

# BRENDA Exercises

## Quick Search

## Exercise 1

- How often can you find the term „glucosidase“ in enzyme names?
- How many EC classes are connected with this term?

## Exercise 2

- How many enzymes accept molybdopterin as a cofactor?
- Display the results for exact matches for molybdopterin
- To which **main EC class** do the enzymes belong?


## Exercise 3


- What is the EC number and the recommended name for the enzyme commonly termed RUBISCO?
- Display the wordmap
- RUBISCO is involved in a biological process. What is its name and what are the major metabolites of this process?
- Display the reaction diagram for RUBISCO
- How many protein sequences for RUBISCO are stored in BRENDA?

Advanced Search











Search term: glucosidase

«« Results 1 - 10 of 53 »»


 download as CSV

 download all results as CSV

Field	Hits found
Enzyme Names (Synonyms)	232
Ligands	2

EC Number ▼▲	Recommended Name ▼▲	Synonyms ▼▲
 2.4.1.219	vomilene glucosyltransferase	raucaffrine beta-D-glucosidase; raucaffrine beta-glucosidase; raucaffrine O-beta-D-glucosidase; transglucosidase
 2.4.1.24	1,4-alpha-glucan 6-alpha-glucosyltransferase	transglucosidase
 3.2.1.10	oligo-1,6-glucosidase	alpha-glucosidase; alpha-glucosidase 2; exo-oligo-1,6-glucosidase; oligo-1,4-1,6-alpha-glucosidase; oligo-1,6-glucosidase; Oligosaccharide alpha-1,6-glucosidase
 3.2.1.104	steryl-beta-glucosidase	glucosidase, hydroxy steroid beta-; steryl-beta-glucosidase
 3.2.1.105	3alpha(S)-strictosidine beta-glucosidase	3alpha(S)-strictosidine beta-glucosidase; glucosidase, strictosidine beta-; strictosidine beta-D-glucosidase; strictosidine beta-glucosidase; strictosidine glucosidase
 3.2.1.106	mannosyl-oligosaccharide glucosidase	(Glc3)-glucosidase; acid alpha-glucosidase; alpha-glucosidase I; Glc3 oligosaccharide glucosidase; Glc3-glucosidase; Glc3-oligosaccharide glucosidase; Glc3-OS-glucosidase; Glc3Man9GlcNAc2 oligosaccharide glucosidase; Glc3Man9NAc2 oligosaccharide glucosidase; glucosidase I; glucosidase, mannosyloligosaccharide; glucosidase-1; glycoengineered acid alpha-glucosidase; mannosyl-oligosaccharide glucosidase; processing alpha-glucosidase I; processing exoglucosidase I; processing glucosidase I; trimming glucosidase I
 3.2.1.107	protein-glucosylgalactosylhydroxylysine glucosidase	glucosidase, glycosylgalactosylhydroxylysine; glycosyl-galactosyl-hydroxylysine glucosidase; glycosylgalactosylhydroxylysine glucosidase; protein-glucosylgalactosylhydroxylysine glucosidase
 3.2.1.112	2-deoxyglucosidase	2-deoxy-alpha-D-glucosidase; 2-deoxy-alpha-glucosidase; 2-deoxyglucosidase
 3.2.1.115	branched-dextran exo-1,2-alpha-glucosidase	branched-dextran exo-1,2-alpha-glucosidase; dextran 1,2-alpha glucosidase; glucosidase, dextran 1,2-alpha
 3.2.1.117	amygdalin beta-glucosidase	amygdalin beta-glucosidase; amygdalin glucosidase; beta-glucosidase; glucosidase

«« Results 1 - 10 of 53 »»

 download as CSV

# Search with „contains“

Cofactor ▼ contains ▼

<< Results 1 - 10 of 51 >>
   
 download as CSV
   
 download all results as CSV

EC Number ▼▲	Recommended Name ▼▲	Cofactor ▼▲	Structure ▼▲
1.1.5.6	formate dehydrogenase-N	bis(molybdopterin guanine dinucleotide)molybdenum cofactor	
1.1.99.6	D-lactate dehydrogenase (acceptor)	molybdopterin mononucleotide	-
1.1.99.33	formate dehydrogenase (acceptor)	bis(molybdopterin guanine dinucleotide)molybdenum cofactor	
1.1.99.33	formate dehydrogenase (acceptor)	molybdopterin	
1.2.1.2	formate dehydrogenase	molybdopterin	
1.2.3.1	aldehyde oxidase	molybdopterin	
1.2.3.1	aldehyde oxidase	molybdopterin cytosine dinucleotide	
1.2.3.8	pyridoxal oxidase	molybdopterin	
1.2.7.5	aldehyde ferredoxin oxidoreductase	molybdopterin	
1.2.7.5	aldehyde ferredoxin oxidoreductase	tungsten-molybdopterin	

<< Results 1 - 10 of 51 >>
   
 download as CSV
   
 as CSV

# Search Cofactor

Cofactor: 
exact ▼ show  results

Don't show organism specific information (fast!)
  
 Search organism in taxonomic tree (slow e.g. "mammalia" for rat human m)

(Not possible to

Refine your search

Recommended Name:

# Search with „exact“

<< Results 1 - 10 of 26 >>
   
 download as CSV
   
 download all results as CSV

EC Number ▼▲	Recommended Name ▼▲	Cofactor ▼▲	Structure ▼▲
1.1.99.33	formate dehydrogenase (acceptor)	molybdopterin	
1.2.1.2	formate dehydrogenase	molybdopterin	
1.2.3.1	aldehyde oxidase	molybdopterin	

# EC 1 Oxidoreductases

rubisco

Enzyme, Ligand

contains

add search field

delete search field

start search

Field	Hits found
Enzyme Names (Synonyms)	27
Ligands	7

Results 1 - 4 of 4

download as CSV  
download all results as CSV

EC Number ▼▲	Recommended Name ▼▲	Synonyms ▼▲
2.1.1.127	[ribulose-bisphosphate carboxylase]-lysine N-methyltransferase	Rubisco large subunit epsilonN-methyltransferase; Rubisco large subunit methyltrans dimethyltransferase; Rubisco LS methyltransferase; Rubisco LSMT; Rubisco methylt
2.1.1.259	[fructose-bisphosphate aldolase]-lysine N-methyltransferase	large subunit of Rubisco methyltransferas; Rubisco methyltransferase
4.1.1.39	Ribulose-bisphosphate carboxylase	archaeal Rubisco; barley rubisco; form I RubisCO; Form II Rubisco; Galdieria Rubisc red-type form I RuBisCO; Rubisco; RubisCO 1; RuBisCO 2; RubisCO redlike form I; Rubisco-LSU; RubiscoL; Tk-Rubisco; type III Rubisco
5.3.2.5	2,3-diketo-5-methylthiopentyl-1-phosphate enolase	RuBisCO-like protein

Sequences- 46425 protein sequences from UniProt

Reaction

Wordmap – The biological process is the photosynthesis. The main metabolites in this process are CO<sub>2</sub>, chlorophyll, 3-phosphoglycerate, and phosphoenolpyruvate

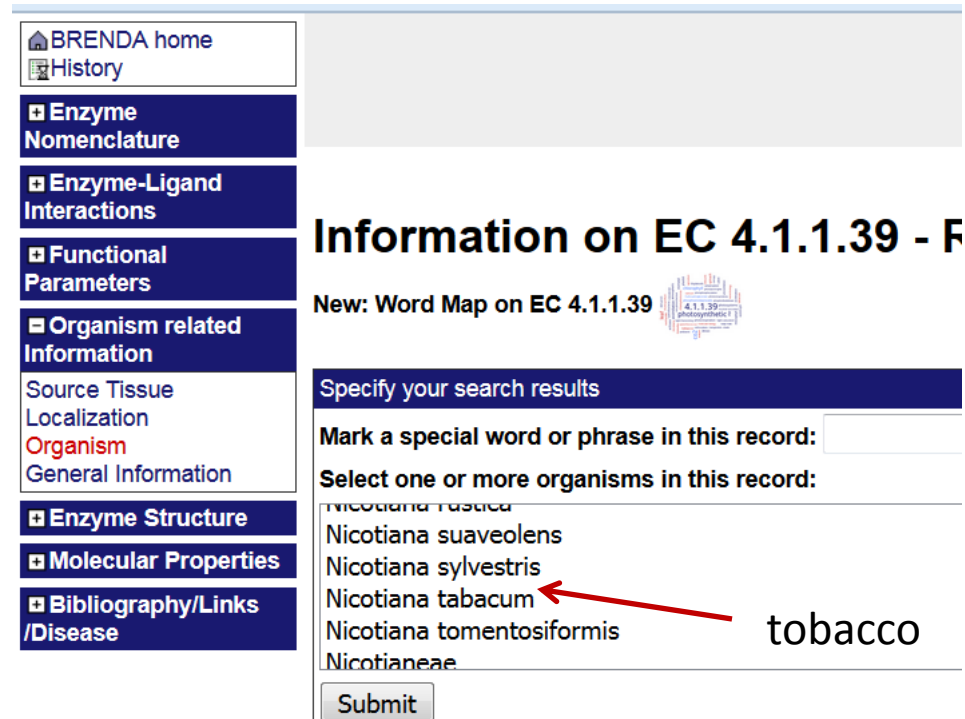
# **BRENDA Exercises The Enzyme Summery Page**

## Exercise 4

- Display the enzyme summary page for RUBISCO
- Open the menu organism-related information on the navigation bar and look at the section „organism“
- Then go back to the top of the flatfile and click *Include FRENDA results (AMENDA + additional results, but less precise; [more...](#))*
- Again open the menu organism-related information on the navigation bar and look at the section „organism“. What is different now?
- The optimal temperature for RUBISCO varies with the enzyme origin. What is the maximal value for optimal activity. In which organism has it been detected?
- You are only interested in RUBISCO from tobacco. How can you reduce the displayed data to show only those related to tobacco? (Note: if you do not know the scientific name for tobacco, you may need to study the tutorial on the Taxonomy Explorer first. If you know the name (or your instructor is willing to reveal it), you can go ahead with this task 🤔 )

- Rubisco, EC 4.1.1.39
- The navigation bar is on the left side of the screen
- 

Navigation bar



The screenshot shows the BRENDA website interface. On the left is a navigation bar with the following items: BRENDA home, History, Enzyme Nomenclature, Enzyme-Ligand Interactions, Functional Parameters, Organism related Information (with sub-items: Source Tissue, Localization, Organism, General Information), Enzyme Structure, Molecular Properties, and Bibliography/Links/Disease. The main content area is titled 'Information on EC 4.1.1.39 - F' and includes a 'New: Word Map on EC 4.1.1.39' link. Below this is a search section with the heading 'Specify your search results' and a form for marking special words or phrases. A list of organisms is shown, with 'Nicotiana tabacum' highlighted in dark blue and 'tobacco' in light blue. A red arrow points from the word 'tobacco' to 'Nicotiana tabacum'. A 'Submit' button is at the bottom of the search section.

In the organism section the BRENDA data are in dark blue. The textmining data are in light blue. The reliability of the textmining data is indicated by +, ++, +++



# BRENDA Exercises

## Fulltext Search

## Exercise 5

- methylmalonyl-CoA is a frequently occurring metabolite. Display a list of all BRENDA data categories where this compound is mentioned.
- How many kinetic values are stored for this compound ( $K_m$ ,  $k_{cat}/K_m$ ,  $K_i$ , turnover numbers)?

## Exercise 6

- What are the EC numbers for enzymes that are related to lactate dehydrogenase deficiency?

## Fulltext Search

Search term:  contains

(use **AND**, **OR**, **AND NOT** for simple boolean queries) ?

Search in the complete database

Include text mining results   
or search only specified fields:


Activating Compound  
 Amino Acid Sequence  
 Application  
 CAS Registry Number  
 Cloned(Commentary)

(hold the ctrl-key to select more than one field)

Field	Hits found
Activating Compound	1
Cloned(Commentary)	3
Crystallization (Commentary)	5
Disease/ Diagnostics	72
Enzyme Names (Synonyms)	30
Inhibitors	17
KCat/KM [mM/s]	3
Ki Value [mM]	2
KM Value [mM]	30
Ligands	118
Natural Product	5
Natural Substrate	13
Natural Substrates/ Products (Substrates)	93
Product	27
Reaction	25
Recommended Name	6
Reference by Title	329
Renatured (Commentary)	2
Substrate	60
Substrates and Products (Substrate)	390
Synonyms	19
Systematic Name	10
Turnover Number [1/s]	22

# Fulltext Search

Search term:  contains

(use AND, OR, AND NOT for simple boolean queries) 

Search in the complete database

Include text mining results  or search only specified fields.

- CAS Registry Number
- Cloned(Commentary)
- Cofactor
- Crystallization(Commentary)
- Disease/ Diagnostics**

(hold the ctrl-key to select more than one field)

Field	Hits found
Disease/ Diagnostics	76

# BRENDA Exercises Advanced Search

## Exercise 7

- Search all acetyltransferases which have been crystallized.
- How many of these have a connected pdb entry?

## Exercise 8

- Xylose from hydrolyzed wood components might be a good material for energy production or biofuel production. Find enzymes that may be useful in these processes.

## Advanced Search results

[New advanced search](#)

« « Results 1 - 10 of 132 » »

### pyruvate dehydrogenase (acetyl-transferring)

(EC 1.2.4.1) from *Homo sapiens*

Crystallization (Commentary)

Crystallization	Reference
recombinant enzyme, orthorhombic crystals in polyethylene glycol 3350 by vapor-diffusion method, space group P222	348993
vapour diffusion method with 14-18% PEG 3350, 0.1 mM sodium azide, and 200 mM NaSCN in 50 mM potassium phosphate (pH 8.0)	685160

### pyruvate dehydrogenase (acetyl-transferring)

(EC 1.2.4.1) from *Escherichia coli*

Crystallization (Commentary)

Crystallization
in complex with phosphonolactylthiamine diphosphate as structural and electrostatic analogue of alpha-lactylthiamin diphosphate. Presence of phosphonolactylthiamine diphosphate is essential for the formation of a stable structure. The structure of the complex was determined by X-ray crystallography at 2.0 Å resolution. The structure of the complex with thiamine 2-thiazolone diphosphate was determined by X-ray crystallography at 2.0 Å resolution. The structure of the complex with thiamine 2-thiazolone diphosphate and Mg <sup>2+</sup> was determined by X-ray crystallography at 2.0 Å resolution. The structure of the complex with thiamine 2-thiazolone diphosphate and Mg <sup>2+</sup> was determined by X-ray crystallography at 2.0 Å resolution.
preparation of catalytic subunit E1 of pyruvate dehydrogenase complex, without cofactors thiamine diphosphate and Mg <sup>2+</sup> , no evidence of disorder/complex with thiamine 2-thiazolone diphosphate
purified enzyme E1 in complex with inhibitor thiamine thiazolone diphosphate and Mg <sup>2+</sup> , sitting drop vapour diffusion method, reservoir solution: 15% PEG 3350, 0.1 M sodium azide, 200 mM NaSCN, 50 mM potassium phosphate (pH 8.0)

## Advanced Search results

[New advanced search](#)

« « Results 1 - 10 of 37 » »

### pyruvate dehydrogenase (acetyl-transferring)

(EC 1.2.4.1) from *Homo sapiens*

Crystallization (Commentary)

Crystallization	Reference
recombinant enzyme, orthorhombic crystals in polyethylene glycol 3350 by vapor-diffusion method, space group P222	348993
vapour diffusion method with 14-18% PEG 3350, 0.1 mM sodium azide, and 200 mM NaSCN in 50 mM potassium phosphate (pH 8.0)	685160

PDB ID

PDB ID	Chain	UniProt (1st accession)
1ni4	A	P08559
1ni4	C	P08559
1ni4	B	P08559

EC Number:   use \* as a wildcard

Organism:   use \* as a wildcard (\* in

Enzyme Name:

Search in text fields



1.

2.



### glucose 1-dehydrogenase (PQQ, quinone)

(EC 1.1.5.2) from *Pyrobaculum aerophilum*

Application

Application	Commentary
biofuel production	construction of a long-life biofuel cell using a hyperthermophilic enzyme. For the cathode, the mul glucose dehydrogenase from <i>Pyrobaculum aerophilum</i> is used. When the enzymes are used as e

Ligands

Role	Ligand	Structure	inchi	chebiID	Reference
KM Value	D-xylose	✓			711018
Substrate	D-xylose	✓			711018
Turnover Number	D-xylose	✓			711018

### acetylxylan esterase

(EC 3.1.1.72) from *Trichoderma reesei*

Application





# BRENDA Exercises

## EC Explorer

## Exercise 9

- You are looking for enzymes that transfer methyl groups
- There are several search modes which you might use for this search.
- However this time use the EC Explorer for this search
- Start with using the search mode of the EC Explorer
- try using a part-name
- try using a compound which is able to donate a methyl group
- try looking at various EC subclasses (remember the EC classes from the first training module? Otherwise ask your instructor 🤔 )
- Then use the browse mode
- Look at the various links and display the information provided there
- Now try other search modes for this tasks (your instructor will appreciate your feedback)

## EC Explorer

[\[browse EC tree\]](#) - [\[search\]](#)

Please use **AND** or **OR** in combination with **NOT** to refine you query

EC number  begins with

Common name  contains

Reaction  contains

Systematic name  contains

Comment  contains

CAS registry number  contains

Synonyms  contains













History  contains

First thing you may guess that these enzymes are called „methyltransferase“ and enter the term into „synonyms“

include  class (x.)  subclass (x.x.)  sub-subclass (x.x.x.)  serial number (x.x.x.x)

10  results

«« Results 1 - 10 of 204 »»

















































































EC ▲ ▼	Common name ▲ ▼	Reaction ▲ ▼	Synonyms ▲ ▼
    1.16.1.8	[methionine synthase] reductase	2 [methionine synthase]-methylcob(I)alamin + 2 S-adenosylhomocysteine + NADP <sup>+</sup> = 2 [methionine synthase]-cob(II)alamin + NADPH + H <sup>+</sup> + 2 S-adenosyl-L-methionine	methionine synthase cob(II)alamin reductase synthase]-cobalamin methyltransferase (co
    2.1.1.1	nicotinamide N-methyltransferase	S-adenosyl-L-methionine + nicotinamide = S-adenosyl-L-homocysteine + 1-methylnicotinamide	nicotinamide methyltransferase
   	guanidinoacetate	S-adenosyl-L-methionine + guanidinoacetate = S-adenosyl-L-homocysteine + creatine	GA methylperase; guanidinoacetate met

## EC Explorer

[browse EC tree] - [search]

△ back to top

### EC Browser

- 1 Oxidoreductases (7908 organisms)   
- 2 Transferases (5546 organisms)   
- 2.1 Transferring one-carbon groups (1114 organisms)   
- 2.1.1 Methyltransferases (963 organisms)   
- 2.1.1.1 nicotinamide *N*-methyltransferase (6 organisms)    
- 2.1.1.2 guanidinoacetate *N*-methyltransferase (9 organisms)    
- 2.1.1.3 thetin—homocysteine *S*-methyltransferase (1 organism)   
- 2.1.1.4 acetylserotonin *O*-methyltransferase (15 organisms)    
- 2.1.1.5 betaine—homocysteine *S*-methyltransferase (13 organisms)    
- 2.1.1.6 catechol *O*-methyltransferase (22 organisms)    
- 2.1.1.7 nicotinate *N*-methyltransferase (5 organisms)   
- 2.1.1.8 histamine *N*-methyltransferase (9 organisms)    
- 2.1.1.9 thiol *S*-methyltransferase (19 organisms)   
- 2.1.1.10 homocysteine *S*-methyltransferase (13 organisms)   
- 2.1.1.11 magnesium protoporphyrin IX methyltransferase (14 organisms)    
- 2.1.1.12 methionine *S*-methyltransferase (15 organisms)   
- 2.1.1.13 methionine synthase (28 organisms)    
- 2.1.1.14 5-methyltetrahydropteroyltriglutamate—homocysteine *S*-methyltransferase (23 organisms)   
- 2.1.1.15 fatty-acid *O*-methyltransferase (4 organisms)   
- 2.1.1.16 methylene-fatty-acyl-phospholipid synthase (1 organism)   
- 2.1.1.17 phosphatidylethanolamine *N*-methyltransferase (1 organism)   
- 2.1.1.18 polysaccharide *O*-methyltransferase (1 organism)   
- 2.1.1.19 trimethylsulfonium—tetrahydropteroyltriglutamate *S*-methyltransferase (1 organism)   
- 2.1.1.20 glycine *N*-methyltransferase (1 organism)   

You can systematically click through the tree until you reach the desired enzyme class. Sequences, reaction, flatfiles can be displayed via the indicated links.

# BRENDA Exercises

## Taxonomic Tree

## Exercise 10

- Search the scientific name for yeast
- How many EC numbers and amino acid sequences are stored in BRENDA for this organism?
- How many synonyms are reported for this organism?

## Tax Tree Explorer

[browse taxonomy tree] - [search] - [Example]

Scientific name or synonym:   (use **AND**, **OR**, **AN**)

type of synonym (optional):

NCBI Taxonomy ID:

Rank:

1 different results found

1: yeast (*Saccharomyces cerevisiae*)

### Details for *Saccharomyces cerevisiae*

7405 aa sequences of *Saccharomyces cerevisiae*

NCBI 4932

Found 2518 enzymes for *Saccharomyces cerevisiae*

### Synonyms

1. *Candida robusta*
2. *Saccaromyces cerevisiae*
3. *Saccharomyces capensis*

### Condensed Tree View

- └ cellular organisms
  - └ Eukaryota (superkingdom)
    - └ Opisthokonta
      - └ Fungi (kingdom)
        - └ Dikarya (subkingdom)
          - └ Ascomycota (phylum)
            - └ saccharomyceta
              - └ Saccharomycotina (subphylum)
                - └ Saccharomycetes (class)
                  - └ Saccharomycetales (order)
                    - └ Saccharomycetaceae (family)
                      - └ Saccharomyces (genus)
                        - └ **Saccharomyces cerevisiae** (species)

7405 amino acid sequences  
2518 EC classes  
15 synonyms

# BRENDA Exercises

## BTO



## Exercise 11

- How many terms in the BTO contain „skin“?
- How many EC numbers are stored in BRENDA for skin cancer cells?
- What is the definition of this term?

## Ontology explorer

**BTO (BRENDA Tissue Ontology)**

Change ontology:  Version 2015-04-30

Term:   use AND (NOT) or OR

Synonym:  use AND (NOT) or OR

Definition:  use AND (NOT) or OR

restrict to BRENDA links:

Tissue

### 12 different search results found

- 2: foreskin fibroblast cell line
- 3: foreskin keratinocyte cell line
- 4: foreskin melanocyte cell line
- 5: skin
- 6: skin cancer cell

### Details for skin cancer cell

**BRENDA**  skin cancer cell

BTO (BRENDA Tissue Ontology) ID

BTO:0001286

BTO:0001286 is **linked to 150** enzymes:

Definition

The two most common forms

### Condensed Tree View

- └ tissues, cell types and enzyme sources
  - └ animal
    - └ whole body
      - └ integument
        - └ skin
          - └ **skin cancer cell**

### Tree view

- └ tissues, cell types and enzyme sources
  - └ tissues, cell types and enzyme sources
    - └ animal
      - └ whole body
        - └ adult stem cell
          - └ adipose-derived stem cell
          - └ adult liver stem cell
          - └ adult stem cell line
          - └ bone marrow stem cell
          - └ bronchoalveolar stem cell
          - └ cancer stem cell
          - └ cord blood stem cell
          - └ epithelial stem cell

# BRENDA Exercises

## Ligands



## Exercise 12

- How many enzymes are affected by promethazine?
- Which enzymes are inhibited by this compound?
- Which enzyme can metabolize this compound and what is the product?
- What happens to the enzyme after the product is formed?

## Exercise 13

- How many enzymes can metabolize cellobiose in an oxidative manner?
- How many enzyme can hydrolyze this compounds?

## Exercise 14

- Display the structure of cellopentaose.
- What are the products of cellopentaose hydrolysis?

Substrates and Products (Substrate):  contains  10 results

Don't show organism specific information (fast!)

Search organism in taxonomic tree (slow, e.g. "mammalia" for rat,human,monkey,...)

(Not possible to combine with the first option)

Refine your search

Recommended Name:   contains

EC Number:  begins with

Commentary Substrates:   contains

Organism:   contains

Products:   contains

Commentary (Products):   contains

Reversibility:   contains

Tip: unclick all options for this search  
EC number begins with 1. gives 45 results

EC number begins with 3. (for hydrolases) gives 65 results

**Search term: cellobiose**

Results 1 - 10 of 45

download as CSV

download all results as CSV

| EC Number ▼▲ | Recommended Name ▼▲               |
|--------------|-----------------------------------|
| 1.1.1.121    | aldose 1-dehydrogenase (NAD+)     |
| 1.1.1.47     | glucose 1-dehydrogenase [NAD(P)+] |

Exercise 14:  
cellooligosaccharides and D-glucose

# BRENDA Exercises Pathways

### Exercise 15

- How many enzymes are part of the BRENDA pyrimidine metabolism?
- How many enzymes are part of the KEGG pyrimidine metabolism?

### Exercise 16

- Display the BRENDA interactive benzoyl-CoA degradation pathway
- What is the final metabolite in this pathway?
- Show the molecule diagram, the molecular formula and the INChI key for this metabolite.

### Search Pathway

Pathway: **pyrimidine metabolism** exact how 100 results

Refine your search

Recommended Name:  contains

EC Number:  contains

KEGG Link:  contains

MetaCyc Link:  contains

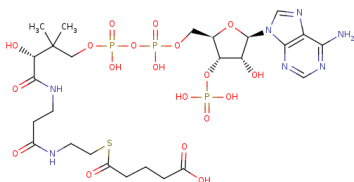
Source Database:  **BRENDA** contains

32 EC classes in the BRENDA  
pyrimidine metabolism  
61 EC classes in the KEGG  
pyrimidine metabolism

### Search term: pyrimidine metabolism

« « Results 1 - 32 of 32 » »

| EC Number ▼▲ | Recommended Name ▼▲                     | Pathway ▼▲            | KEGG Link ▼▲ | MetaCyc Link ▼▲ | Source Database |
|--------------|---|-----------------------|--------------|-----------------|-----------------|
| 1.3.1.2      | dihydropyrimidine dehydrogenase (NADP+) | pyrimidine metabolism | -            | -               | BRENDA          |
| 1.3.1.14     | dihydroorotate dehydrogenase (NAD+)     | pyrimidine metabolism | -            | -               | BRENDA          |



$C_{26}H_{42}N_7O_{19}P_3S$   
glutaryl-CoA



# **BRENDA Exercises**

## **Sequences, Genomes**

## Exercise 17

- Search for amino acid sequences of RUBISCO from soybean (if you can't remember the EC number or the recommended name for RUBISCO or the scientific name for the soybean you might try to find it in BRENDA by yourself. Of course your instructor can give valuable tips)
- Perform a BLAST with entry [P00865](#) and find out how many other sequences can be matched with 100% identity.
- Find out the molecular weight and a literature reference for [P00865](#).

## Exercise 18

- Search for transferases in the genomes of the genus *Solanum*.
- Select 5 entries for visualization and look for enzyme details

## Amino acid sequence search

Amino acid Sequence:

No. of results:

Recommended name:

(of enzyme)

EC Number:

1st Accession Code:

(UniProt)

Organism:

Number of amino acids: =

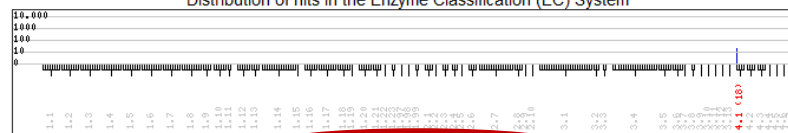
Molecular weight [Da]: =

Transmembrane helices: =


N-terminus:  inside  outside

Source:  SwissProt  TREMBL

Distribution of hits in the Enzyme Classification (EC) System



Results 1 - 10 of 18

| EC Number | Recommended Name<br>Organism                            | UNIPROT | No of trans. helices<br>No of amino acids | MW [kD] | Source     | Tools/Links   |
|-----------|---|---------|---|---------|------------|---|
| 4.1.1.39  | Ribulose-bisphosphate carboxylase<br><i>Glycine max</i> | P00865  | 0 transm. helices<br>178 amino acids      | 20073   | Swiss-Prot |  |

Available genomes: **Eukaryota**

down CTRL or SHIFT to select multiple genomes)

- Solanum bulbocastanum cultivar PT29 chloroplast
- Solanum lycopersicum chromosome ch01
- Solanum lycopersicum chromosome ch02
- Solanum lycopersicum chromosome ch03
- Solanum lycopersicum chromosome ch04
- Solanum lycopersicum chromosome ch05
- Solanum lycopersicum chromosome ch06

Organism: begins with **solanum**

Taxonomy: begins with

EC Number: begins with **2**

UniProt Accession: exact

Protein Name: exact

Max. number of results: 50  Preview all results

Restrict your search:  Search only in selected genomes

Extend your search:  Display homolog proteins with min.  50%  90%  10

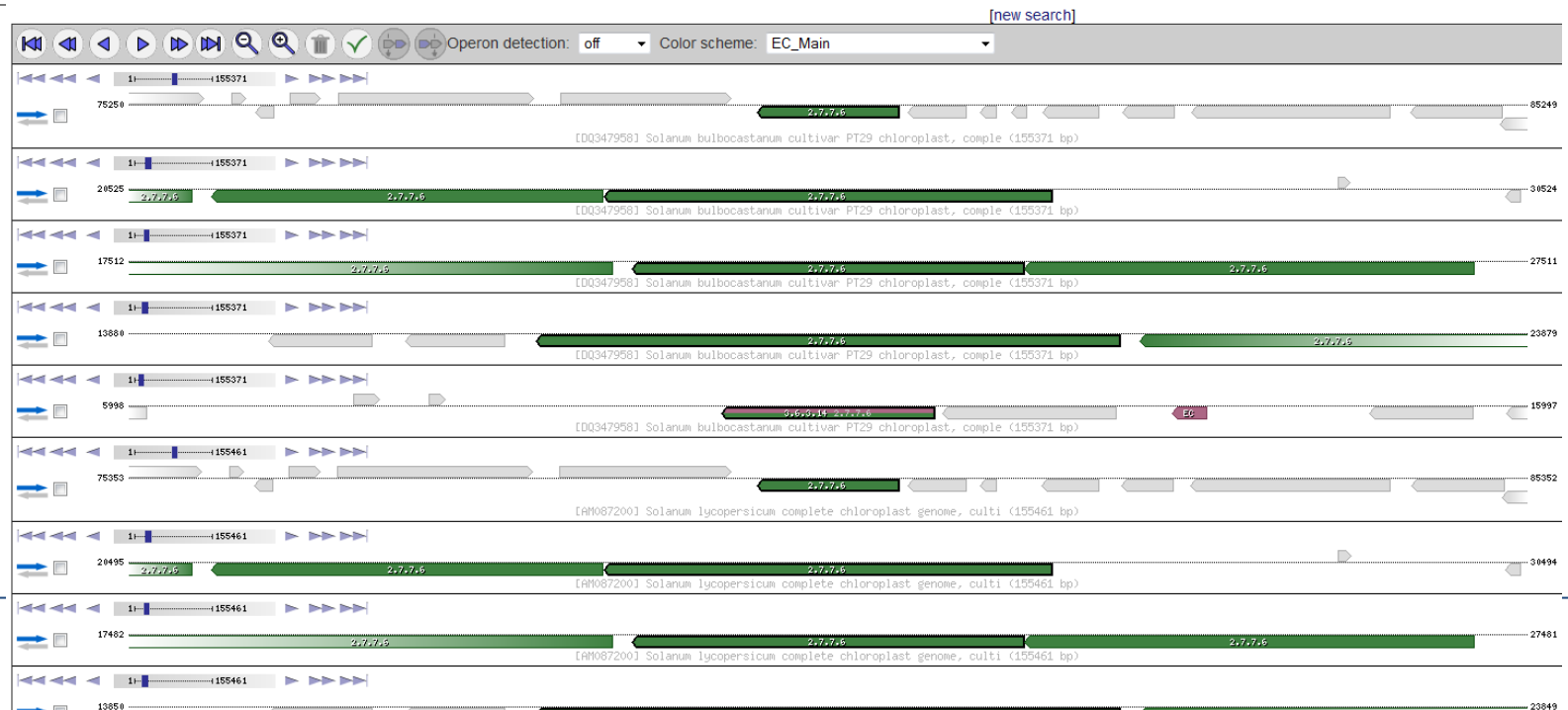
### Genome Explorer

[new search]  
Please select one or more genomes from below for visualization.

Results 1 - 20 of 35

Results per page: 20

| Organism                                       | Gene  | Product  | EC Number           | Accession |
|--|-------|--|---------------------|-----------|
| <input type="checkbox"/> Solanum bulbocastanum | rpoA  | RNA polymerase alpha subunit<br>DNA-directed RNA polymerase subunit alpha<br>Plastid-encoded RNA polymerase subunit alpha          | 2.7.7.6             | Q2MIF6    |
| <input type="checkbox"/> Solanum bulbocastanum | rpoB  | RNA polymerase beta subunit<br>DNA-directed RNA polymerase subunit beta<br>PEP<br>Plastid-encoded RNA polymerase subunit beta      | 2.7.7.6             | Q2MIJ5    |
| <input type="checkbox"/> Solanum bulbocastanum | rpoC1 | RNA polymerase beta subunit<br>DNA-directed RNA polymerase subunit beta'<br>PEP<br>Plastid-encoded RNA polymerase subunit beta'    | 2.7.7.6             | Q2MIJ6    |
| <input type="checkbox"/> Solanum bulbocastanum | rpoC2 | RNA polymerase beta' subunit<br>DNA-directed RNA polymerase subunit beta''<br>PEP<br>Plastid-encoded RNA polymerase subunit beta'' | 2.7.7.6             | Q2MIJ7    |
| <input type="checkbox"/> Solanum bulbocastanum | atpA  | ATP synthase CF1 alpha subunit<br>ATP synthase subunit alpha, chloroplastic<br>ATP synthase F1 sector subunit alpha                | 3.6.3.14<br>2.7.7.6 | Q2MIK2    |



# **BRENDA Exercises**

## **Exploring more Features**

## Extra Exercises

- a) Organisms and their enzymes are adapted to the environment in which they live. Use the search option **Functional Parameters** to display the temperature optimum for the enzymes of *Clostridium acetobutylicum*, *Homo sapiens*, and *Sulfolobus solfataricus* to display the optimal temperatures. Can you detect differences?
- b) The pH optima of enzyme-catalyzed reactions often depends on the type of reaction. Redox reactions are catalyzed best at neutral pH-values. Hydrolytic reactions require different conditions. Display the pH optima for oxidoreductases acting on C-OH bond with NAD(P)<sup>+</sup> as cofactors. Then display the pH optima for serine endopeptidases. (Note: you may have to consult the EC Explorer to find out the EC subclasses for these enzymes)

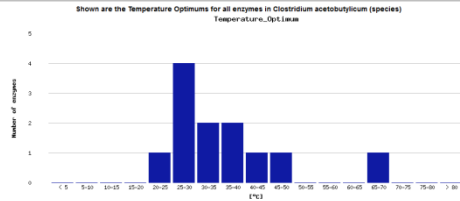
### Functional Enzyme Parameters

Specify the chart of interest:

Functional parameter: Temperature\_Optimum

Taxonomic group or organism: Clostridium acetobutylicum (species)

EC-Number or beginning of EC-Number: Use "\*" as wildcard



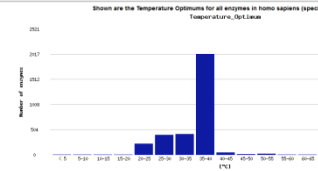
### Functional Enzyme Parameters

Specify the chart of interest:

Functional parameter: Temperature\_Optimum

Taxonomic group or organism: homo sapiens (species)

EC-Number or beginning of EC-Number: Use "\*" as wildcard



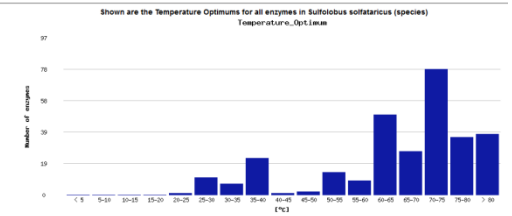
### Functional Enzyme Parameters

Specify the chart of interest:

Functional parameter: Temperature\_Optimum

Taxonomic group or organism: Sulfolobus solfataricus (species)

EC-Number or beginning of EC-Number: Use "\*" as wildcard



b)

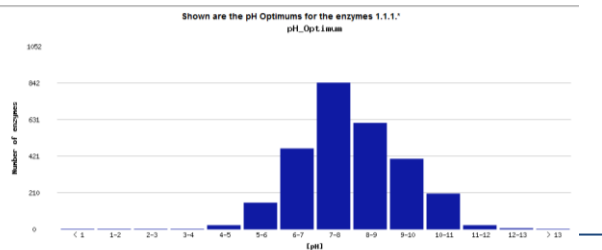
### Functional Enzyme Parameters

Specify the chart of interest:

Functional parameter: pH\_Optimum

Taxonomic group or organism: Please enter the beginning of a valid taxonomic term

EC-Number or beginning of EC-Number: 1.1.1.\* Use "\*" as wildcard



### Functional Enzyme Parameters

Specify the chart of interest:

Functional parameter: pH\_Optimum

Taxonomic group or organism: Please enter the beginning of a valid taxonomic term

EC-Number or beginning of EC-Number: 3.4.21.\* Use "\*" as wildcard

