Enzyme Portal: Quick tour

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Proteins
Chemical biology
Beginner
0.5 hour

This quick tour provides a brief introduction to the Enzyme Portal - a data resource that provides access to information from several enzyme-related databases, both at EMBL-EBI and the Swiss Institute of Bioinformatics (SIB).

Learning objectives:

- Basic understanding of the Enzyme Portal and how it can help you to access enzyme-related data
- Know where to find out more about the Enzyme Portal

What is the Enzyme Portal?

The Enzyme Portal is a free resource that integrates publicly available information about enzymes, such as small-molecule chemistry, biochemical pathways and drug compounds. It provides a concise summary of information from:

- UniProt Knowledgebase [2]: a database of protein sequence and functional information;
- Protein Data Bank in Europe (PDBe [3]): a database of protein structures;
- Rhea [4]: a database of enzyme-catalysed reactions;
- Reactome [5]: a database of biological pathways;
- IntEnz [6]: a resource with enzyme nomenclature information;
- ChEBI [7] and ChEMBL [8]: resources that contain information about small molecule chemistry and bioactivity;
- EFO: the Experimental Factor Ontology [9]. This is a system for annotating experiments, and the Enzyme Portal uses this to retrieve disease-related information.

The Enzyme Portal collates diverse information about enzymes and displays it in an organised overview. It covers many species, including mammals, invertebrates and plants, and provides a simple way to compare orthologues.

What can I do with the Enzyme Portal?

- Browse enzyme data available by diseases, enzyme classification, taxonomy and pathways.
- Find enzymes by searching a wide range of associated metadata [10]. The Enzyme Portal
Enzyme Portal: Quick tour

uses EMBL-EBI's global search engine (EBI Search), which gathers information from all of EMBL-EBI's resources and then presents only the enzyme-related data.

- Filter your search results by species, chemical compounds, diseases and enzyme family.
- Retrieve known orthologues for a given enzyme.
- Retrieve summarised information about specific enzymes, based on their:
  - 3D protein structure;
  - catalytic activity;
  - metabolic pathways they are involved in;
  - small molecules [11] interacting with them (co-factors, activators, inhibitors, drugs);
  - related diseases;
  - relevant bibliographic information.

Browsing Enzyme Portal data

Enzyme Portal homepage

The homepage shows boxes that represent the types of data you can browse using the Enzyme Portal. For example, you can click on 'Disease' and view a list of all diseases that have enzymes linked to them in Enzyme Portal. You can also search for your disease of interest within this list. Clicking on a disease name will take you to a results page listing all enzymes related to that disease. You can explore data in similar ways through the 'Enzyme Classification', 'Taxonomy' and 'Pathways' boxes.

![Enzyme Portal homepage](image)

Figure 1 Enzyme Portal homepage, showing the types of data you can browse: diseases, enzyme classification, taxonomy and pathways.

Browse by diseases
The Enzyme Portal homepage has a square button on it called ‘Diseases’. You can click on this button to start browsing enzymes by diseases that have enzymes linked to them.

Clicking on ‘Diseases’ on the homepage will bring you a list of all diseases for which there are enzymes in the Enzyme Portal. You can also search within this list of diseases. Clicking on a disease in the list will bring you to a results page with all the enzymes related to that disease in the Enzyme Portal.

![Figure 2 Browsing for enzymes by diseases.](image)

### Browse by enzyme classification

Another square button on the Enzyme Portal homepage enables you to browse enzymes by ‘Enzyme Classification’. Once you have clicked this, you will be presented with a page showing the top level of the Enzyme Classification with links for EC1, EC2, EC3, EC4, EC5 and EC6. Clicking on one of these links will show you all the lower branches for that particular enzyme classification family.

For example, clicking on EC1 shows you all the 'children' branches from EC 1.1 to EC 1.99. You can click on one of these to drill down to the next levels of the classification until you reach the page showing the list of the final leaf nodes, for example EC1.1.1.1 and so on. Clicking on one of these leaf nodes of the classification will take you to a results page showing all enzymes belonging to that enzyme classification in the Enzyme Portal.

If you are looking for an exact Enzyme Classification (EC) number, you can also search by this EC number using the search box in the header of the Enzyme Portal website. Just start entering your EC number of choice (without the prefix ‘EC’) and you will see an autocomplete list of all
available matches.

Figure 3 Browsing for enzymes by Enzyme Classification (EC).

**Browse by taxonomy**

The next square button on the Enzyme Portal homepage is called ‘Taxonomy’. You can click on this button to start browsing enzymes by selected model organisms in the taxonomy tree for which there are enzymes in the Enzyme Portal.

Clicking on the 'Taxonomy' button will bring you to a page with these selected model organisms listed. If you click on any one of these organisms you will see all the enzymes associated with this particular organism in the Enzyme Portal.
Browse by pathways

The final square button on the Enzyme Portal homepage is called ‘Pathways’. You can click on this button to start browsing enzymes by the pathways in which they are known to participate.

Clicking on the 'Pathways' button will take you to a list of all the Pathways for which there are related enzymes in the Enzyme Portal. You can also search within this list using the search button under the 'Pathways' heading on the page. Clicking on a pathway will take you to a results page with all the enzymes known to participate in your selected pathway.
Figure 5 Browsing enzymes by pathways.

**Searching data in the Enzyme Portal**

**Searching: the Enzyme Portal homepage**

From the homepage, you can use the search box in the header to search using any relevant query terms, such as enzyme names, EC numbers, [UniProt](https://www.uniprot.org) accessions, gene names and small molecule names.
Search results

Search results are shown in a table with orthologues grouped into one result entry. The results list the:

- enzyme name;
- description of its function;
- list of species in which the enzyme is found;
- Enzyme Classification;
- catalytic activity of the enzyme.

If there is a 3D structure available for any of the species that the enzyme is found in, this will also be displayed.
Filtering search results

On the left-hand side there is a list of species which match the search term. You can filter the search results by species - simply click the corresponding checkbox.

Figure 7 Example search results for the term 'cathepsin'.

Figure 8 Example search results for 'cathepsin', filtered to display only human enzymes.
Comparing enzymes in your basket

You can add enzymes to your basket from the search results page and then select any two enzymes to compare. The tool shows a comparison of the enzymes’ names, species, function, enzyme classification, reactions and pathways, small molecules [11] and related diseases. It provides a link to launch sequence alignment of the enzyme’s sequences in UniProt [13] and a link to launch the PDBBeFold structure similarity tool.

![Figure 9 Example of the results of comparing two enzymes using the Enzyme Portal basket.](image)

Visualising data from the Enzyme Portal

Enzyme summary tab

If you click on an enzyme name (or one of its orthologues) in the search results, you will be directed to the enzyme page. This page is organised into tabs (on the left-hand side). The first is the enzyme summary tab, which contains:

- the description of the enzyme function;
- its classification in the EC hierarchy;
- any synonyms;
- a link to the protein sequence in UniProt [13].
**Protein structure tab**

The protein structure tab shows any experimental 3D models of the enzyme. If there are several of them, you can select one from the drop-down menu, and it indicates the number of structures available.
Reactions and pathways tab

The reactions and pathways tab shows the biochemical reaction(s) catalysed by the enzyme and the chemical structures of the participants are linked to ChEBI [7]. It also shows any metabolic pathways that the enzyme may participate in.

Figure 12 Example Reactions and Pathways tab for Insulin Receptor EC 2.7.10.1.

Small molecules tab

In the small molecules [11] tab you can find cofactors, activators, inhibitors and drugs, as well as any bioactive compounds that are associated with the enzyme. You can also click on the chemical structures to navigate to ChEBI [7] or ChEMBL [8].
Disease tab

The disease tab lists any diseases that are related to the selected enzyme, with a short description of the disease and how it affects the enzyme's function.

Figure 13 Example small molecules tab for Insulin Receptor EC 2.7.10.1.

Figure 14 Example diseases tab for Insulin Receptor EC 2.7.10.1.
Literature tab

The literature tab lists bibliographic citations relevant to the enzyme.

Article titles are linked to the Europe PMC [14] database. If an abstract is available, you can view it by clicking on 'toggle abstract'.

Note the filters at the top of the list: these are related to the other tabs (enzyme summary, protein structure, reactions and pathways, small molecules [11], and diseases). These filters allow you to view papers that are relevant to one of these enzyme characteristics.

Figure 15 Example literature citations tab for Insulin Receptor EC 2.7.10.1.

Submitting data to the Enzyme Portal

Since the Enzyme Portal integrates data from many specialised resources, any submissions must be sent directly to one of these resources, depending on the nature of the data. For example:

- New protein sequences: UniProt Knowledgebase [15].
- EC numbers: NC-IUBMB [16].
- Protein 3D structures: wwPDB [17].
- Reactions: Rhea [18].

Your feedback

Please tell us what you thought about this course. Your feedback is invaluable and helps us to
improve our courses and thus enhance your learning experience.

Get help and support on the Enzyme Portal

Support and find out more

- For comments, suggestions or help requests, use the EBI support form [20] - selecting 'Enzyme Portal' as the subject.

- For source code, feature requests and bug reports, see the GitHub pages [21]. [22]

Contributors

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Sangya Pundir is a User Experience (UX) Manager in EMBL-EBI’s UniProt team, where she established a user-centred process for the redesign of the world's leading protein resource. To make UniProt easy for researchers to explore, Sangya conducts usability testing and information-gathering methods such as card sorting, contextual studies and workshops. Before she came to EMBL-EBI, Sangya worked at a healthcare consultancy, designing bespoke management systems. She holds an MSc in Biotechnology, Bioprocessing and Business Management from the University of Warwick.
**Source URL:** http://www.ebi.ac.uk/training/online/course/enzyme-portal-quick-tour-0

**Links**

[1] http://www.ebi.ac.uk/training/online/trainers/sangya.pundir  
[7] http://www.ebi.ac.uk/training/online/glossary/chebi  
[8] http://www.ebi.ac.uk/training/online/glossary/chembl  
[10] http://www.ebi.ac.uk/training/online/glossary/metadata  
[12] http://www.ebi.ac.uk/training/online/glossary/ec-number  
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[17] https://www.ebi.ac.uk/pdbe-xdep/autodep/  
[18] https://sourceforge.net/tracker/?group_id=255417&atid=1126897  
[19] https://www.ebi.ac.uk/chebi/submissions/login  
[21] https://github.com/uniprot/enzymeportal  
[22] https://sourceforge.net/projects/enzymeportal/