesporium	PO:0030074	juvenile leaf	PO:0006339	spore capsule annulus	PO:0025093
archsporial cell	PO:0030056	leaf apex	PO:0020040	spore capsule calyptra	PO:0030037
brachyocyte	PO:0030058	leaf base	PO:0020137	spore capsule columella	PO:0025231
bract	PO:0009055	leaf epidermis	PO:0006016	spore capsule operculum	PO:0030044
caulonema cell	PO:0030002	leaf trichome	PO:0006504	sporocyte	PO:0006204
caulonema tissue	PO:0030005	meristematic apical cell	PO:0030007	sporophyte foot	PO:0030029
chloronema cell	PO:0030001	non-vascular leaf	PO:0025075	stem base	PO:0008039
chloronema tissue	PO:0030004	non-vascular leaf apical cell	PO:0030013	stomatal complex	PO:0002000
costa	PO:0030072	paraphyllium	PO:0030069	tmema	PO:0030061
endothecium	PO:0030049	perigonal bract	PO:0030028	tmema cell	PO:0030059
epidermal rhizoid	PO:0030071	peristome	PO:0030042	transfer cell	PO:0000078
exothecium	PO:0030073				
gametophore	PO:0030018				

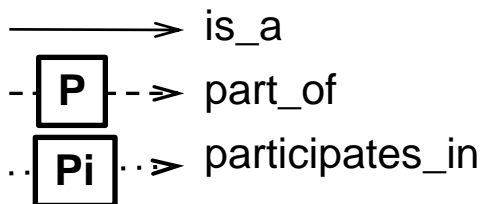
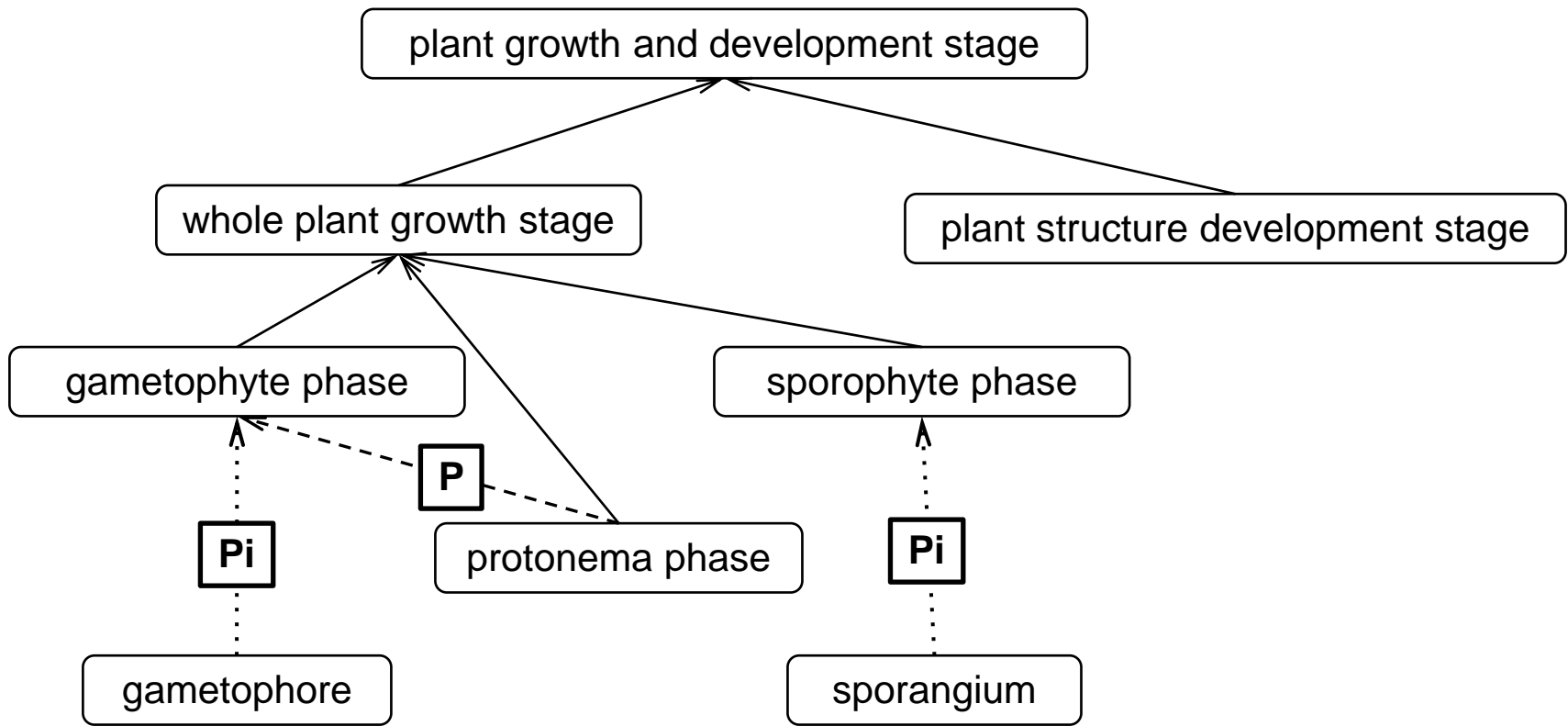


# Top level re-organization of the PAO



New top-level terms include material and immaterial entities and provide parents for all plant structures

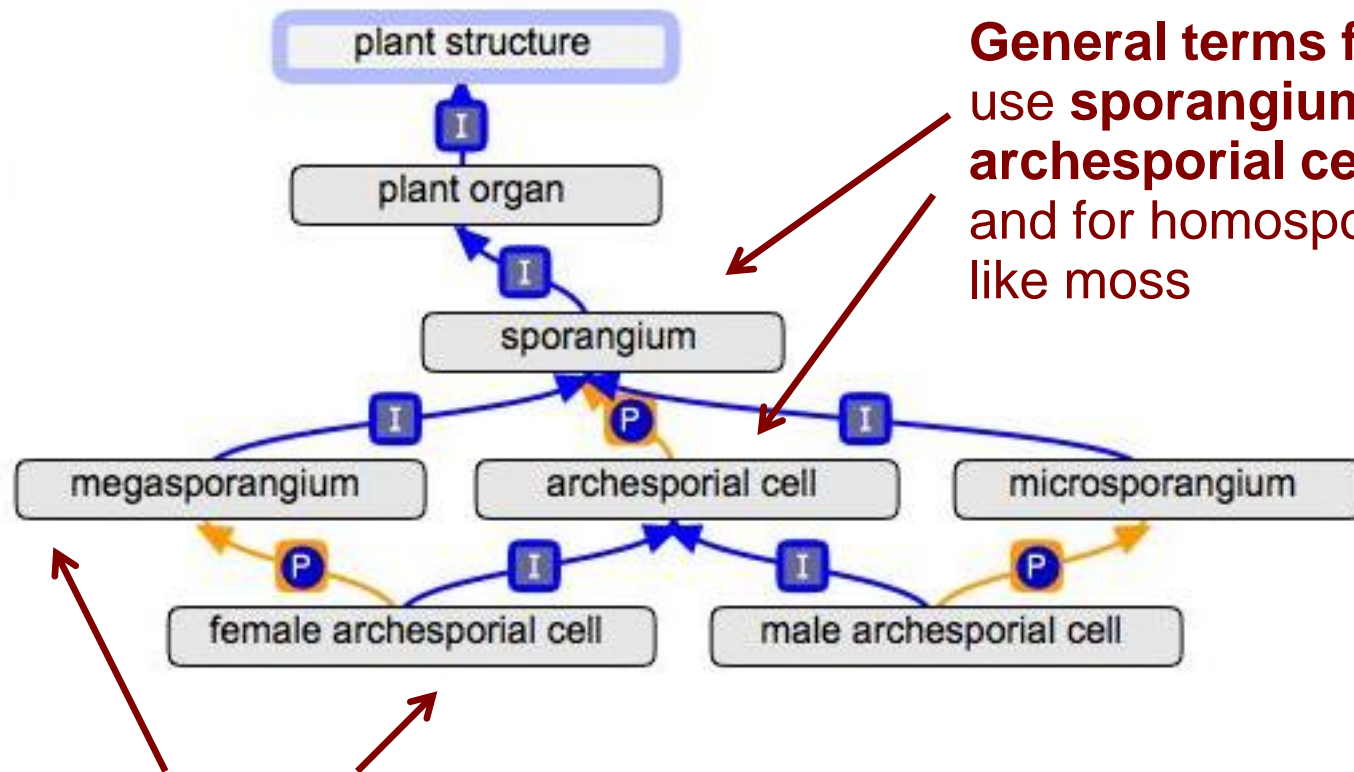
# Plant life cycle phases: specified using the *Participates\_in* relation



Examples:

gametophore participates\_in gametophyte phase  
sporangium participates\_in sporophyte phase

**Ontology structure:** general categories for all plants,  
specific children for particular taxa, as needed

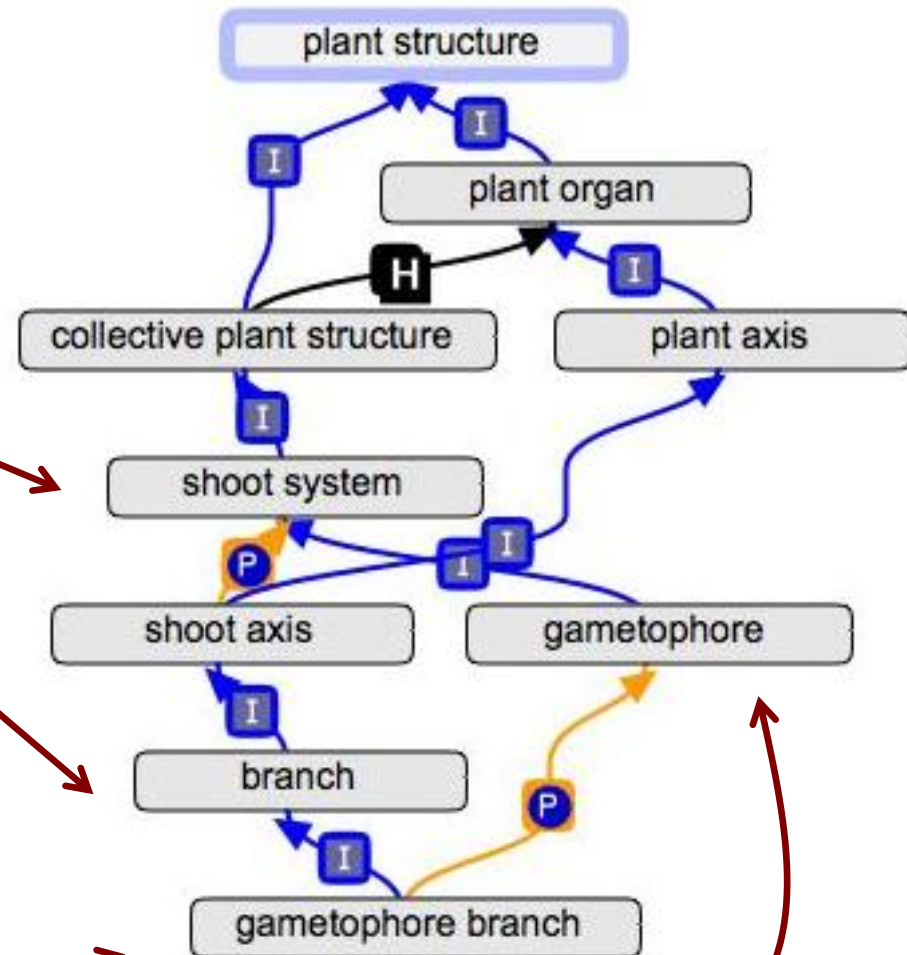


**General terms for all plants:**  
use **sporangium** and  
**archesporial cell** for all plants,  
and for homosporous plants,  
like moss

**Specialized child terms:**  
use **micro-** or **megasporangium** and  
**male** or **female archesporial cell** for  
heterosporous plants, like angiosperms

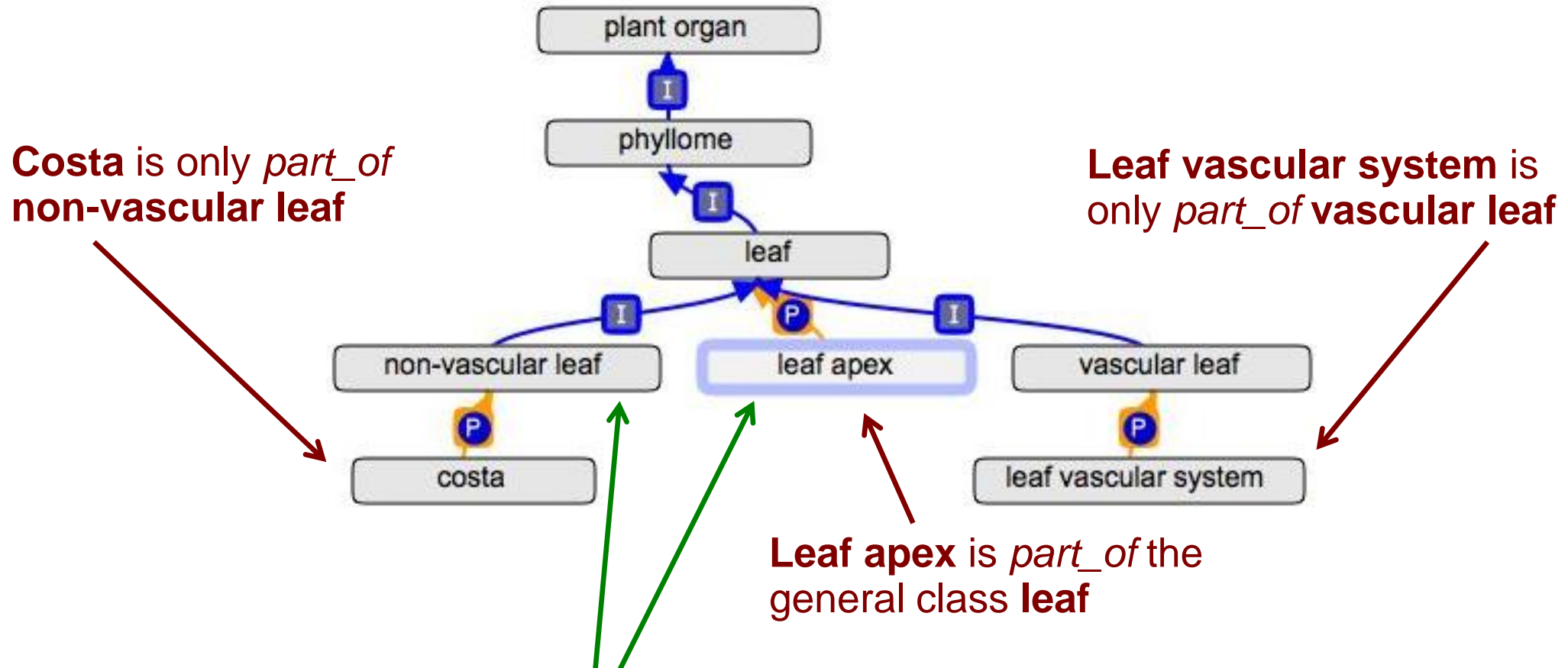
**Ontology structure:** general categories for all plants,  
specific children for particular taxa, as needed

**General terms for all plants:**  
use **shoot system** and **branch** for  
all plants, and for vascular plants



**Specialized child terms:**  
use **gametophore** and **gametophore  
branch** for bryophytes

# How to describe structures if no pre-composed term exists in the PO



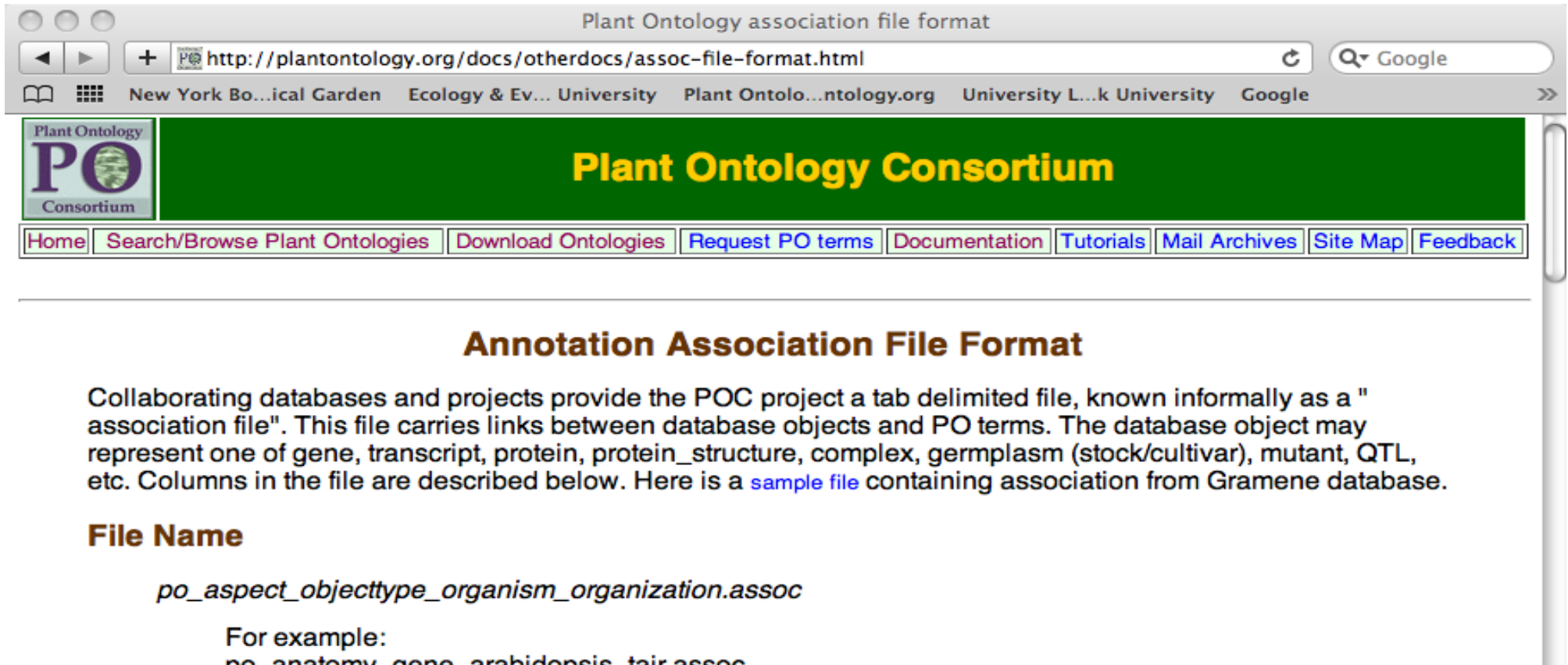
To describe gene expression in a leaf apex in *Physcomitrella*, put annotation on both **leaf apex** and **non-vascular leaf**



# Annotations: links to genomics datasets

- May be created for:
  - whole genome sequencing projects
  - EST data sets
  - QTL data sets
  - protein data sets
  - germplasm data sets
  - phenotype data sets
- Annotation files must be in the GAF1 or GAF2 format:  
15 or 16 column spreadsheets, one line per association

# Details on annotation file format:



The screenshot shows a web browser window with the title "Plant Ontology association file format". The address bar displays the URL <http://plantontology.org/docs/otherdocs/assoc-file-format.html>. The browser's search bar contains the text "Google". The website's header features the Plant Ontology Consortium logo on the left and the text "Plant Ontology Consortium" in large yellow letters on a green background. Below the header is a navigation bar with links: Home, Search/Browse Plant Ontologies, Download Ontologies, Request PO terms, Documentation, Tutorials, Mail Archives, Site Map, and Feedback. The main content area has the heading "Annotation Association File Format" in bold. Below this heading is a paragraph explaining that collaborating databases and projects provide the POC project a tab delimited file, known informally as an "association file". This file carries links between database objects and PO terms. The database object may represent one of gene, transcript, protein, protein\_structure, complex, germplasm (stock/cultivar), mutant, QTL, etc. Columns in the file are described below. Here is a [sample file](#) containing association from Gramene database. Below the paragraph is the section "File Name" in bold, followed by the file name `po_aspect_objecttype_organism_organization.assoc`. Below this is the text "For example:" followed by the example file name `po_anatomy_gene_arabidopsis_tair.assoc`.

Plant Ontology association file format

<http://plantontology.org/docs/otherdocs/assoc-file-format.html> Google

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology Consortium University of Kentucky Google

Plant Ontology Consortium

[Home](#) [Search/Browse Plant Ontologies](#) [Download Ontologies](#) [Request PO terms](#) [Documentation](#) [Tutorials](#) [Mail Archives](#) [Site Map](#) [Feedback](#)

## Annotation Association File Format

Collaborating databases and projects provide the POC project a tab delimited file, known informally as a "association file". This file carries links between database objects and PO terms. The database object may represent one of gene, transcript, protein, protein\_structure, complex, germplasm (stock/cultivar), mutant, QTL, etc. Columns in the file are described below. Here is a [sample file](#) containing association from Gramene database.

### File Name

`po_aspect_objecttype_organism_organization.assoc`

For example:

`po_anatomy_gene_arabidopsis_tair.assoc`

<http://plantontology.org/docs/otherdocs/assoc-file-format.html>

# Sample *Physcomitrella* annotations

po\_anatomy\_gene\_physcomitrella\_gramene.assoc - Microsoft Excel non-commercial use

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Gramene	ESTEXT_GENEWISE1.C_800048	FtsZ2-1		PO:0030002	PMID:19567705	IEP	S	plastid division		protein	gene	taxon:14548:	20110525	jaiswallab	
2	Gramene	ESTEXT_GENEWISE1.C_800048	FtsZ2-1		PO:0030023	PMID:19567705	IEP	S	plastid division		protein	gene	taxon:14548:	20110525	jaiswallab	
3	Gramene	ESTEXT_FGENESH1_PM.C_381001	ACTIN3		PO:0030002	PMID:19567705	IEP	S	Actin 3		ACT3	gene	taxon:14548:	20110525	jaiswallab	
4	Gramene	ESTEXT_FGENESH1_PM.C_381001	ACTIN3		PO:0030023	PMID:19567705	IEP	S	Actin 3		ACT3	gene	taxon:14548:	20110525	jaiswallab	
5	Gramene	ESTEXT_FGENESH1_PG.C_265002	DRP5B		PO:0030002	PMID:19567705	IEP	S	dynammin-related protein 5B		dynammin-related pro	gene	taxon:14548:	20110525	jaiswallab	
6	Gramene	ESTEXT_FGENESH1_PG.C_265002	DRP5B		PO:0030023	PMID:19567705	IEP	S	dynammin-related protein 5B		dynammin-related pro	gene	taxon:14548:	20110525	jaiswallab	
7	Gramene	ESTEXT_GWP_GW1.C_2440051	ARC6		PO:0030002	PMID:19567705	IEP	S	accumulation and replication of chloroplasts 6			gene	taxon:14548:	20110525	jaiswallab	
8	Gramene	ESTEXT_GWP_GW1.C_2440051	ARC6		PO:0030023	PMID:19567705	IEP	S	accumulation and replication of chloroplasts 6			gene	taxon:14548:	20110525	jaiswallab	
9	Gramene	E_GW1.100.158.1	PDV2		PO:0030002	PMID:19567705	IEP	S	plastid division 2		PDV2-1	gene	taxon:14548:	20110525	jaiswallab	
10	Gramene	E_GW1.100.158.1	PDV2		PO:0030023	PMID:19567705	IEP	S	plastid division 2		PDV2-1	gene	taxon:14548:	20110525	jaiswallab	
11																
12																
13																
14																


- See <http://plantontology.org/docs/otherdocs/assoc-file-format.html> for more details

# Annotation files are uploaded to our SVN repository:

[/\[Poc\]/trunk/associations](#)

**Index of /trunk/associations**

Files shown: 31  
 Directory revision: [1150](#) (of [1151](#))  
 Sticky Revision:



File	Rev.	Age	Author	Last log entry
<a href="#">Parent Directory</a>				
<a href="#">po_anatomy_gene_physcomitrella_gramene.assoc</a>	<a href="#">1150</a>	11 days	elserj	Added physco assoc file
<a href="#">po_growth_germplasm_S.lycopersicum_sgn.assoc</a>	<a href="#">1146</a>	13 days	elserj	Oops, was a bit overzealous with the tab removal
<a href="#">po_anatomy_germplasm_S.lycopersicum_sgn.assoc</a>	<a href="#">1146</a>	13 days	elserj	Oops, was a bit overzealous with the tab removal
<a href="#">po_temporal_gene_arabidopsis_tair.assoc</a>	<a href="#">1138</a>	2 weeks	cooperl	Copied 5 annotations from the po_anatomy_gene_arabidopsis_tair.assoc file on se...
<a href="#">po_anatomy_gene_arabidopsis_tair.assoc</a>	<a href="#">1137</a>	2 weeks	cooperl	Updated the TAIR anatomy and temporal files by reassigning annotations to new t...
<a href="#">po_anatomy_stock_zea_MaizeGDB_Stock.assoc</a>	<a href="#">1136</a>	2 weeks	cooperl	Updated the MaizeGDB, and TAIR temporal files by reassigning annotations to new ...
<a href="#">po_anatomy_stock_zea_MaizeGDB.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_qtl_oryza_gramene.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_Nicotiana_sgn.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_zea_MaizeGDB.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_S.lycopersicum_sgn.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_oryza_gramene.assoc</a>	<a href="#">1134</a>	2 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_S.tuberosum_sgn.assoc</a>	<a href="#">1009</a>	4 months	cooperl	S. tuberosum - 1 annotation moved from pollen tube (PO:0006345)to new term polle...
<a href="#">po_growth_qtl_oryza_gramene.assoc</a>	<a href="#">955</a>	8 months	cooperl	101 annotations to SDLGVIG from'po_anatomy_qtl_oryza_gramene.assoc' copied to po...
<a href="#">po_growth_gene_Coffea_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations
<a href="#">po_growth_gene_Nicotiana_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations
<a href="#">po_growth_gene_S.lycopersicum_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations
<a href="#">po_growth_gene_Petunia_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations
<a href="#">po_growth_gene_Capsicum_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations
<a href="#">po_growth_germplasm_S.melongena_sgn.assoc</a>	<a href="#">947</a>	8 months	nm249	updated growth stage sgn associations

x zotero

<http://palea.cgrb.oregonstate.edu/viewsvn/Poc/trunk/associations/>

# Searching for annotations

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology Consortium University of London University Google

**Plant Ontology Consortium**

Advanced Search Browse Help Request PO Term Home

Search PO Term  ☐ Ontology ☒ Annotations ☐ Exact Match

Searching annotations for "actin" returns 236 results

## Annotation Search Results

Filtering results by "P. patens" returns 1 result

**236 results for actin in field(s) name(s), symbol, synonyms**

**Filter search results**

Filter Annotation Objects

Species	Data source
N. tabacum	Gramene QTL
O. sativa	Gramene Ensembl
P. patens	MaizeGDB
P. x hybrida	MGCSC

Filter Annotation Evidence

IEP
IMP
NAS
TAS

**Annotation Search Results**

**1 result for actin in field(s) name(s), symbol, synonyms**

**Current filters**

Species: P. patens

**Filter search results**

Filter Annotation Objects

Species	Data source
H. niger	All
N. tabacum	Gramene Genes
O. sativa	Gramene QTL
P. patens	Gramene Ensembl

Filter Annotation Objects by Associations

Evidence Code	Ontology
All Curator Approved	All
IC	Plant Anatomy
IDA	Plant Growth Stage
IEP	

Name	Details
<input type="checkbox"/> <b>ACT11</b> AT5G01370 Query matches synonym ALC-Inter <u>actin</u> g protein 1	
<input type="checkbox"/> <b>ACT1</b> <u>actin</u> 1	
<input type="checkbox"/> <b>ACT1</b> <u>actin</u> 1	
<input type="checkbox"/> <b>ACT1</b> AT2G37620 Query matches synonyms <u>actin</u> 1, and 1 more	
<input type="checkbox"/> <b>ACT11</b> AT3G12110 Query matches synonym <u>actin</u> -11	
<input type="checkbox"/> <b>ACT12</b> AT3G46520 Query matches synonyms <u>ACTIN</u> and 1 more	protein from <i>Arabidopsis thaliana</i>

☐ Get annotation summary



# View the annotations associated with any term:

### Term Information

**Accession** PO:0030002

**Ontology** plant anatomy

**Synonyms** None

**Definition** A chlorenchyma cell that is part of a POC:rw]

**Comment** A caulonema cell contains fewer, less

### Term Lineage

**Current filters**  
Species: *P. patens*

**Filter tree view**

Filter Annotation Objects Counts

Data source

All  
Gramene Genes  
Gramene QTL  
Gramene Ensembl

Species

☐ All species

**Term View Options**

☒ Term ancestors

☒ all : all [view annotations]

☒ PO:0025131 : plant anatomical entity [view annotations]

☒ PO:0009011 : plant structure [view annotations]

☒ PO:0009002 : plant cell [view annotations]

☒ PO:0025030 : ground tissue cell [view annotations]

☒ PO:0000074 : parenchyma cell [view annotations]

☒ PO:0000076 : chlorenchyma cell [view annotations]

☒ **PO:0030002 : caulonema cell [view annotations]**

☒ PO:0009007 : portion of plant tissue [view annotations]

### PO Browser: Term Association Details

http://plantontology.org/amigo/go.cgi?view=assoc&search\_constraint=terms&depth=0&query=PO:0030002&sess=...

New York Botanical Garden Ecology & Evolutionary Biology Plant Ontology University of Maryland System Google USAA / Welcome to USAA

## caulonema cell

Term annotations Term information Term lineage External references

**Current filters**  
Species: *P. patens*

**Filter annotations displayed**

Filter annotations

Species: *H. niger*, *N. tabacum*, *O. sativa*, *P. patens*

Data source: All, Gramene Genes, Gramene QTL, Gramene Ensembl

Evidence Code: All Curator Approved, IC, IDA, IEP

View annotations: ☒ All annotations, ☐ Direct annotations

Set filters Remove all filters

### Annotations to caulonema cell ; PO:0030002 and its children

Get this data as [RDF/XML](#).

**caulonema cell ; PO:0030002** [show def]

Qualifier	Name / Symbol	Information	Evidence	Reference	Assigned by	Associated to
<input type="checkbox"/>	<b>ACTIN3</b> Actin 3	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	IEP	PMID:19567705	jaiswallab	
<input type="checkbox"/>	<b>ARC6</b> accumulation and replication of chloroplasts 6	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	IEP	PMID:19567705	jaiswallab	(via Gramene Ensembl)
<input type="checkbox"/>	<b>DRP5B</b> dynamin-related protein 5B	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	IEP	PMID:19567705	jaiswallab	(via Gramene Ensembl)
<input type="checkbox"/>	<b>FtsZ2-1</b> plastid division	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	IEP	PMID:19567705	jaiswallab	(via Gramene Ensembl)
<input type="checkbox"/>	<b>PDV2</b> plastid division 2	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	IEP	PMID:19567705	jaiswallab	(via Gramene Ensembl)

Select all Clear all Get annotation summary

Clicking "view annotations" takes you to the annotations associated with a terms

# Links out to source database

NCBI Resources ▾ How To ▾

PubMed.gov  
U.S. National Library of Medicine  
National Institutes of Health

Search: PubMed ▾ Limits Advanced search Help

Search Clear

[Display Settings:](#) ▾ Abstract

[Send to:](#) ▾

[Plant Cell](#). 2009 Jun;21(6):1769-80. Epub 2009 Jun 30.

## The PLASTID DIVISION1 and 2 components of the chloroplast division machinery determine the rate of chloroplast division in land plant cell differentiation.

[Okazaki K](#), [Kabeya Y](#), [Suzuki K](#), [Mori T](#), [Ichikawa T](#), [Matsui M](#), [Nakanishi H](#), [Miyagishima SY](#).

Initiative Research Program, Advanced Science Institute, RIKEN, Wako, Saitama 351-0198, Japan.

### Abstract

In most algae, the chloroplast division rate is held constant to maintain the proper number of chloroplasts per cell. By contrast, land plants evolved cell and chloroplast differentiation systems in which the size and number of chloroplasts change along with their respective cellular function by regulation of the division rate. Here, we show that PLASTID DIVISION (PDV) proteins, land plant-specific components of the division apparatus, determine the rate of chloroplast division. Overexpression of PDV proteins in the angiosperm *Arabidopsis thaliana* and the moss *Physcomitrella patens* increased the number but decreased the size of chloroplasts; reduction of PDV levels resulted in the opposite effect. The level of PDV proteins, but not other division components, decreased during leaf development, during which the chloroplast division rate also decreased. Exogenous cytokinins or overexpression of the cytokinin-responsive transcription factor CYTOKININ RESPONSE FACTOR2 increased the chloroplast division rate, where PDV proteins, but not other components of the division apparatus, were upregulated. These results suggest that the integration of PDV proteins into the division machinery enabled land plant cells to change chloroplast size and number in accord with the fate of cell differentiation.

### Comment in

[Plant Signal Behav](#). 2010 Feb;5(2):164-7.

PMID: 19567705 [PubMed - indexed for MEDLINE] PMCID: PMC2714929 [Free PMC Article](#)



# Annotation Search Results

1 result for **actin** in field(s) **name(s), symbol, synonyms**

## Current filters

Species: [P. patens](#)

## Filter search results ?

### Filter Annotation Objects

Species	Data source
H. niger	All
N. tabacum	Gramene Genes
O. sativa	Gramene QTL
P. patens	Gramene Ensembl

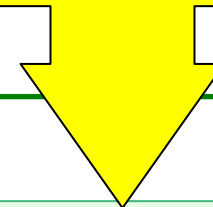
### Filter Annotation Objects by Associations

Evidence Code	Ontology
All Curator Approved	All
IC	Plant Anatomy
IDA	Plant Growth Stage
IEP	

Set filters

Remove all filters

Clicking on gene name from Annotation Search Results or from the annotations associated with a term provides more details on that gene



Name
<b>ACTIN3</b> gene from <i>Physcomitrella patens</i>
Actin 3
Select all Clear all Get annotation summary

## ACTIN3

### Information

<b>Name(s)</b>	Actin 3
<b>Type</b>	gene
<b>Species</b>	<a href="#">Physcomitrella patens subsp. patens</a>
<b>Synonyms</b>	ACT3
<b>Database</b>	Gramene Ensembl, <a href="#">Gramene:ESTEXT_FGENESH1_PM.C_3810004</a>
<b>Associated</b>	No associations to GO
<b>Sequence</b>	No peptide sequence available

[Back to top](#)

### Term Annotations

#### Current filters

Species: [P. patens](#)

#### Filter annotations displayed ?

Evidence Code	Ontology
All Curator Approved	All
IC	Plant Anatomy
IDA	Plant Growth Stage
IEP	

Set filters

Remove all filters

Qualifier	Term	Ontology	Evidence	Reference	Assigned by
	<a href="#">caulonema cell</a> <a href="#">[view annotations]</a>	<a href="#">plant anatomy</a>	<a href="#">IEP</a>	<a href="#">PMID:19567705</a>	<a href="#">jaiswallab</a>
			<a href="#">IEP</a>	<a href="#">PMID:19567705</a>	<a href="#">(via Gramene Ensembl)</a>
	<a href="#">gametophore axis meristematic apical cell</a> <a href="#">[view annotations]</a>	<a href="#">plant anatomy</a>	<a href="#">IEP</a>	<a href="#">PMID:19567705</a>	<a href="#">jaiswallab</a>
			<a href="#">IEP</a>	<a href="#">PMID:19567705</a>	<a href="#">(via Gramene Ensembl)</a>

# Downloading annotations

## caulonema cell

Term annotations [↓](#) Term information [→](#) Term lineage [→](#) External references [→](#)

### Current filters

Species: *P. patens*

### Filter annotations displayed [?](#)

Filter annotations

Species	Data source	Evidence Code
<input type="radio"/> H. niger	<input type="radio"/> All	<input type="radio"/> All Curator Approved
<input type="radio"/> N. tabacum	<input type="radio"/> Gramene Genes	<input type="radio"/> IC
<input type="radio"/> O. sativa	<input type="radio"/> Gramene QTL	<input type="radio"/> IDA
<input type="radio"/> P. patens	<input type="radio"/> Gramene Ensembl	<input type="radio"/> IEP

View annotations

☒ All annotations ☐ Direct annotations

[Set filters](#)

[Remove all filters](#)

### Annotations to caulonema cell ; PO:0030002

Get this data as [RDF/XML](#).

[caulonema cell ; PO:0030002](#) [\[show def\]](#)

Annotations for individual terms can be downloaded as RDF/XML files

	Qualifier	Name / Symbol	Information	Evidence	Reference	Assigned by	Associated to
<input type="checkbox"/>		<a href="#">ACTIN3</a> Actin 3	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	<a href="#">IEP</a> <a href="#">IEP</a>	<a href="#">PMID:19567705</a> <a href="#">PMID:19567705</a>	jaiswallab (via Gramene Ensembl)	
<input type="checkbox"/>		<a href="#">ARC6</a> accumulation and replication of chloroplasts 6	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	<a href="#">IEP</a> <a href="#">IEP</a>	<a href="#">PMID:19567705</a> <a href="#">PMID:19567705</a>	jaiswallab (via Gramene Ensembl)	
<input type="checkbox"/>		<a href="#">DRP5B</a> dynamin-related protein 5B	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	<a href="#">IEP</a> <a href="#">IEP</a>	<a href="#">PMID:19567705</a> <a href="#">PMID:19567705</a>	jaiswallab (via Gramene Ensembl)	
<input type="checkbox"/>		<a href="#">FtsZ2-1</a> plastid division	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	<a href="#">IEP</a> <a href="#">IEP</a>	<a href="#">PMID:19567705</a> <a href="#">PMID:19567705</a>	jaiswallab (via Gramene Ensembl)	
<input type="checkbox"/>		<a href="#">PDV2</a> plastid division 2	gene from <i>Physcomitrella patens</i> subsp. <i>patens</i>	<a href="#">IEP</a> <a href="#">IEP</a>	<a href="#">PMID:19567705</a> <a href="#">PMID:19567705</a>	jaiswallab (via Gramene Ensembl)	
<input type="checkbox"/>	<a href="#">Select all</a>	<a href="#">Clear all</a>	<input type="radio"/> Get annotation summary	<a href="#">Submit</a>			

# Downloading annotations

[Poc] Index of /trunk/associations

http://palea.cgrb.oregonstate.edu/viewsvn/Poc/trunk/associations/

New York Botanical Garden Ecology & Evolutionary Biology University Plant Ontology University of California Berkeley University of Illinois at Urbana-Champaign

**Index of /trunk/associations**

Files shown: 31  
Directory revision: 1150 (of 1155)  
Sticky Revision:  Set

File	Rev.	Age	Author	Last log entry
Parent Directory				
<a href="#">po_anatomy_gene_Anisodus_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Atropa_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Capsicum_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Coffea_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Datura_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Hyoscyamus_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Nicotiana_sgn.assoc</a>	1134	4 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_Petunia_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_Physalis_sgn.assoc</a>	945	8 months	nm249	updated sgn anatomy association files
<a href="#">po_anatomy_gene_S.lycopersicum_sgn.assoc</a>	1134	4 weeks	cooperl	Updated the MaizeGDB, Gramene and SGN files by reassigning annotations to new te...
<a href="#">po_anatomy_gene_S.tuberosum_sgn.assoc</a>	1009	5 months	cooperl	S. tuberosum - 1 annotation moved from pollen tube (PO:0006345)to new term polle...
<a href="#">po_anatomy_gene_arabidopsis_tair.assoc</a>	1137	3	cooperl	Updated the TAIR anatomy and temporal files by reassigning

Entire annotation files can be downloaded from our SVN site.

<http://palea.cgrb.oregonstate.edu/viewsvn/Poc/trunk/associations/>



# Sending feedback

## Suggestions? Comments? Please let us know.

**Note:** Please provide a **valid** email address so that we may respond. Thanks!

**\*\* required field**

Refer to URL:

Subject:

Questions/Comments:

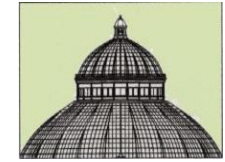
Your Name:

Your Email:

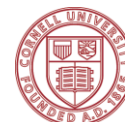
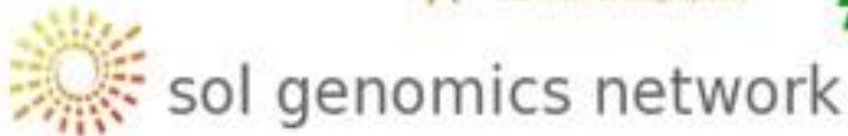
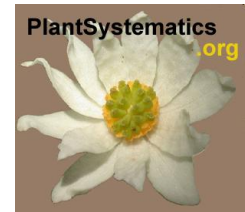
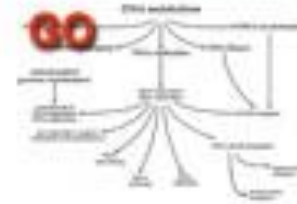
Organization:

Estimate Price

# Acknowledgements:



THE NEW YORK  
BOTANICAL GARDEN



Cornell University



**Your name could be here, too!**