The PathwaysWeb Web Service API

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API Documentation for the PathwaysWeb API, a resource-oriented web service that facilitates retrieval of information regarding cancer-related regulatory and signaling pathways, genes, gene-to-gene interactions and terms and relationships from The Gene Ontology.

The PathwaysWeb API

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Introduction

Cancer is the uncontrolled growth of abnormal cells in the body. For cancer to occur multiple signaling mechanisms must break down to allow the cell to avoid the many checks and balances in the body that prevent such uncontrolled growth from happening. An understanding of molecular interactions and biological processes that support or prevent this growth is a key element to finding the causes and cures for cancer. Scientists have grouped the molecular interactions and biological processes into signaling and regulatory pathways. This information includes data about the pathways, the genes that make up those pathways and interactions between the genes. The PathwaysWeb web service was created to provide a mechanism by which software programs could easily access such information easily.

The PathwaysWeb Web Service

The PathwaysWeb API is a read-only resource-based web service that makes it possible to programmatically retrieve data (known as resources) regarding cancer-related biological pathways and related data using standard HTTP protocol GET requests. Resources may be objects (i.e. a single pathway) or collections of objects (i.e. a set of pathways that all contain certain genes). Resources accessible via the API include information about pathways, the genes within those pathways, interactions between genes, gene synonyms, references to multiple gene database ids for genes with an approved HUGO gene symbol, and references to PubMed ids for articles related to genes and interactions. The system contains multiple versions of data which are snapshots of the full collection of data from different sources at a given point in time. The API provides for data can be retrieved by version to help reproduce results or to easily retrieve the latest version of the data without knowing the beforehand what the latest version is.

Available Content Types

All resources can be requested to return the requested data as XML [the default] , "application/xml", or as JSON formatted data, "application/json".

Available Data

The PathwaysWeb API includes data from the National Cancer Institute (NCI), the National Center for Biotechnology (NCBI), the HUGO Gene Nomenclature Committee (HGNC), and The Gene Ontology. The information is made available based on resources. As of 5/10/2014, resources include:

Resources	Record Count per latest data load (version)
Pathways and sub pathways	Total: 1600; NCI-Curated: 201; Reactome: 1399
Interactions	1,024,802
Interaction Types	79 specific, 11 generic
PubMed Documents Identifiers	28,734 for genes; 468,474 for interactions
Genes	Human: 38,674
Gene Name Synonyms	46,041
Gene Symbol Synonyms	87,524
Gene Ontology Taxa	2
Gene Ontology (GO) Terms	38,959
Gene Ontology (GO) Genes	Total: 44,047 Human: 18,991; Mouse: 25,416
GO Gene-Term Associations	Assigned By GO: 482,214; Calculated: 2,822,163 Human: 3,102,124; Mouse: 3,124,827 Common to Human and Mouse: 2,944,786

PathwaysWeb Resource Relationships

One of the features of the PathwaysWeb Web Service is that one may navigate between resources. The highest level of resource in the PathwaysWeb API is the collection of data versions (Resource name: versions) which are based on when the data was collected from various sources. The versions list contains version resources (Resource name: version) which themselves contain references (URIs) to other resources such as interactions, genes, and pathways. The diagram below displays the resource relationships in the PathwaysWeb API.
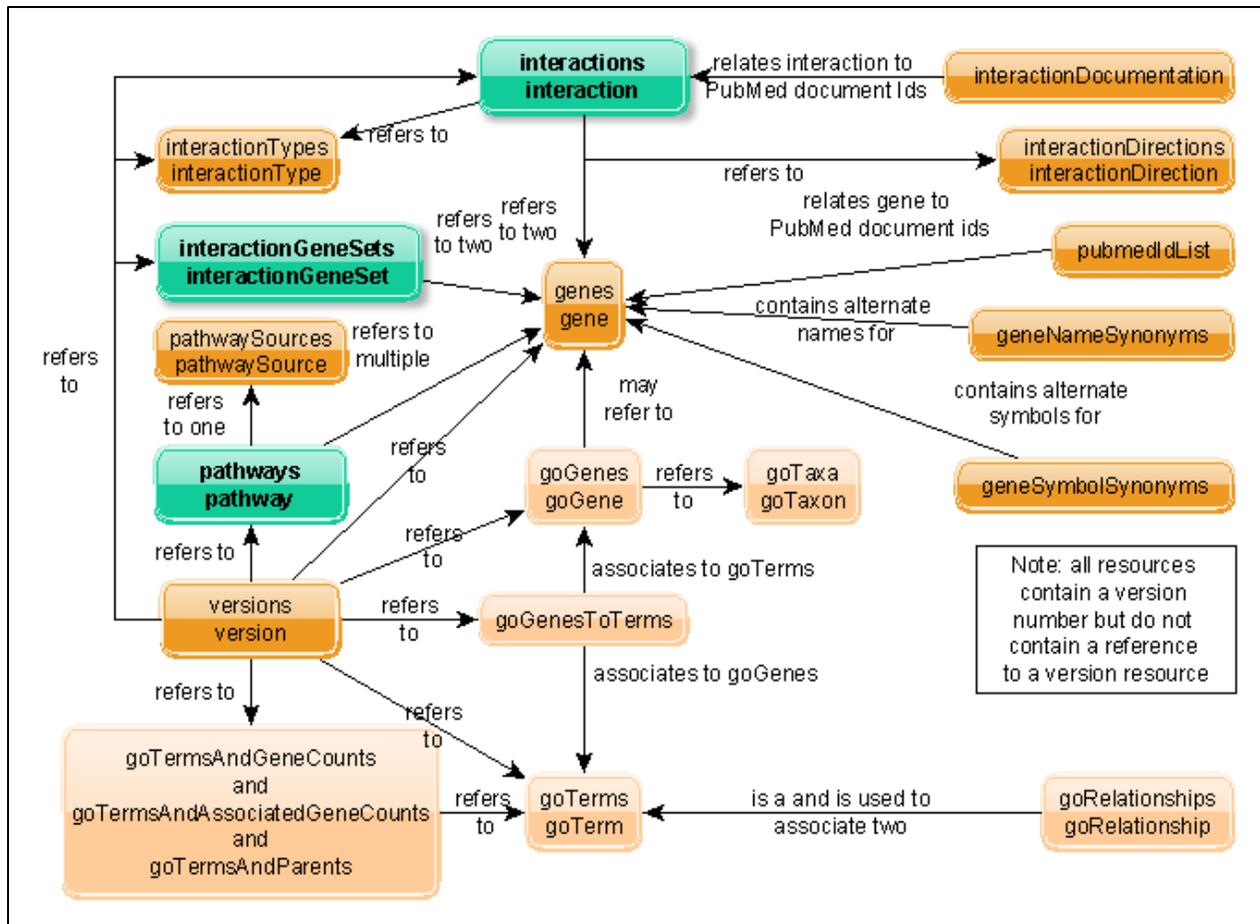
PathwaysWeb Resource Relationships:

Blue-Green (dark gray) - Bold	Primary Resources
Orange (medium gray)	Metadata and Supporting Resources
Peach (light gray)	Gene Ontology Related Resources

Resources

The PathwaysWeb Web Service API can be broken down into the following types of resources:

Primary API	Information on Pathways and Interactions
Metadata	Additional Metadata regarding Pathways and Interactions (sources, interaction types, etc.)
Supporting Data	PubMed information for Genes and Interactions, Gene information, including gene name and symbol synonyms)
Gene Ontology Related Data	Gene Ontology Terms and relationships to genes.

Resource descriptions are divided into the above groups.

Note: A quick reference to the use and URL structure for each API call can be found in Appendix: API Quick Reference at the end of this document.

Format of Descriptions of Resources

For each resource the descriptions are arranged as follows, where applicable:

Resource Name and Description

Table containing the description of the information provided in the resource.
The table lists the various data fields, a description, and a cardinality that tells how many times that field may appear in the resource.

The URI formats available for the resource. Items that are variable and need to be replaced by the client of the API are shown in curly braces {}.
i.e.   For the resource format listing for the version resource,
        PathwaysWeb/genes/version/{version_id}
The client calling the resource must replace the part of the URL listed as {version_id} with an actual version id value. For instance, to look at version 1, the correct call would be:
        PathwaysWeb/genes/version/1

A table describing the optional query parameters that can be applied to the URI formats listed above.
These would be listed as normal web query parameters, that is, adding a question mark "?"and then name=value pairs separated by ampersands "&" after the base URI format selected above.
i.e.
For the pathways URI, the base URI is listed as PathwaysWeb/pathways/version/{version_id}
To start retrieve 3 pathways from version 8 of the data, starting at pathway number 2 (the start parameter starts at 0) , the final URI would look as follows:
http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=1&count=3
Most resources do not include additional parameters.

Any sample API calls and samples of returned data are included at the end of the resource description.

Primary API: Pathways and Interactions

Pathways Collection Resource
Retrieve information on a set of pathways.

The data returned will be a pathways resource object which is a collection of pathway resource objects and additional data. If no data matches the specific requested criteria, an empty pathway list will be returned.

Data Element			Description	Cardinality
pathways			Pathways Collection	1
	uri		URI representing the data that follows.	1
	next		Points to additional data after current data subset if some exists. Missing if no additional data.	0-1
		uri	URI represents next subset of data for request.	0-1
	previous		Points to additional data prior to current data subset if some exists. Missing if at start of list.	0-1
		uri	URI represents previous subset of data for request.	0-1
	pathway		Data for a single pathway object (See pathway resource for detail description of data).	0-n

Resource URI Formats:
Returns all pathway names and ids and link in latest database version (HTTP GET and POST)
PathwaysWeb/pathways/latest
Optional query/form parameters: start, count, sourceId, allGenes, anyGenes, description

Returns all pathway names and ids and links in specified database version (HTTP GET and POST)
PathwaysWeb/pathways/version/{version_id}
Optional query/form parameters: start, count, sourceId, allGenes, anyGenes, description

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	20
sourceId	Id of pathway source (see sourceId in pathwaySources resource for acceptable values).	
allGenes	Comma separated list of HUGO gene symbols where all genes must be in pathway.	
anyGenes	Comma separated list of HUGO gene symbols where at least one must be in pathway.	
description	Text to search for in description field. (Case insensitive).	

Sample pathways URIs:

http://server:port/PathwaysWeb/pathways/latest	Retrieve pathway information for all pathways in latest data version.
http://server:port/PathwaysWeb/pathways/version/1	Retrieve pathway information for version 8 of all pathways.
http://server:port/PathwaysWeb/pathways/latest/?start=0&count=5&sourceId=1&allGenes=AR,DLX1&anyGenes=ATF1,ATF2	Retrieve pathway information for first 5 pathways starting with pathway 0 using the latest data version where the source id = 1, the genes AR and DLX1 must both be part of the pathway and one or both of genes ATF1 and ATF2 must be part of the pathway.

If the count parameter is not included in the URI, the API will default to returning a list of 20 pathways at a time. To retrieve beyond the first 20, a "next" element will be provided that will contain a URI to the next 20 pathways.

Examples:

Samples responses for empty collections
 http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/10?start=0&count=2

XML:
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<pathways
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=0&count=2"/>

JSON:
{"pathway":[],"uri":"http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=0&count=2"}

Sample Resource HTTP Get
http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=0&count=2

Sample data XML response with data:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<pathways uri="http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=1&count=2">
    <next>http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=3&count=2</next>
    <pathway uri="http://bioinformatics.mdanderson.org/PathwaysWeb/pathway/version/1/mdaPathwayId/2/">
      <description>Posttranslational regulation of adherens junction stability and dissassembly</description>
      <genes>
        <geneRef entrezGeneId="25"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/ABL1/">ABL1</geneRef>
        <geneRef entrezGeneId="102"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/ADAM10/">ADAM10</geneRef>
        <geneRef entrezGeneId="382"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/ARF6/">ARF6</geneRef>
        <geneRef entrezGeneId="627"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/BDNF/">BDNF</geneRef>
```

```
        <geneRef entrezGeneId="91768"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/CABLES1/">CABLES1</geneRef>
        <geneRef entrezGeneId="836"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/CASP3/">CASP3</geneRef>

        ... (additional genRefs removed from example) ...

        <geneRef entrezGeneId="10009"
uri="http://bioinformatics.mdanderson.org/PathwaysWeb/gene/version/1/approvedHugoId/ZBTB33/">ZBTB33</geneRef>
    </genes>
    <idFromSource>ajdiss_2pathway</idFromSource>
    <interactionsRef uri="http://localhost:8080/PathwaysWeb/interactions/version/1/pathwayIds/2"/>
    <mdaPathwayId>2</mdaPathwayId>
    <nciWebsitePathwayDiagramUrl
uri="http://pid.nci.nih.gov/search/pathway_landing.shtml?what=graphic&jpg=on&pathway_id=ajdiss_2pathway"/>
    <numGenes>53</numGenes>
    <sourceId>1</sourceId>
    <subPathway>N</subPathway>
    <versionId>1</versionId>                        </pathway>
  <previous>http://bioinformatics.mdanderson.org/PathwaysWeb/pathways/version/1?start=0&count=2</previous>
</pathways>
```

Sample JSON response:

```
{
  "next": "http:\\bioinformatics.mdanderson.org\PathwaysWeb\pathways\version\1?start=2&count=2",
  "pathway": [
  {
    "interactionsRef": {
      "value": "",
      "uri": "http:\\bioinformatics.mdanderson.org\PathwaysWeb\interactions\version\1\pathwayIds\1"
    },
    "mdaPathwayId": 1,
    "description": "a4b1 and a4b7 Integrin signaling",
    "versionId": 1,
    "geneRef": [

… additional pathway data removed from sample output …

    {
      "value": "ITGB7",
      "uri": "http:\\bioinformatics.mdanderson.org\PathwaysWeb\gene\version\1\approvedHugoId\ITGB7\",
      "entrezGeneId": "3695",
      "geneSymbol": "ITGB7"
    }
    ],
    "idFromSource": "a4b1_a4b7_pathway",
    "sourceId": "1",
    "numGenes": 3,
    "uri": "http:\\bioinformatics.mdanderson.org\PathwaysWeb\pathway\version\1\mdaPathwayId\1\"
  },

… data removed from sample output …

  ],
  "uri": "http:\\bioinformatics.mdanderson.org\PathwaysWeb\pathways\version\1?start=0&count=2"
}
```

Single Pathway Resource

Retrieve information for a single pathway.

The data returned will be a single pathway resource object.

Data Element				Description	Cardinality
pathway				Pathway Information	1
	uri			URI to represent single pathway resource	1
	description			Text description of pathway	1
	genes			Collection of genes in pathway	1
		geneRef		Hugo Gene Symbol for gene. If no HUGO gene symbol has been assigned to gene, then gene name constructed from Entrez Id.	1
			entrezId	Entrez Id for gene.	0-1
			uri	URI reference to gene resource for gene.	1
	idFromSource			Id given to pathway by source site	1
	interactions			Interactions for single pathway resource	1
		uri		URI to represent interactions for single pathway resource	1
	mdaPathwayId			Integer id defined by program that loads the data. Should remain the same between different versions.	1
	nciWebsitePathwayDiagramUrl			Diagram of Pathway on NCI's website.	0-1
		uri		URI to NCI pathway diagram.	1
	numGenes			Count of number of genes in the pathway	1
	parentPathways			List of Parent pathways of pathway	0-1
		parentPathway		Parent Pathway mdaPathwayId (and URI)	1-n
			uri	URI to parent pathway resource	1
	reactomeWebsitePathwayDiagramUrl			Diagram of Pathway on Reactome's website.	0-1
		uri		URI to Reactome pathway diagram.	1
	sourceId			Id of source of pathways data (corresponds to sourceId of PathwaySource object).	1
	subPathway			Y if is a subpathway, N if not.	1
	versionId			Version id of data (corresponds to versionId of version resource).	1

Returns all information for pathway of specified id in latest database version
PathwaysWeb/pathway/latest/mdaPathwayId/{mdaPathwayId}

Returns all information for pathway of specified id in specified database version
PathwaysWeb/pathway/version/{versionId}/mdaPathwayId/{mdaPathwayId}

Sample URIs:

http://server:port/PathwaysWeb/pathway/latest/mda Pathwayid/1	Retrieve pathway information for pathway 1 in latest data version.
http://server:port/PathwaysWeb/pathways/version/1/ mdaPathwayId/2	Retrieve pathway information of version 1 of pathway 2.

Interactions Collection Resource
Retrieve information for a set of interactions.

Data Element			Description	Cardinality
interactions				
	uri		URI representing the data that follows.	1
	interaction		Data for a single interaction object (See interaction resource for detail description of data)	0-n
	next		Points to additional data after current data subset if some exists. Missing if no additional data.	0-1
		uri	URI represents next subset of data for request.	1
	previous		Points to additional data prior to current data subset if some exists. Missing if at start of list.	0-1
		uri	URI represents previous subset of data for request	1

Resource URI Formats:
Returns all first order interaction information in specified database version (HTTP GET and POST)
PathwaysWeb/interactions/latest
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns all first order interaction information in specified database version (HTTP GET and POST)
PathwaysWeb/interactions/version/{version_id}
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns first order interaction information for specified pathway ids in latest database version
PathwaysWeb/interactions/latest/pathway/pathwayIds/{csv list of pathway Ids}
Optional query parameters: start, count

Returns first order interaction information for specified pathway ids in specified database version
PathwaysWeb/interactions/version/{version_id}/pathwayIds/{csv list of pathway Ids}
Optional query parameters: start, count

Optional query parameters:

Query / Form parameter	Description of parameter	Comments	Default value
start	Starting record number (first record is 0)		0
count	Max number of records to return with each call.		100
genes	Comma separated list of gene symbols where if any gene in list is on left or right in interaction record is included.	Does not apply to URIs containing pathwayIds	
limitGenes	Comma separated list of gene symbols where both sides of interaction must be in this list for interaction to be included.	Does not apply to URIs containing pathwayIds	
interactionTypes	Comma separated list of interaction Type Ids that interaction must be labeled with to be included. (See interactionTypes resource for valid interaction type ids.)	Does not apply to URIs containing pathwayIds	

Single Interaction Resource

Retrieve information for a single interaction.

	Data Element					Description	Cardinality
interaction							
	uri					URI representing the data that follows.	1
	detailsCount					Count of number of interactionDetails records in interactionDetails node.	1
	entrezIdA					Entrez gene id for gene A.	0-1
	entrezIdB					Entrez gene id for gene B.	0-1
	hugoGeneA					Hugo gene symbol for gene A. Hugo symbols standardized to always have hugoGeneA come before hugoGeneB if not the same symbol.	1
	hugoGeneB					Hugo gene symbol for gene B.	1
	interactionDetails					Collection of InteractionDetail entries.	1
		InteractionDetail				Defines information regarding the description of a single interaction from a source record.	1..n
			geneA			First gene symbol in original source record.	1
			geneB			Second gene symbol in original source record.	1
			hasDocumentation			Y if there are PubMed records describing this interaction.	1
			interactionDetailId			Integer id assigned to interaction. Unique for every interaction detail in system. Not preserved across data versions.	1

				interaction Direction				1
					direction		Direction description	1
					id		Id for direction, corresponds to id for resource InteractionDirection	1
					interaction Types		Collection of Interaction Type Information	1
					interaction Type		Interaction Type Information each corresponds to resource InteractionType	1..n
						interactionGenericType	Generic Type	1
						interactionType	Specific Type	1
						interactionTypeId	Id of specific interaction type resource	1
						typeIsDescriptive	Y if the specific interaction type is detailed enough to tell what kind of interaction it is. N if it isn't specific i.e. "INTERACTION" or "UNKNOWN".	1
					positive		Y or N, tells if the text in textFromSource (below) is a positive or negated statement .	1
					predicate		Important word used to determine interaction type. Some sources use this in addition to or instead of providing an original text string that would be in textFromSource	1
					source		Corresponds to resource InteractionSource	1
						interaction SourceDesc	Interaction Source description	1
						interaction SourceId	Id for Interaction source.	1
						versionId	Version Id for	1

						Description	
						Interaction Source. (Should always match versionId for interaction detail.)	
			sourceOfSource			Where the sources of interaction data used by PathwaysWeb get their data.	1
				interaction SourceDetailDesc		Text Description of Source of data	1
				interaction SourceDetailId		Id of Source if data. Not preserved between data load versions.	1
			textFromSource			Detailed description of interaction as defined by source. Might be blank, a simple phrase, or multiple sentences. The interaction types were assigned according to text strings found in this data.	1
			versionId			Version Id for Interaction Detail. (Should always match versionId for interaction.)	1
	interactionDirection					Direction of interaction based on order of genes for overall interaction. Determined by count number of LEFT or RIGHT direction statuses for each interaction detail entry. If more LEFT than right, then overall status is LEFT, otherwise it is RIGHT.	1
		direction				Text description of overall direction of interaction.	1
		id				Id of overall direction for interaction. Corresponds to id of InteractionDirection	1

						resource.	
	interactionId					Integer id assigned to interaction. Unique for every interaction in system. Not preserved across data versions.	1
	pubmedCount					Number of articles in PubMed associated with this interaction in version of specified data load. Actual PubMed Ids can be found by using interactionDocumentationList resource	1
	versionId					Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Returns first order interaction information for specified interaction id in latest database version
PathwaysWeb/interaction/latest/interactionId/{interaction_id}

Returns first order interaction information for specified interaction id in specified database version
PathwaysWeb/interaction/version/{version_id}/interactionId/{interaction_id}

InteractionGeneSets Collection Resource

Retrieve set of gene information only for a set of interactions. Similar in functionality to Interactions Collection Resource, but only returns the two genes in the interactions rather than all interaction details.

Data Element			Description	Cardinality
interaction GeneSets				
	uri		URI representing the data that follows.	1
	interactionGeneSet		Wrapper for set of genes that interact. (order of genes does not imply directionality of interaction)	0-n
		a	First gene in interaction	1
		b	Second gene in interaction	1
	next		Points to additional data after current data subset if some exists. Missing if no additional data.	0-1
		uri	URI represents next subset of data for request.	1
	previous		Points to additional data prior to current data subset if some exists. Missing if at start of list.	0-1
		uri	URI represents previous subset of data for request	1

Resource URI Formats:

Returns all first order interaction gene sets in specified database version (HTTP GET and POST)
PathwaysWeb/interactionGeneSets/latest
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns all first order interaction gene sets in specified database version (HTTP GET and POST)
PathwaysWeb/interactionGeneSets/version/{version_id}
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns first order interaction gene sets for specified pathway ids in latest database version
PathwaysWeb/interactionGeneSets/latest/pathway/pathwayIds/{csv list of pathway Ids}
Optional query/form parameters: start, count

Returns first order interaction gene sets for specified pathway ids in specified database version
PathwaysWeb/interactionGeneSets/version/{version_id}/pathwayIds/{csv list of pathway Ids}
Optional query/form parameters: start, count

Optional query parameters:

Query / Form parameter	Description of parameter	Comments	Default value
start	Starting record number (first record is 0)		0
count	Max number of records to return with each call.		100
genes	Comma separated list of gene symbols where if any gene in list is on left or right in interaction record is included.	Does not apply to URIs containing pathwayIds	
limitGenes	Comma separated list of gene symbols where both sides of interaction must be in this list for interaction to be included.	Does not apply to URIs containing pathwayIds	
interactionTypes	Comma separated list of interaction Type Ids that interaction must be labeled with to be included. (See interactionTypes resource for valid interaction type ids.)	Does not apply to URIs containing pathwayIds	

Metadata: Additional Metadata regarding Pathways and Interactions

Interaction Directions Collection Resource

Retrieve information regarding the different directions of pathway information. (These are not versioned, but constant between different data loads.)

Data Element			Description	Cardinality
interactionDirec tions			Interaction Direction Collection	1
	uri		URI representing the data that follows.	
	interactionDire ction			1-n
		uri	URI representing the data that follows.	1
		direction	Text description of interaction direction	1
		id	Id for interaction direction	1

Resource URI Formats:
Returns all information for all interaction directions (This resource is not versioned)
PathwaysBrowser/interactionDirections

Single Interaction Direction Resource

Retrieves information regarding a single interaction direction.

Data Element		Description	Cardinality
interactionDirec tion			1
	uri	URI representing the data that follows.	1
	direction	Text description of interaction direction	1
	id	Id for interaction direction	1

Resource URI Formats:
Returns all information for interaction direction with specified interaction id (This resource is not versioned)
PathwaysBrowser/interactionDirection/{interactionDirectionId}

Pathway Sources Collection Resource

Retrieve information regarding the different sources of pathway information.

Data Element			Description	Cardinality
pathwaySources			Pathways Collection	1
	uri		URI representing the data that follows.	1
	pathwaySource		Data for a single pathway source object (See pathwaySource resource for detail description of data)	0-n

Resource URI Formats:
Returns all information for Pathway Sources in latest database version
PathwaysWeb/pathwaySources/latest

Returns all information for Pathway Sources in specified database version
PathwaysWeb/pathwaySources/version/{versionId}

Single Pathway Source Resource

Retrieves information regarding a single source of pathway information

Data Element		Description	Cardinality
pathwaySource		Pathway Source	1
	uri	URI representing the data that follows.	1
	description	Name of source of pathway data	1
	sourceId	Integer id of source (kept consistent across versions).	1
	versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Returns all information for Pathway Source for specified source id in latest database version
PathwaysWeb/pathwaySource/latest/sourceId/{sourceId}

Returns all information for Pathway Source for specified source id in specified database version
PathwaysWeb/pathwaySource/version/{versionId}/sourceId/{sourceId}

Versions Collection Resource

Retrieves information regarding all versions of data provided by the API.

Data Element			Description	Cardinality
versions			Pathways Collection	1
	uri		URI representing the data that follows.	1
	version		Data for a single version object (See version resource for detail description of data)	1-n

Returns list of all pathway database versions
PathwaysWeb/versions

Single Version Resource

Retrieves information regarding a single version of data provided by the API.

Data Element			Description	Cardinality
version				
	uri		URI representing the data that follows.	1
	genesRef			1
		uri	URI representing genes resource for version.	1
	goGenesRef			1
		uri	URI representing goGenes resource for version.	1
	goGenesToTermsRef			1
		uri	URI representing goGenesToTerms resource for version.	1
	goTermsAndAssociatedGeneCountsRef			1
		uri	URI representing goTermsAndAssociatedGeneCountsRef resource for version.	1
	goTermsAndGeneCountsRef			1
		uri	URI representing goTermsAndGeneCounts resource for version.	1
	goTermsAndParentsRef			1
		uri	URI representing goTermsAndParentsRef resource for version.	1
	goTermsRef			1
		uri	URI representing goTerms resource for version.	1
	interactionsRef			1
		uri	URI representing interactions resource for version.	1
	pathwaySourcesRef			1

		uri	URI representing pathwaySources resource for version.	1
	pathwaysRef			1
		uri	URI representing pathways resource for version.	1
	versionDate		Date version of data was added to database.	1
	versionDesc		Description of load of data.	1
	versionId		Version id of data	1

Resource URI Formats:
Returns latest pathway database version
PathwaysWeb/version/latest

Returns specified pathway database version
PathwaysWeb/version/{version_id}

Returns active pathway database version at a specified date
PathwaysWeb/version/date/{dateString}   (date in format yyyy-MM-dd)

Interaction Type Collection Resource

Retrieves information regarding all interaction types.

Data Element		Description	Cardinality
interactionTypes		List of interactions types for interaction	1
	uri		1
	interactionType	Data for a single interactionType object (See interactionType resource for detail description of data)	1-n

Resource URI Formats:
Returns all interaction types in latest database version
PathwaysWeb/interactionTypes/latest

Returns all interaction types in specified database version
PathwaysWeb/interactionTypes/version/{version_id}

Optional query parameters:

Query parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	100

Single Interaction Type Resource

Retrieves information regarding a single interaction type.

Data Element		Description	Cardinality
interactionType		(See appendix "Interaction Types" to get complete list of possible sets of values.)	1
	uri	URI for specific interaction type.	
	interactionGenericType	One out of 11 generic interaction types.	1
	interactionType	One out of 79 interaction types. More specific than interaction generic types above. There is a one-to-many relationship between generic interaction types and interaction types.	1
	interactionTypeId	Integer id of corresponding to interaction type data element.	1
	typeIsDescriptive	Y or N value to distinguish if interaction type is descriptive enough to determine the type of interaction.	1
	versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Returns information for specified interaction type in latest database version
PathwaysWeb/interactionType/latest/typeId/{interaction_type_id}

Returns information for specified interaction type in specified database version
PathwaysWeb/interactionType/version/{version_id}/typeId/{interaction_type_id}

Supporting Data:

PubMed information for Pathways and Interactions, Gene information (Including gene name and symbol synonyms)

Gene Related PubMed Documentation

Retrieves PubMed ids related to a specific gene.

Data Element			Description	Cardinality
pubmedIdList				1
	uri		URI representing the data that follows.	1
	id		Value of item PubMed ids are associated with. (Currently gene symbol)	1
	identifierType		Type of identifier id refers to. (Currently gene)	1
	pubmedIds		List of PubMed Ids.	1
		pubmedId	PubMed id.	1-n
	versionId		Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Return list of PubMed ids for specified Hugo gene id in latest database version
PathwaysWeb/pubmedList/latest/approvedHugoId/{hugo_gene_id}

Return list of PubMed ids for specified Hugo gene id in specified database version
PathwaysWeb/pubmedList/version/{version_id}/approvedHugoId/{hugo_gene_id}

Interaction Documentation Collection Resource

Retrieves PubMed ids related to a specific interaction.

Data Element			Description	Cardinality
interactionDocumentationList			List of interaction documentation nodes.	1
	uri		URI representing the data that follows.	1
	interactionDocumentation		Mapping between one interactionDetailId and a PubMed document	1-n
		documentLink	URI to PubMed document.	1
		documentationId	Id of interactionDocumentation	1
		Id	Id of PubMed document in PubMed.	1
		interactionDetailId	Interaction detail id.	1
		Interactionid	Interaction id.	1
		Location	Location (PM=PubMed or PC=PubMed Central).	1

Data Element				Description	Cardinality
		versionId		Version id of data (corresponds to versionId of version resource).	1

Return list of PubMed ids for specified interaction id in latest database version
PathwaysWeb/interactionDocumentationList/latest/interactionId/{interaction_id}

Return list of PubMed ids for specified interaction id in specified database version
PathwaysWeb/interactionDocumentationList/version/{version_id}/interactionId/{interaction_id}

Gene Collection Resource

Retrieves information regarding genes and their ids in other systems.

Data Element				Description	Cardinality
genes				Genes Collection	1
	uri			URI representing the data that follows.	1
	next			Points to additional data after current data subset if some exists. Missing if no additional data.	0-1
		uri		URI represents next subset of data for request.	0-1
	previous			Points to additional data prior to current data subset if some exists. Missing if at start of list.	0-1
		uri		URI represents previous subset of data for request.	0-1
	gene			Data for a single gene object (See gene resource for detail description of data)	0-n

Returns list of HUGO gene symbols for all genes in latest database version
PathwaysWeb/genes/latest

Returns list of HUGO gene symbols for all genes in specified database version
PathwaysWeb/genes/version/{version_id}

Optional query parameters:

Query parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	100

Single Gene Resource

Retrieves information regarding a single gene and its ids in other systems.

Data Element			Description	Cardinality
gene				1
	uri		URI representing the data that follows.	1
	chromosome		Text string telling in which chromosome the gene is located in humans.	1
	ensemblGeneId		Ensembl Gene Id (manually curated by HGNC).	1
	ensemblId		Ensembl ID (mapped data supplied by Ensembl)	1
	entrezGeneId		Entrez Gene Id (manually curated by HGNC).	1
	entrezGeneIdNcbi		Entrez Gene ID (mapped data supplied by NCBI).	1
	geneFamilyTag		Designates the gene family or group assigned by HGNC, according to either sequence similarity or information from publications, specialist advisors for that family or other databases.	1
	geneName		Approved name for the gene according to HGNC.	1
	geneSymbol		Approved HUGO symbol for the gene according to HGNC.	1
	hgncId		A unique ID provided by the HGNC.	1
	interactionsRef		Reference to related interactions.	1
		uri	URI that references the interactions resource for the gene.	1
	locusGroup		Locus group described by gene.	1
	locusType		Specifies the type of locus described by the gene.	1
	nameSynonymsRef		Reference to related gene name synonyms.	1
		uri	URI that references the geneNameSynonyms resource for the gene.	1
	omimId		Identifier provided by Online Mendelian Inheritance in Man (OMIM) at the NCBI.	1
	pathwaysRef		Reference to pathways containing gene.	1
		uri	URI that references the pathways resource for the gene.	1
	pubmedIdsRef		Reference to related PubMed articles.	1
		uri	URI that references the pubmedList resource for the gene.	1
	refseq		The Reference Sequence (RefSeq) identifier for that entry, provided by the NCBI.	1
	symbolSynonymsRef		Reference to related gene symbol synonyms.	1
		uri	URI that references the geneSymbolsSynonyms resource for the gene. Only one mapped RefSeq is displayed per gene.	1
	ucscId		UCSC ID (mapped data supplied by UCSC)	1
	uniprotId		The UniProt identifier, provided by the EBI.	1
	vegaId		VEGA gene Id	1
	versionId		Version id of data (corresponds to versionId of	1

		version resource).	

Resource URI Formats:
Return gene information for specified HUGO gene Id in latest database version
PathwaysWeb/gene/latest/approvedHugoId/{hugo_gene_id}

Return gene information for specified HUGO gene Id in specified database version
PathwaysWeb/gene/version/{version_id}/approvedHugoId/{hugo_gene_id}

Gene Name Synonyms Collection Resource

Retrieves alternate names for a particular gene.

Data Element			Description	Cardinality
geneNameSynonyms				1
	uri		URI representing the data that follows.	1
	geneRef		Gene symbol approved by HGNC.	1
		uri	URI representing genes resource for version.	1
	names		List of name synonyms. Includes name approved by HGNC	1
		name	Alternate name of gene.	1-n
	versionId		Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Returns all various gene names for designated HUGO gene Id in latest database version
PathwaysWeb/geneNameSynonyms/latest/approvedHugoId/{hugo_gene_id}

Returns all various gene names for designated HUGO gene Id in latest database version
PathwaysWeb/geneNameSynonyms/version/{version_id}/approvedHugoId/{hugo_gene_id}

Gene Symbol Synonyms Collection Resource

Retrieves a list of alternate gene symbols for a particular gene.

Data Element				Description	Cardinality
geneSymbols Synonyms					1
	uri			URI representing the data that follows.	1
	geneSymbol Synonyms			URI representing the data that follows for a single gene	1-n
		uri		URI representing the data that follows. (if request uses the approvedHugoId form, then this URI will be the same as the URI for the level above.)	1

		hugoGeneS ymbolRef		Gene symbol approved by HGNC.	1
			uri	URI representing gene	1
		synonyms		List of symbol synonyms. Includes symbol approved by HGNC.	1
			synonym	Alternate symbol for gene.	1-n
		versionId		Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Returns all various gene symbols for specified HUGO gene Id in latest database version
PathwaysWeb/geneSymbolsSynonyms/latest/approvedHugoId/{hugo_gene_id}

Returns all various gene symbols for specified HUGO gene Id in specified database version
PathwaysWeb/geneSymbolsSynonyms/version/{version_id}/approvedHugoId/{hugo_gene_id}

Returns all various gene symbols for specified gene symbol synonym in latest database version
PathwaysWeb/geneSymbolsSynonyms/latest/synonym/{synonym}

Returns all various gene symbols for specified gene symbol synonym in specified database version
PathwaysWeb/geneSymbolsSynonyms/version/{version_id}/synonym/{synonym}

Returns all various gene symbols for list of gene synonyms in latest database version
PathwaysWeb/geneSymbolsSynonyms/latest/geneIds/{csv_list_of_gene_synonyms }

Returns all various gene symbols for list of gene synonyms in specified database version
PathwaysWeb/geneSymbolsSynonyms/version/{version_id}/geneIds/{csv_list_of_gene_synonyms}

Gene Ontology (GO) Related:

Gene Ontology related resources including Taxa, Genes, Terms, GO Relationship Types, and GO Gene to Term mappings and related counts of such mappings.

Gene Ontology Gene Information

Retrieves information on a single gene imported from The Gene Ontology.   The gene symbol may not one found in the data imported from HGNC. Currently genes for humans (taxon id 9606) and house mouse (taxon id 10090) have been imported into the system. PathwaysWeb only contains pathways and genes from HGNC for humans in the current version.

Data Element			Description	Cardinality
goGene				1
	uri		URI representing data that follows.	1
	geneName		Name of GO Gene. Note: May not match HGNC name.	1
	geneRef		HGNC gene reference if PathwaysWeb contains HGNC gene with the same symbol. Not present if no corresponding symbol found.	0-1
		uri	URI representing corresponding HGNC gene.	0-1
	geneSymbol		Symbol for GO Gene. Note: May not match HGNC Symbol.	1
	taxonRef		NCBI Taxon (species) Id - (9606 or 10090)	1
		uri	URI representing Taxon resource.	1
	versionId		Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Return list of genes (according to GO) in the latest database version for the specified taxon (species).
/PathwaysWeb/goGene/version/{versionId}/geneSymbol/{geneSymbol}/taxonId/{taxonId}

Return list of genes (according to GO) in specified database version for the specified taxon (species).
/PathwaysWeb/goGene/latest/geneSymbol/{geneSymbol}/taxonId/{taxonId}

Gene Ontology Genes

Retrieves list of genes imported from The Gene Ontology.   The list may contain gene symbols that do not match those found in the data imported from HGNC. Currently genes for humans (taxon id 9606) and house mouse (taxon id 10090) have been imported into the system. PathwaysWeb only contains pathways and genes from HGNC for humans in the current version.

Data Element				Description	Cardinality
goGenes					1
	uri			URI representing the data that follows.	1
	goGene			List of single goGene resources	1-n
	next			Points to additional data after current data subset if some exists. Missing if no additional data.	0-1
		uri		URI represents next subset of data for request.	1
	previous			Points to additional data prior to current data subset if some exists. Missing if at start of list.	0-1
		uri		URI represents previous subset of data for request.	1

Resource URI Formats:
Retrieve information on genes as defined in the Gene Ontology in a specified database version.
/PathwaysWeb/goGenes/version/{versionId}/
Optional query/form parameters: start, count, taxonId

Retrieve information on genes as defined in the Gene Ontology in latest database version.
/PathwaysWeb/goGenes/latest/
Optional query/form parameters: start, count, taxonId

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	1000
taxonId	NCBI Taxon (species) id of gene (see taxonId in goTaxa resource for acceptable values).	9606

Gene To GO Term Associations

Retrieves list of genes imported from The Gene Ontology that are associated with Terms in the Gene Ontology.   The list may contain gene symbols that do not match those imported from HGNC. (See goGenes resource for more information). The Gene Ontology associates genes and terms, but this list of GO Ids is not limited to those specific associations made by GO. All paths from a given term back to the root term of the three GO ontologies are determined. This resource returns all unique GO Ids for each gene associated by GO and all terms along the paths back to the root terms.

Data Element				Description	Cardinality
goGenes					1
	uri			URI representing the data that follows.	1
	goGene			List	1-n
		uri		URI representing one GO gene entry.	1
		geneName		Name of GO Gene. Note: May not match HGNC name.	1
		geneRef		HGNC gene reference if PathwaysWeb contains HGNC gene with the same symbol. Not present if no corresponding symbol found.	0-1
			uri	URI representing corresponding HGNC gene.	1
		geneSymbol		Symbol for GO Gene. Note: May not match HGNC Symbol.	1
		goTermIds		List of Gene Ontology Term Ids	1
			goId	GO Term Id in format "GO:#######"	1-n
		taxonRef		NCBI Taxon (species) Id - (9606 or 10090)	1
			uri	URI representing Taxon resource.	1
		versionId		Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on related GO Terms for a specified list of genes in specified database version.
(HTTP GET and POST)
/PathwaysWeb/goGenesToTerms/version/{versionId}/
Optional query/form parameters: start, count, taxonId, genes.

Retrieve information on related GO Terms for a specified list of genes in latest database version.
(HTTP GET and POST)
/PathwaysWeb/goGenesToTerms/latest/
Optional query/form parameters: start, count, taxonId, genes.

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	1000
taxonId	NCBI Taxon id of gene (see taxonId in goTaxa resource for values).	9606
genes	Comma separated list of gene symbols	

Gene Ontology Term to Term Relationship Type

Retrieves a single GO term from The Gene Ontology that is used to describe a relationship between other terms.   This term would not be associated with a gene, only between GO Terms.

Data Element		Description	Cardinality
relationship			1
	uri	URI representing the data that follows.	1
	relationship	The term that describes a type of term-to-term relationship.	1
	relationshipId	Unique relationship Id - originally defined by GO and not guaranteed to remain consistent between different versions of PathwaysWeb database.	1
	versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on a single GO Term used to associate other GO Terms to one another in specified database version.
/PathwaysWeb/goRelationship/version/{versionId}/relationshipId/{relationshipId}

Retrieve information on a single GO Term used to associate other GO Terms to one another in latest database version.
/PathwaysWeb/goRelationship/latest/relationshipId/{relationshipId}

Gene Ontology Term to Term Relationship Types

Retrieves list of genes imported from The Gene Ontology.

Data Element			Description	Cardinality
relationships				1
	uri		URI representing the data that follows.	1
	relationship			1-n
		uri	URI representing one relationship term.	1
		relationship	The term that describes a type of term-to-term relationship.	1
		relationshipId	Unique relationship Id - originally defined by GO and not guaranteed to remain consistent between different versions of PathwaysWeb database.	1
		versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on GO Terms used to associate other GO Terms to one another in specified database version.
/PathwaysWeb/goRelationships/versionId/{versionId}

Retrieve information on GO Terms used to associate other GO Terms to one another in latest database version.
/PathwaysWeb/goRelationships/latest/

Gene Ontology Taxa (Species) Information

Retrieves information about a single taxon (species) imported from The Gene Ontology.

Data Element		Description	Cardinality
taxon			1
	uri	URI representing the data that follows.	1
	commonName	Common name of taxon.	1
	genus	Name of genus	1
	species	Name of species	1
	taxonId	Taxon Id as defined by NCBI	1
	versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on a single Taxon Species imported from the Gene Ontology in specified database version.

/PathwaysWeb/goTaxon/version/{versionId}/taxonId/{taxonId}

Retrieve information on a single Taxon Species imported from the Gene Ontology in latest database version.

/PathwaysWeb/goTaxon/latest/taxonId/{taxonId}

Gene Ontology Individual Taxon (Species) Information

Retrieves information about all taxa (species) imported from The Gene Ontology.

Data Element			Description	Cardinality
taxa			List of taxon resources defined in PathwaysWeb that were imported from The Gene Ontology.	1
	uri		URI representing the data that follows.	1
	taxon		An individual taxon reference.	1-n
		uri	URI reference to a single Taxon resource.	1
		commonName	Common name of taxon.	1
		genus	Name of genus	1
		species	Name of species	1
		taxonId	Taxon Id as defined by NCBI	1
		versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on the Taxons (species identifiers) imported from the Gene Ontology in specified database version.

/PathwaysWeb/goTaxa/version/{versionId}/

Retrieve information on the Taxons (species identifiers) imported from the Gene Ontology in latest database version.

/PathwaysWeb/goTaxa/latest/

Gene Ontology Term

Retrieves information about a specific Gene Ontology Term.

Data Element		Description	Cardinality
goTerm			1
	goTermAndGenes	URI to corresponding goTermAndGenes resource	1
	uri	URI representing the data that follows.	1
	definition	Definition of the term.	1
	goId	The Gene Ontology Id for the term. (Unique Id for term)	1
	term	The short text description of the term.	1
	termType	Specific Ontology within The Gene Ontology to which this term belongs. One of the following three values: biological_process, cellular_component, molecular_function	1
	termTypeId	Capitalized first letter of the text description of the particular Ontology within The Gene Ontology this term belongs. B = Biological Process, C = Cellular Component, M = Molecular Function	1
	versionId	Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:
Retrieve information on a single Gene Ontology term in specified database version.
/PathwaysWeb/goTerm/version/{versionId}/goId/{goId}

Retrieve information on a single Gene Ontology term in latest database version.
/PathwaysWeb/goTerm/latest/goId/{goId}

Gene Ontology Terms

Retrieves a list of information about multiple Gene Ontology Terms.

Data Element			Description	Cardinality
goTerms				1
	uri		URI representing the data that follows.	1
	goTerm		Information regarding a single goTerm resource.	1-n
	next		URI pointing to additional data after current data subset if some exists. Missing if no additional data.	0-1
	previous		URI pointing to additional data prior to current data subset if some exists. Missing if at start of list.	0-1

Resource URI Formats:
Retrieve information on multiple Gene Ontology terms in specified database version.
/PathwaysWeb/goTerms/version/{versionId}/

Retrieve information on multiple Gene Ontology terms in latest database version.
/PathwaysWeb/goTerms/latest/

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	20
termTypeId	Id of Term Type. Capitalized first letter of the text description of the particular Ontology within The Gene Ontology this term belongs. Choices are B,C, or M where B = Biological Process, C = Cellular Component, M = Molecular Function	

Gene Ontology Term and Related Genes

Retrieves a GO Term and the list of genes associated with that term.

	Data Element			Description	Cardinality
goTermAndGenes					
	uri			URI representing the data that follows.	1
	definition			Definition of GO term.	1
		genes		List of associated genes.	1
			gene	Single gene associated with GO term.	0-n
	goId			Id of GO term.	1
	term			Go term.	1
	termType			Type of GO term (which Ontology).	1
	termTypeId			Id assigned to Type of Go term (1 char).	1
	versionId			Version id of data (corresponds to versionId of version resource).	1

Resource URI Formats:

Retrieve information on Term imported from The Gene Ontology and the genes associated with that term and the genes associated with that term in specified database version. (HTTP GET and POST)
/PathwaysWeb/goTermAndGenes/version/{versionId}/goId/{goId}

Retrieve information on Term imported from The Gene Ontology and the genes associated with that term and the genes associated with that term in specified latest version. (HTTP GET and POST)
/PathwaysWeb/goTermAndGenes/latest /goId/{goId}

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
taxonId	NCBI Taxon Id as imported from The Gene Ontology.	9606

Gene Ontology Terms and Related Gene Counts

Retrieves list of GO terms and counts of the number of associated genes.

Data Element					Description	Cardinality
goTerms AndGen eCounts or goTerms AndAsso ciatedG eneCou nts						1
	uri				URI representing the data that follows.	1
	goTerm					1-n
		uri			URI representing the data that follows.	1
		definition			Definition of the term.	1
		geneCounts			List of gene Counts	1
			geneC ount			1-2
				count	Number of genes matching the countType below.	1
				count Type	Currently the countType will be one of two different values, SELECTED_GENES or ASSOCIATED_GENES. ASSOCIATED_GENES refers to the total number of genes associated with that term in GO. SELECTED_GENES refers to the number of genes specified in the web service request parameter genes. If no specific genes were requested, then no geneCount entry for SELECTED_GENES will be present in the output.	1
		goId			The Gene Ontology Id for the term. (Unique Id for term)	1
		termType			Specific Ontology within The Gene Ontology to which this term belongs. One of the following three values: biological_process, cellular_component, molecular_function	1
		termTypeId			Capitalized first letter of the description of the particular Ontology within GO this term belongs. B = Biological Process, C = Cellular Component, M = Molecular Function	1
		versionId			Version id of data (corresponds to versionId of version resource).	1

	next				URI pointing to additional data after current data subset if some exists. Missing if no additional data.	0-1
	previous				URI pointing to additional data prior to current data subset if some exists. Missing if at start of list.	0-1

Resource URI Formats:

Retrieve information on Terms imported from The Gene Ontology and the number of genes associated with those terms and the count of specified genes associated with that term in specified database version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndGeneCounts/version/{versionId}/

Retrieve information on Terms imported from The Gene Ontology and the number of genes associated with those terms and the count of specified genes associated with that term in specified latest version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndGeneCounts/latest/

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	20
taxonId	NCBI Taxon Id as imported from The Gene Ontology.	9606
genes	Comma separated list of Gene Ontology gene symbols. Counts of the specified genes for each GO Term will be returned.	
goIds	Comma separated list of Gene Ontology Ids for desired terms. Format: GO:1234567,GO:1234568	

Retrieve information on Terms imported from The Gene Ontology and the total number of genes associated with those terms in specified database version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndAssociatedGeneCounts/version/{versionId}/

Retrieve information on Terms imported from The Gene Ontology and the total number of genes associated with those terms in specified latest version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndAssociatedGeneCounts/latest/

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	20
taxonId	NCBI Taxon Id as imported from The Gene Ontology.	9606
goIds	Comma separated list of Gene Ontology Ids for desired terms. Format: GO:1234567,GO:1234568	

Gene Ontology Terms and Parent Terms

Retrieves list of terms and their parent terms imported from The Gene Ontology.

Data Element					Description	Cardinality
goTermsAndParents					List of GO Terms and Parent Terms.	1
	uri				URI to information that follows.	1
	goTermAndParents				Wrapper for single term and its parent terms.	1-n
		goId				1
		parentRelationships				1
			parentRelationship			1
				parentGoId	Parent Go Id of goId	1
				relationshipId	Id of goRelationship term. Typically 1 which equates to "IS A".	1
		versionId			Version id of data (corresponds to versionId of version resource).	1
	next				URI pointing to additional data after current data subset if some exists. Missing if no additional data.	0-1
	previous				URI pointing to additional data prior to current data subset if some exists. Missing if at start of list.	0-1

Resource URI Formats:

Retrieve information on Terms imported from The Gene Ontology and it parent terms. (HTTP GET and POST)
/PathwaysWeb/goTermsAndParents/version/{versionId}/

Retrieve information on Terms imported from The Gene Ontology and its parent terms. (HTTP GET and POST)
/PathwaysWeb/goTermsAndParents/latest/

Optional query parameters:

Query / Form parameter	Description of parameter	Default value
start	Starting record number (first record is 0)	0
count	Max number of records to return with each call.	40000
goIds	Comma separated list of Gene Ontology Ids for desired terms. Format: GO:1234567,GO:1234568	

Appendix: Sources of Data for API and Use of Data Sources:

HGNC Dataset
> **Use**: Used in genes and gene resources and in providing correct HUGO gene names in pathways, pathway, interactions, and interaction resources.
> **Description**: http://www.genenames.org/cgi-bin/hgnc_stats.pl
> **Data**: http://www.genenames.org/cgi-bin/hgnc_downloads.cgi?title=HGNC+output+data&hgnc_dbtag=on&preset=all&status=Approved&status=Entry+Withdrawn&status_opt=2&level=pri&=on&where=&order_by=gd_app_sym_sort&limit=&format=text&submit=submit&.cgifields=&.cgifields=level&.cgifields=chr&.cgifields=status&.cgifields=hgnc_dbtag

NCBI GeneRIFS (Gene Reference Into Function)
> **Use**: Used in interactions and interaction resources.
> **Description**: http://www.ncbi.nlm.nih.gov/projects/GeneRIF/GeneRIFhelp.html
> **Data**: ftp://ftp.ncbi.nlm.nih.gov/gene/GeneRIF/interactions.gz

Pathway Commons: NCI Nature SIF (Simple Interaction Format)
> **Use**: Used in interactions and interaction resources.
> **Description**: http://www.pathwaycommons.org/pc/sif_interaction_rules.do
> **Data**: http://www.pathwaycommons.org/pc-snapshot/current-release/sif/by_species/homo-sapiens-9606.sif.zip

Predictive Networks: CSV
> **Use**: Used in interactions and interaction resources. Only data sources for functional interactions (2010) and pathways commons extractions (2010) were used. Interactions mined from Pubmed and Medline were determined to contain too much bad data to use.
> **Description**: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3245161/ and https://compbio.dfci.harvard.edu/predictivenetworks/
> **Data**:
> https://compbio.dfci.harvard.edu/predictivenetworks/network/download/3?format=csv&extension=csv
> https://compbio.dfci.harvard.edu/predictivenetworks/network/download/4?format=csv&extension=csv

NCBI Gene To PubMed
> **Use**: Used in genes and gene resources.
> **Description**: http://www.ncbi.nlm.nih.gov/entrez/query/static/entrezlinks.html#gene
> **Data**: ftp://ftp.ncbi.nlm.nih.gov/gene/DATA/gene2pubmed.gz

Pathways and Genes
> **Use**: Used in pathways, pathway, and interactions resources.
> **Description**: List of NCI-Nature Curated and Reactome pathways and genes in those pathways imported from caBio Web service.
> https://wiki.nci.nih.gov/display/caBIO/caBIO+Wiki+Home+Page
> **Data**: Read via client software from caBio web service using caBio Java API.

NCI pathways and sub pathways (Scraped from web page)
   Use: Used in pathway resources.
   Description: Used to determine if pathway from caBio API is a sub pathway and parent if it is.
   Data: http://pid.nci.nih.gov/browse_pathways.shtml

Reactome
   Use: Used in pathway resources.
   Description: Used to determine if pathway from caBio API is a sub pathway and parent if it is.
   Data: http://pid.nci.nih.gov/browse_pathways.shtml

The Gene Ontology
   Use: Used in gene ontology related goGenes, goGene, goTaxa, goTaxon, goTerms, goTerm, goRelationships, goRelationship, goGenesToTerms, and goTermsAndGeneCounts resources.
   Description: Latest SQL dump of assocdb-data form of data is downloaded from archive.geneontology.org/latest-lite. SQL is filtered to retrieve only the tables we want and the SQL is parsed, filtered, and reformatted.

Interaction Search Terms
   Use: Used in interactions and interaction resources to create translate interaction descriptions to interaction types.
   Description: Manually created list from review of interactions descriptions from multiple sources used to search interaction details and determine type of interaction.

Interaction Types
   Use: Used in interactions, interaction, interactionTypes, and interactionType resources.
   Description: Manually created list used to categorize types of interactions (somewhat detailed types and generic types). Created from review of descriptions of interactions in interaction source files and online documentation.

Appendix: Interaction Types

Interaction Types were constructed to group the various descriptions provided by different sources of interaction information into a smaller subset of different interaction types. Some of the interaction descriptions provided by different sources were very descriptive whereas others were not. There was no standard. The descriptions given by the various sources were searched for certain key terms that were then used to compile a list of fairly specific interaction types and more generic interaction types to group those. Some descriptions provided by the sources hinted how the interaction was discovered and not what type of interaction it was. Those that actually described the interaction in such a manner that the true type of interaction could be identified were assigned a Y value in the IS_DESCRIPTIVE field where as others were assigned a value of N. The interaction ids are assigned and an attempt is made to keep them consistent between data versions.

INTERACTION_TYPE_ID	INTERACTION_TYPE	INTERACTION_GENERIC_TYPE	IS_DESCRIPTIVE
1	BINDS	BIND	Y
2	BINDS_TO	BIND	Y
3	FORM_BOND	BIND	Y
4	CATALYZES_PALMITOYLATION	CATALYSIS	Y
5	METABOLIC_CATALYSIS	CATALYSIS	Y
6	CLEAVES	CLEAVAGE_OF_BOND	Y
7	DEMETHYLIMINATES	CLEAVAGE_OF_BOND	Y
8	DEPHOSPHORYLATES	CLEAVAGE_OF_BOND	Y
9	DESUMOYLATES	CLEAVAGE_OF_BOND	Y
10	DEUBIQUITINATION	CLEAVAGE_OF_BOND	Y
11	STATE_CHANGE	CONVERSION	Y
12	ACETYLATION	COVALENT_MODIFICATION	Y
13	MYRISTOYLATION	COVALENT_MODIFICATION	Y
14	PHOSPHORYLATION	COVALENT_MODIFICATION	Y
15	POLY(ADP_RIBOSYL)ATES	COVALENT_MODIFICATION	Y
16	S_NITROSYLATED	COVALENT_MODIFICATION	Y
17	SUMOYLATION	COVALENT_MODIFICATION	Y
18	UBIQUITINATION	COVALENT_MODIFICATION	Y
19	DIMERIZES	DIMERIZATION	Y
20	FORM_DIAMER	DIMERIZATION	Y
21	FORM_HOMOMERIC_COMPLEX	DIMERIZATION	Y
22	FORM_HOMOOLIGOMER	DIMERIZATION	Y
23	HETERODIMERIZATION	DIMERIZATION	Y
24	HOMODIMERIZATION	DIMERIZATION	Y
25	OLIGOMERIZATION	DIMERIZATION	Y
26	ACTIVATES	ENHANCES	Y
27	ENHANCES	ENHANCES	Y
28	PHENOTYPIC_ENHANCEMENT	ENHANCES	Y
29	PROMOTES_UBIQUITINATION	ENHANCES	Y
30	FORM_COMPLEX	FORM_COMPLEX	Y
31	INHIBITS	INHIBITS	Y
32	PHENOTYPIC_SUPPRESSION	INHIBITS	Y
33	PREVENTS_ACTIVATION	INHIBITS	Y
34	REPRESSES	INHIBITS	Y
35	ACTS_ON	REACTION_TYPE_UNKNOWN	Y

36	ASSOCIATES_WITH	REACTION_TYPE_UNKNOWN	Y
37	INTERACTION	REACTION_TYPE_UNKNOWN	Y
38	INTERACTS_WITH	REACTION_TYPE_UNKNOWN	Y
39	IS_A	REACTION_TYPE_UNKNOWN	Y
40	IS_COVALENTLY_ATTACHED	REACTION_TYPE_UNKNOWN	Y
41	NEIGHBOURING_REACTION	REACTION_TYPE_UNKNOWN	Y
42	UBIQUITIN_LIGASE_ACTIVITY	COVALENT_MODIFICATION	Y
43	REACTION	REACTION_TYPE_UNKNOWN	Y
44	REACTS_WITH	REACTION_TYPE_UNKNOWN	Y
45	NON_INTERACTION	OTHER	N
46	AFFINITY_CAPTURE	OTHER	N
47	BIDIRECTIONAL	OTHER	N
48	BIOCHEMICAL_ACTIVITY	OTHER	N
49	CO_CONTROL	OTHER	N
50	CO_CRYSTAL_STRUCTURE	OTHER	N
51	CO_FRACTIONATION	OTHER	N
52	CO_LOCALIZATION	OTHER	N
53	CO_PURIFICATION	OTHER	N
54	ECREL	OTHER	N
55	FAR_WESTERN	OTHER	N
56	FRET	OTHER	N
57	G_EREL	OTHER	N
58	IN_SAME_COMPONENT	OTHER	N
59	IN_VITRO	OTHER	N
60	IN_VIVO	OTHER	N
61	INDIRECT_COMPLEX	OTHER	N
62	PCA	OTHER	N
63	PROTEIN_PEPTIDE	OTHER	N
64	PROTEIN_RNA	OTHER	N
65	RECONSTITUTED_COMPLEX	OTHER	N
66	SYNTHETIC_RESCUE	OTHER	N
67	TARGETS_CHIP	OTHER	N
68	TARGETS_CORE	OTHER	N
69	TWO_HYBRID	OTHER	N
70	SEQUENTIAL_CATALYSIS	OTHER	N
71	IS_CLEAVED	CLEAVAGE_OF_BOND	Y
72	UBC9 WITH	OTHER	N
73	NO_DECRIPTION_PROVIDED	OTHER	N
74	HOMOMULTIMERIZES	BIND	Y
75	FUNCTIONAL_INTERACTION	OTHER	N
76	DOSAGE_RESCUE	OTHER	N
77	DOSAGE_LETHALITY	OTHER	N
78	PROXIMITY_LABEL_MS	OTHER	N
79	SYNTHETIC_GROWTH_DEFECT	OTHER	N

Appendix: API Quick Reference

(All support only HTTP GET unless specified otherwise)

Primary API

Pathways

Returns all pathway names and ids and link in latest database version (HTTP GET and POST)
PathwaysWeb/pathways/latest
Optional query/form parameters: start, count, sourceId, allGenes, anyGenes

Returns all pathway names and ids and links in specified database version (HTTP GET and POST)
PathwaysWeb/pathways/version/{version_id}
Optional query/form parameters: start, count, sourceId, allGenes, anyGenes

Pathway

Returns all information for pathway of specified id in latest database version
PathwaysWeb/pathway/latest/mdaPathwayId/{mdaPathwayId}

Returns all information for pathway of specified id in specified database version
PathwaysWeb/pathway/version/{versionId}/mdaPathwayId/{mdaPathwayId}

First Order Interactions

Returns first order interaction information in specified database version (HTTP GET and POST)
PathwaysWeb/interactions/latest
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns first order interaction information in specified database (HTTP GET and POST)
PathwaysWeb/interactions/version/{version_id}
Optional query/form parameters: start, count, genes, limitGenes, interactionTypes

Returns first order interaction information for specified pathway ids in latest database version
PathwaysWeb/interactions/latest/pathway/pathwayIds/{csv list of pathway Ids}
Optional query parameters: start, count

Returns first order interaction information for specified pathway ids in specified database version (HTTP GET and POST)
PathwaysWeb/interactions/version/{version_id}/pathwayIds/{csv list of pathway Ids}
Optional query parameters: start, count

First Order Interaction

Returns first order interaction information for specified interaction id in latest database version
PathwaysWeb/interaction/latest/interactionId/{interaction_id}

Returns first order interaction information for specified interaction id in specified database version
PathwaysWeb/interaction/version/{version_id}/interactionId/{interaction_id}

First Order Interaction Gene Sets

Returns all first order interaction gene sets in specified database version filtered by optional parameters (HTTP GET and POST)
PathwaysWeb/interactionGeneSets/latest
Optional query parameters: genes, limitGenes, interactionTypes

Returns all first order interaction gene sets in specified database version filtered by optional parameters (HTTP GET and POST)
PathwaysWeb/interactionGeneSets/version/{version_id}
Optional query parameters: genes, limitGenes, interactionTypes

Returns first order interaction gene sets for specified pathway ids in latest database version
PathwaysWeb/interactionGeneSets/latest/pathway/pathwayIds/{csv list of pathway Ids}

Returns first order interaction gene sets for specified pathway ids in specified database version
PathwaysWeb/interactionGeneSets/version/{version_id}/pathwayIds/{csv list of pathway Ids}

Metadata

Pathway Sources
Returns all information for pathway sources in latest database version
PathwaysWeb/pathwaySources/latest

Returns all information for pathway sources in specified database version
PathwaysWeb/pathwaySources/version/{versionId}

Pathway Source
Returns all information for pathway source with specified source id in latest database version
PathwaysWeb/pathwaySource/latest/sourceId/{sourceId}

Returns all information for pathway source with specified source id in specified database version
PathwaysWeb/pathwaySource/version/{versionId}/sourceId/{sourceId}

Data Versions
Returns list of all pathway database versions
PathwaysWeb/versions

Data Version
Returns latest pathway database version
PathwaysWeb/version/latest

Returns specified pathway database version
PathwaysWeb/version/{version_id}

Returns active pathway database version at a specified date
PathwaysWeb/version/date/{dateString}
(Date in format yyyy-MM-dd)

Interaction Types

Returns all interaction types in latest database version
PathwaysWeb/interactionTypes/latest
Optional query parameters: start, count

Returns all interaction types in specified database version
PathwaysWeb/interactionTypes/version/{version_id}
Optional query parameters: start, count

Interaction Type

Returns information for specified interaction type in latest database version
PathwaysWeb/interactionType/latest/typeId/{interaction_type_id}

Returns information for specified interaction type in specified database version
PathwaysWeb/interactionType/version/{version_id}/typeId/{interaction_type_id}

Supporting Data

Gene-related PubMed Documents

Return list of PubMed ids for specified Hugo gene id in latest database version
PathwaysWeb/pubmedList/latest/approvedHugoId/{hugo_gene_id}

Return list of PubMed ids for specified Hugo gene id in specified database version
PathwaysWeb/pubmedList/version/{version_id}/approvedHugoId/{hugo_gene_id}

Interaction-related PubMed Documents

Return list of PubMed ids for specified interaction in latest database version
PathwaysWeb/pubmedList/latest/interactionId/{interaction_id}

Return list of PubMed ids for specified interaction in specified database version
PathwaysWeb/pubmedList/version/{version_id}/interactionId/{interaction_id}
Optional query parameters: start, count

HGNC Genes

Returns list of HUGO gene symbols for all genes in latest database version
PathwaysWeb/genes/latest
Optional query parameters: start, count

Returns list of HUGO gene symbols for all genes in specified database version
PathwaysWeb/genes/version/{version_id}
Optional query parameters: start, count

HGNC Gene

Return gene information for specified HUGO gene Id in latest database version
PathwaysWeb/gene/latest/approvedHugoId/{hugo_gene_id}

Return gene information for specified HUGO gene Id in specified database version
PathwaysWeb/gene/version/{version_id}/approvedHugoId/{hugo_gene_id}

HGNC Gene Name Synonyms

Returns all various gene names for designated HUGO gene Id in latest database version
PathwaysWeb/geneNameSynonyms/latest/approvedHugoId/{hugo_gene_id}

Returns all various gene names for designated HUGO gene Id in latest database version
PathwaysWeb/geneNameSynonyms/version/{version_id}/approvedHugoId/{hugo_gene_id}

HGNC Gene Symbol Synonyms

Returns all various gene symbols for specified HUGO gene Id in latest database version
PathwaysWeb/geneSymbolSynonyms/latest/approvedHugoId/{hugo_gene_id}

Returns all various gene symbols for specified HUGO gene Id in specified database version
PathwaysWeb/geneSymbolSynonyms/version/{version_id}/approvedHugoId/{hugo_gene_id}

Returns all various gene symbols for specified gene symbol synonym in latest database version
PathwaysWeb/geneSymbolSynonyms/latest/synonym/{synonym}

Returns all various gene symbols for specified gene symbol synonym in specified database version
PathwaysWeb/geneSymbolSynonyms/version/{version_id}/synonym/{synonym}

Gene Ontology (GO) Related

Gene Ontology Gene Information

Return list of genes (according to GO) in the latest database version for the specified taxon (species) in specified database version.
/PathwaysWeb/goGene/version/{versionId}/geneSymbol/{geneSymbol}/taxonId/{taxonId}

Return list of genes (according to GO) in specified database version for the specified taxon (species) in latest database version. /PathwaysWeb/goGene/latest/geneSymbol/{geneSymbol}/taxonId/{taxonId}

Gene Ontology Genes

Retrieve information on genes as defined in the Gene Ontology in specified database version.
/PathwaysWeb/goGenes/version/{versionId}/
Optional query/form parameters: start, count, taxonId

Retrieve information on genes as defined in the Gene Ontology in latest database version.
/PathwaysWeb/goGenes/latest/
Optional query/form parameters: start, count, taxonId

GO Gene To GO Term Associations

Retrieve information on a related Gene Ontology Terms for a specified list of genes in specified database version. (HTTP GET and POST)
/PathwaysWeb/goGenesToTerms/version/{versionId}/
Optional query/form parameters: start, count, taxonId, genes.

Retrieve information on a related Gene Ontology Terms for a specified list of genes in latest database version. (HTTP GET and POST)
/PathwaysWeb/goGenesToTerms/latest/
Optional query/form parameters: start, count, taxonId, genes.

Gene Ontology Term to Term Relationship Type

Retrieve information on a single GO Term used to associate other GO Terms to one another in specified database version.
/PathwaysWeb/goRelationship/version/{versionId}/relationshipId/{relationshipId}

Retrieve information on a single GO Term used to associate other GO Terms to one another in latest database version.
/PathwaysWeb/goRelationship/latest/relationshipId/{relationshipId}

Gene Ontology Term to Term Relationship Types

Retrieve information on GO Terms used to associate other GO Terms to one another in specified database version.
/PathwaysWeb/goRelationships/latest/relationshipId/{relationshipId}

Retrieve information on GO Terms used to associate other GO Terms to one another in latest database version.
/PathwaysWeb/goRelationships/latest/

Gene Ontology Taxa (Species) Information

Retrieve information on the Taxons (species identifiers) imported from the Gene Ontology in specified database version.

/PathwaysWeb/goTaxa/version/{versionId}/

Retrieve information on the Taxons (species identifiers) imported from the Gene Ontology in latest database version.

/PathwaysWeb/goTaxa/latest/

Gene Ontology Individual Taxon (Species) Information

Retrieve information on a single Taxon Species imported from the Gene Ontology in specified database version.

/PathwaysWeb/goTaxon/version/{versionId}/taxonId/{taxonId}

Retrieve information on a single Taxon Species imported from the Gene Ontology in latest database version.

/PathwaysWeb/goTaxon/latest/taxonId/{taxonId}

Gene Ontology Term

Retrieve information on a single Gene Ontology term in specified database version.

/PathwaysWeb/goTerm/version/{versionId}/goId/{goId}

Retrieve information on a single Gene Ontology term in latest database version in specified database version.

/PathwaysWeb/goTerm/latest/goId/{goId}

Gene Ontology Terms

Retrieve information on multiple Gene Ontology terms in specified database version.

/PathwaysWeb/goTerms/version/{versionId}/
Optional query/form parameters: start, count, termTypeId

Retrieve information on multiple Gene Ontology terms in latest database version.

/PathwaysWeb/goTerms/latest/
Optional query/form parameters: start, count, termTypeId

Gene Ontology Terms and Related Gene Counts

Retrieve information on Terms imported from The Gene Ontology and the number of genes associated with those terms and the count of specified genes associated with that term in specified database version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndGeneCounts/version/{versionId}/
Optional query/form parameters: start, count, taxonId, genes, goIds

Retrieve information on Terms imported from The Gene Ontology and the number of genes associated with those terms and the count of specified genes associated with that term in latest database version. (HTTP GET and POST)

/PathwaysWeb/goTermsAndGeneCounts/latest/
Optional query/form parameters: start, count, taxonId, goIds

Retrieve information on Terms imported from The Gene Ontology and the total number of genes associated with those terms in specified database version. (HTTP GET and POST)
/PathwaysWeb/goTermsAndAssociatedGeneCounts/version/{versionId}/
Optional query/form parameters: start, count, taxonId, genes, goIds

Retrieve information on Terms imported from The Gene Ontology and the total number of genes associated with those terms in latest database version. (HTTP GET and POST)
/PathwaysWeb/goTermsAndAssociatedGeneCounts/latest/
Optional query/form parameters: start, count, taxonId, goIds