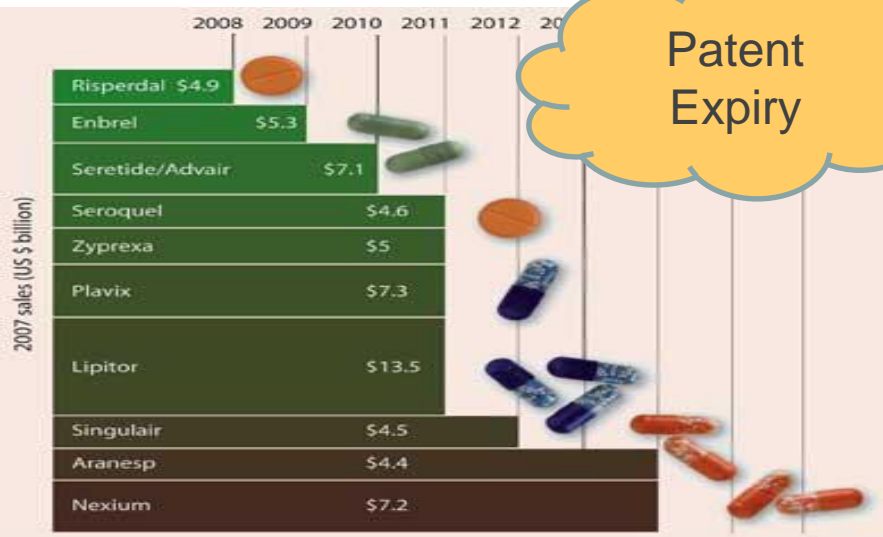


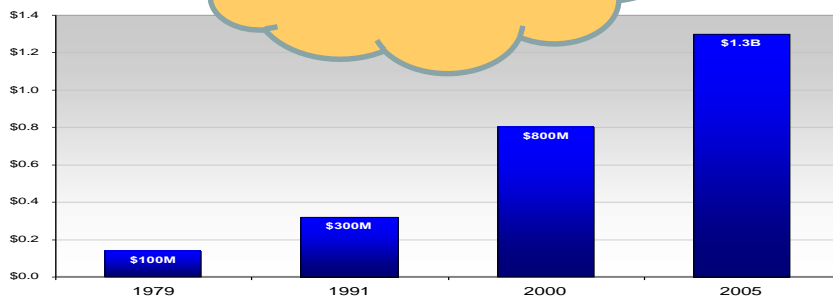
The Open PHACTS Discovery Platform

Semantic Data Integration for Life Sciences



<http://www.rsc.org/chemistryworld/Issues/2009/January/PharmaRefocusesOnThePatentCliff.asp>

Cost Containment



Resulting in a sales revenue

Value of patent expiries 2001-2015 (constant US\$ bn)



PricewaterhouseCoopers LLP

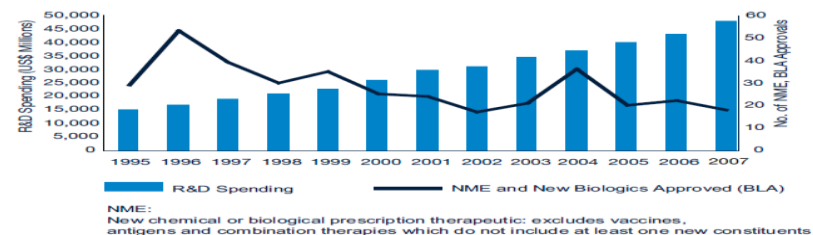
Source: IMS Health Midas

7

PwC - Pharma 2020 - Value of Patent Expiries

Improve R&D Productivity

Figure 1: The decline in R&D productivity



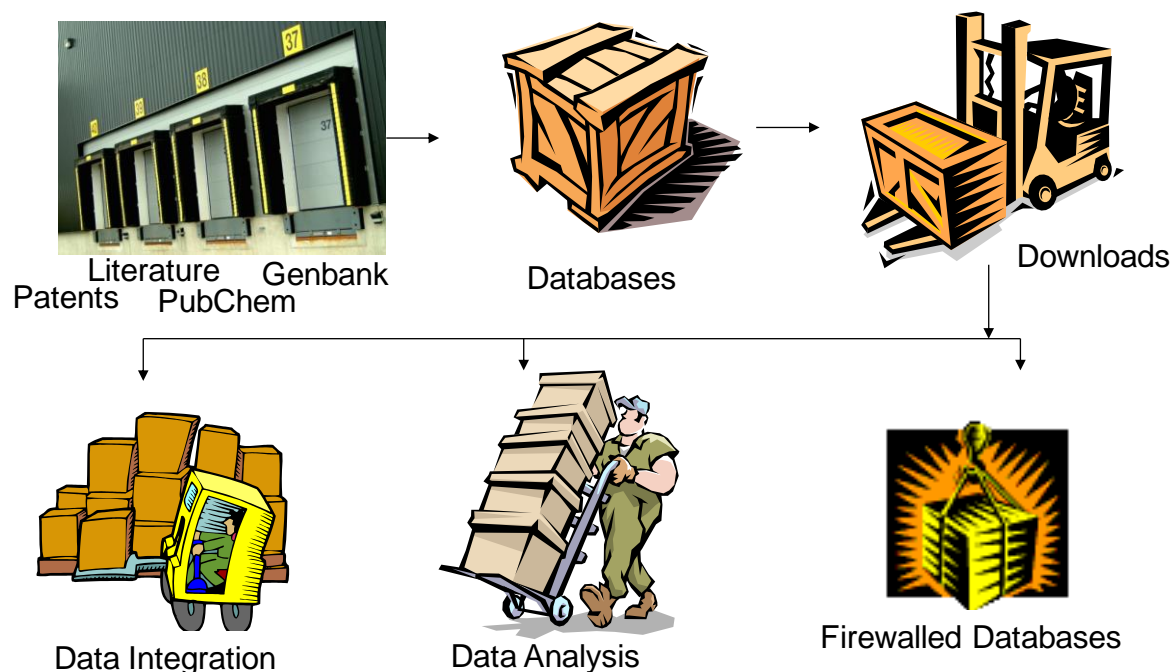
Source: FDA CDER, PhRMA and PricewaterhouseCoopers analysis

Note: Data on R&D spending for non-PhRMA companies are not included here.



Pre-competitive Informatics:

Pharma are all accessing, processing, storing & re-processing external research data



**Repeat @
X each
company**

Lowering industry firewalls: pre-competitive informatics in drug discovery
Nature Reviews Drug Discovery (2009) 8, 701-708 doi:10.1038/nrd2944



Over the last decade

- Data has become more open
- Data has become better represented (Standards)
- Major providers are becoming more organised (NCBI, EBI, FDA)

BUT

Integration across sources, and across providers is
still a gap





The Innovative Medicines Initiative

- EC funded public-private partnership for pharmaceutical research
 - Focus on key problems
 - Efficacy, Safety, Education & Training,
- Knowledge Management**



The Open PHACTS Project

- Create a *semantic integration hub* (“Open Pharmacological Space”)...
- *Runs 2011-2014, ENSO till 2016*
- Deliver services to support on-going drug discovery programs in pharma and public domain
- Leading academics in semantics, pharmacology and informatics, driven by solid industry business requirements
- 31 academic partners, 9 pharmaceutical companies, 3 software SMEs
- Work split into clusters:
 - Technical Build
 - Scientific Drive
 - Community & Sustainability



Open PHACTS Mission:
Integrate Multiple Research
Biomedical Data Resources
Into A Single **Open & Free**
Access Point



"What is the selectivity profile of known p38 inhibitors?"



"Let me compare MW, logP and PSA for known oxidoreductase inhibitors"



"Find me compounds that inhibit targets in NFkB pathway assayed in only functional assays with a potency <1 μ M"



ChEMBL

DrugBank

Gene
Ontology

Wikipathways

GeneGo

ChEBI

UniProt

UMLS

GVKBio

ConceptWiki

ChemSpider

TrialTrove

TR Integrity



Business Question Driven Approach

Number	sum	Nr of 1	Question
15	12	9	All oxidoreductase inhibitors active <100nM in both human and mouse
18	14	8	Given compound X, what is its predicted secondary pharmacology? What are the on and off, target safety concerns for a compound? What is the evidence and how reliable is that evidence (journal impact factor, KOL) for findings associated with a compound?
24	13	8	Given a target find me all actives against that target. Find/predict polypharmacology of actives. Determine ADMET profile of actives.
32	13	8	For a given
37	13	8	The current in serine pr
38	13	8	Retrieve all structure (v
41	13	8	A project is compounds the target o level of the
44	13	8	Give me all
46	13	8	Give me th (disease)
59	14	8	Identify all



Drug Discovery Today

Volume 18, Issues 17–18, September 2013, Pages 843–852



Review


Scientific competency questions as the basis for semantically enriched open pharmacological space development

Kamal Azzaoui¹, Edgar Jacoby¹⁴, Stefan Senger², Emiliano Cuadrado Rodríguez³, Mabel Loza³, Barbara Zdrzil⁴, Marta Pinto⁴, Antony J. Williams⁵, Victor de la Torre⁶, Jordi Mestres⁷, Manuel Pastor⁷, Olivier Taboureau⁸, Matthias Rarey⁹, Christine Chichester¹⁰, Steve Pettifer¹¹, Niklas Blomberg^{12, a}, Lee Harland¹³, Bryn Williams-Jones¹³, Gerhard F. Ecker⁴.  




The Open PHACTS Discovery Platform

- **Cloud-Based “Production” Level System. Secure & Private**
- **Guided By Business Questions**
- **Uses Semantic Web Technology But provides a simple REST-ful API for everyone else**





Drug Discovery Today
Volume 18, Issues 17–18, September 2013, Pages 843–852




Review


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<http://dx.doi.org/10.1016/j.drudis.2013.05.008>



Web Semantics: Science, Services and Agents on the World Wide Web
Available online 8 April 2014
In Press, Accepted Manuscript — Note to users



API-centric Linked data integration: The open PHACTS discovery platform case study

Paul Groth^a.   , Antonis Loizou^a, Alasdair J.G. Gray^d, Carole Goble^b, Lee Harland^c, Steve Pettifer^b

<http://dx.doi.org/10.1016/j.websem.2014.03.003>



HOW STANDARDS PROLIFERATE: (SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)



<http://imgs.xkcd.com/comics/standards.png>

- ❖ Basic Semantic web standards
 - SPARQL 1.1, RDF(S), SKOS
- ❖ Dataset descriptions
 - Vocabulary of Interlinked Datasets (VoID)
 - VoID linkset descriptions
- ❖ QUDT Quantities, Units, Dimensions and Types
- ❖ Provenance
 - W3C PROV, PAV, Nanopublications
- ❖ BioPortal, ConceptWiki, ChEMBL, identifiers.org, Uniprot, ChemSpider



HELLO
my name is

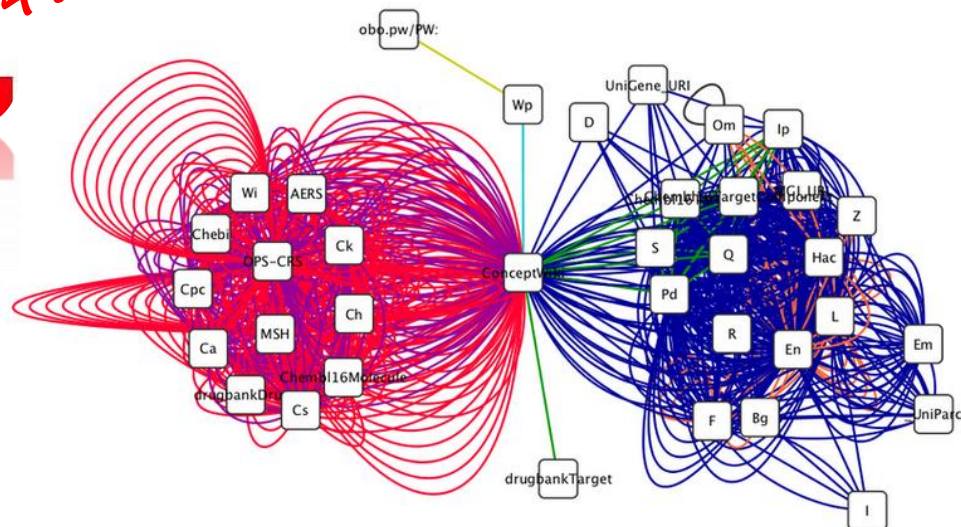
~~RS_2353~~

~~GB:29384~~

~~P12047~~

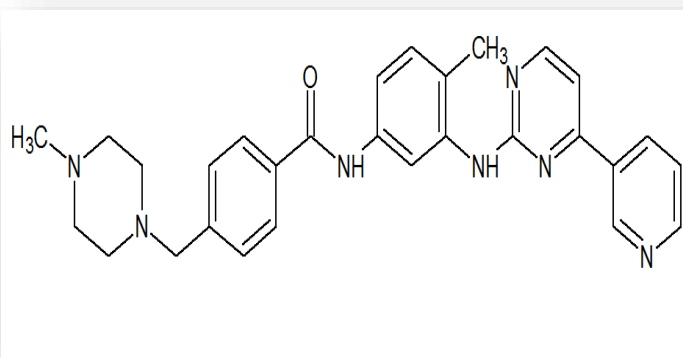
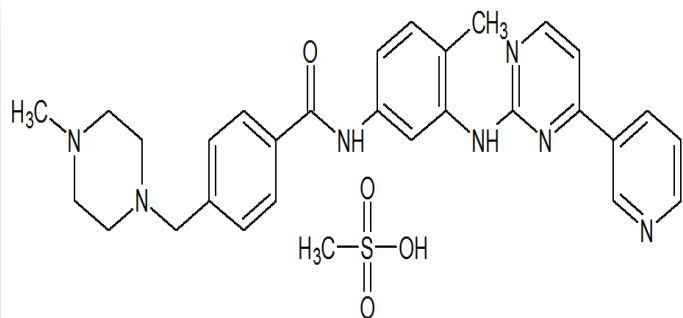
~~X31045~~

P12047





Are These Two Molecules The Same(*)



*Really: Is it sensible to combine data associated with these two molecules?



[Developer Home](#)[Want help?](#)[Documentation](#)[Get my API keys!](#)[Featured Apps](#)[Workflow](#)

Create!

Build with the Open PHACTS Discovery Platform. The platform provides a convenient API to query across multiple pharmacology datasets.

You'll find complete documentation for the API in our [documentation](#) section. You'll need an API key to use the platform. [Sign-up](#) is free. For more information on the project, check out www.openphacts.org.

News:

- [Let us know](#) if you have a feature request or bug report.
- August 11, 2014 - [version 1.4 of the platform is made available](#).
- June 24, 2014 - [Open PHACTS Foundation announces first 3 members](#).
- January 24, 2014 - [version 1.3 of the platform is made available](#).
- April 22, 2013 - launch of public beta at the [4th Open PHACTS community workshop](#) held at the Royal Society of Chemistry. Great turnout!

Powered By:



ChemSpider
Search and share chemistry



OPENLINK
SOFTWARE
Making Technology Work For You®



ConceptWiki



github
SOCIAL CODING



BridgeDb
connecting knowledge



ChEMBL




UniProt



DRUGBANK
Open Data Drug & Drug Target Database





Open PHACTS Support Portal

Welcome
[Login](#) [Sign up](#)

[Home](#) [Solutions](#) [Forums](#)

How can we help you today?

[SEARCH](#)

[Login](#) or [Signup](#) to submit a new ticket
[Check ticket status](#)

Knowledge base

General Overview

Platform FAQ (11)

- [Current System Status](#)
- [Are there rate limits to the API?](#)
- [What is the current production version of t...](#)
- [How can I download your entire dataset?](#)
- [Do you provide a SPARQL End Point?](#)
- [» See all 11 articles](#)

Release Notes (2)

- [1.3 API](#)
- [1.4 API](#)

Getting started (2)

- [How do I get access to the API?](#)
- [Reviewing API query results: Copy query U...](#)


Support portal FAQ (2)


- [How do I add a solution to the portal?](#)
- [One of your solutions should be changed, ...](#)


Community forums


Showing recent updates
[Start a new topic](#)


Open PHACTS Forums


 [Announcements \(4\)](#)

 [System Issues](#)
Posted by **Open PHACTS**, a year ago ,
Last Reply by Open PHACTS a year ago

 [Developers Mailing List](#)
Posted by **Open PHACTS**, a year ago

 [Staying Up To Date](#)
Posted by **Open PHACTS**, a year ago
[» See all 4 topics](#)

 [General Discussion \(4\)](#)

 [New Datasets](#)
Posted by Lee Harland, a year ago



The Application Ecosystem

Browsers



Open PHACTS

Browse and search the data within the Open PHACTS Discovery Platform. Developed by the [University of Manchester](#) and [University of Vienna](#)

[Open PHACTS Explorer »](#)

SciBite



Connects the latest news and events in Pharma and Biotech directly to Open PHACTS pharmacology data. Developed by [SciBite Limited](#)

[SciBite »](#)

Predictions



Intuitive predicts target pharmacology based on the Similar Ensemble Approach. Developed by the [Technical University of Denmark](#)

[GARField »](#)



Extracts data to build QSAR predictive models with data from the eTOX project. Developed by [PSMAR](#) as part of the [eTOX project](#)

[Collector »](#)

Advanced Analytics



ChemBioNavigator

Visualise the chemical and biological space of a molecule group. Developed by the [University of Hamburg](#) and [BioSolveIT GmbH](#)

[ChemBioNavigator »](#)

PHARMATREK

Navigate pharmacological space in a flexible and interactive way. Developed by the [Consorci Mar Parc de Salut de Barcelona \(PSMAR\)](#)

[PharmaTrek »](#)



Interconnecting Open PHACTS data with multiple target centric services. Developed by the [Spanish National Cancer Research Centre \(CNIO\)](#)

[Target Dossier »](#)



Allows the semantic enrichment of scientific articles in PDF format. Developed by the [University of Manchester](#)

[Utopia »](#)

Workflow Integration



accelrys[®] Pipeline Pilot

A repository of useful Pipeline Pilot components and workflows has been developed. Developed by the [Open PHACTS Scientific Community](#)

[Pipeline Pilot Components »](#)



A KNIME repository of components and workflows has been developed. Developed by the [Open PHACTS Scientific Community](#)

[KNIME Repository »](#)



Helium for Excel Community Edition contains three functions that use the Open PHACTS API. Developed by [Celba Solutions](#)

[Helium for Excel »](#)



Identifies significant entities in scientific text, and provides links to Open PHACTS Explorer. Developed by [AQnowledge](#)

[AQnowledge »](#)

How do I build my own application?

The Open PHACTS API allows external applications to query the data within the Open PHACTS Discovery Platform. The data can be combined with other datasets, analysed and visualised in any number of ways.



[Open PHACTS Services »](#)

Would you like your application mentioned on this page?

If you have an application or application idea that could use the Open PHACTS API, please contact us and we can tell our growing community of developers, app users and scientists.

[Contact us »](#)









TARGETS




p38 alpha homo X You have 1 targets selected

Mitogen-activated protein kinase 14 (Homo sapiens)
Amino Acid, Peptide, or Protein


  

alpha thalassemia/mental retardation syndrome X-linked homolog (human) protein, mouse
Amino Acid, Peptide, or Protein




  


   ☐ connect

LIGANDS







2(1H)-quinazolinone, 5-(2-chloro-4-fluorophenyl)-1-(2,6-dichlorophenyl)-3,4-dihydro-7-(4-piperidinyl)-






2(1H)-quinazolinone, 5-(2-chloro-4-fluorophenyl)-1-(2,6-dichlorophenyl)-3,4-dihydro-7-(4-piperidinyl)-

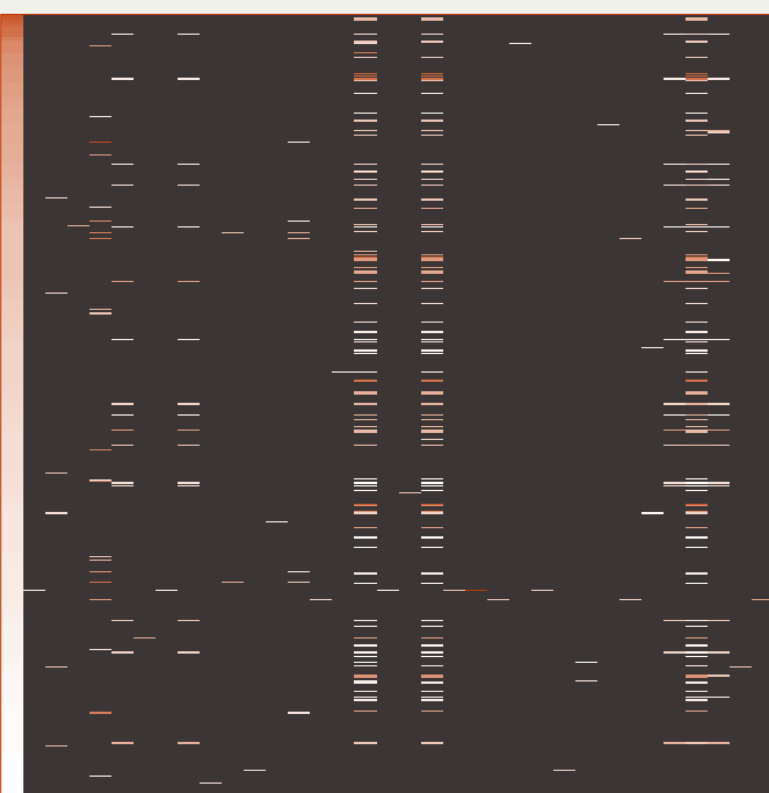
  



2(1H)-quinazolinone, 5-(2-chlorophenyl)-1-(2,6-dichlorophenyl)-3,4-dihydro-7-(1-piperazinylmethyl)-




  

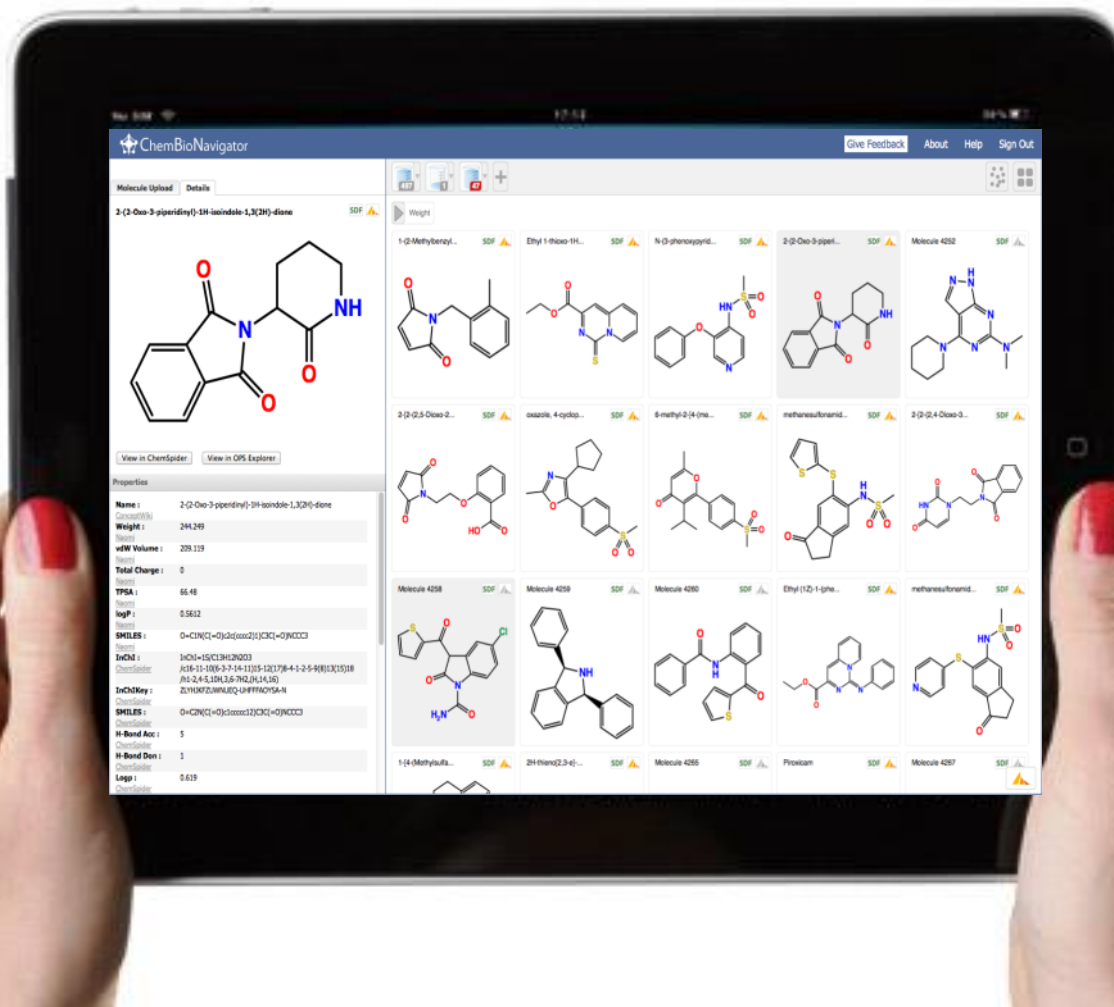
Interaction Map



35 TARGETS
546 MOLECULES
Min annotation [8.00]
Max annotation [10.41]

☒ Expand target space

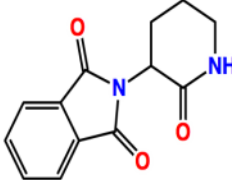
  

The tablet screen shows the ChemBioNavigator web application. The interface includes a top navigation bar with 'Give Feedback', 'About', 'Help', and 'Sign Out' links. The main content area is divided into a left sidebar for molecule details and a main grid for molecule thumbnails.

Molecule Upload Details

2-(2-Oxo-3-piperidinyl)-1H-isindole-1,3(2H)-dione

Chemical Structure: 

Properties:

- Name: 2-(2-Oxo-3-piperidinyl)-1H-isindole-1,3(2H)-dione
- Weight: 244.249
- Volume: 239.119
- Total Charge: 0
- TPSA: 66.48
- logP: 0.5612
- SMILES: O=C1NC(=O)C2=CC=CC=C2N1C3=CC=CC=C3
- InChI: O=C1NC(=O)C2=CC=CC=C2N1C3=CC=CC=C3
- InChIKey: O=C1NC(=O)C2=CC=CC=C2N1C3=CC=CC=C3
- H-Bond Acc: 5
- H-Bond Don: 1
- LogP: 0.619

Molecule Grid:

- 1-(2-Methylbenzyl)-...
- Ethyl 1-thioxo-1H-...
- N-(3-phenoxypyridin-2-yl)-...
- 2-(2-Oxo-3-piperidinyl)-...
- Molecule 4252
- 2-(2-Oxo-3-piperidinyl)-...
- oxazole, 4-cyano-...
- 6-methyl-2-(4-oxo-...
- methanesulfonamid-...
- 2-(2-Oxo-3-piperidinyl)-...
- Molecule 4258
- Molecule 4259
- Molecule 4260
- Ethyl (2Z)-1-phenyl-...
- methanesulfonamid-...
- 1-(4-Methylsulfonyl)-...
- 2H-thieno[2,3-b]pyridine
- Molecule 4265
- Proxiam
- Molecule 4267

9 of 16 pages



KNIME

Table View - 0:31 - Interactive Table (7 x 6)

File	Hilite	Navigation	View	Output	
\$ Name	\$ Inchi	\$ Activity	\$ Units	\$ Relation	\$ Target
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	3400	nM	=	Serine/threonine-protein kinase PLK4
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	250	nM	=	MAP kinase signal-integrating kinase 2
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	5.4	uM	=	HCT-116 (Colon carcinoma cells)
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	1700	nM	=	Ephrin type-B receptor 1
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	3300	nM	=	Dual specificity mitogen-activated protein kinase kin.
.. Sorafenib	MLDQTXFUGDVEO-UHFFFAOYSA...	6200	nM	=	Cyclin-dependent kinase 5

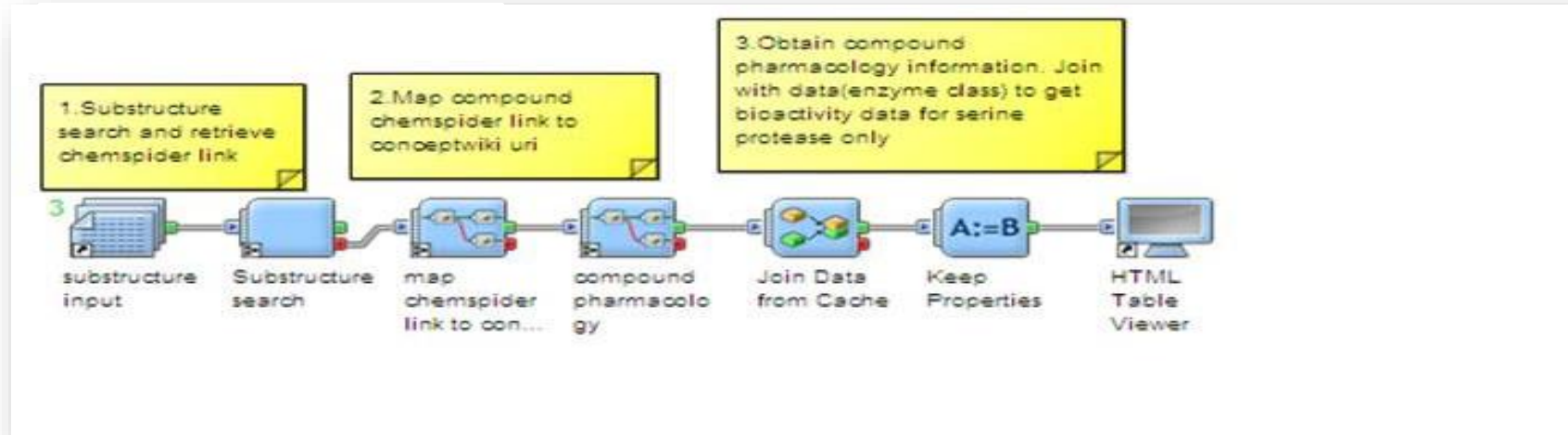
Workflow Projects | Node Description

0: KNIME_project | *0: OPS_Pharmacology

Workflow:

- File Reader: Simply gets the URL [I dont know how to get it to start otherwise!]
- Java Snippet: Fetch JSON from web
- Get Name and Inchi: Name & Inchi Grabber
- Get Activity: Now turn the activity JSON into rows
- Activity Parser: For each activity row, extract the columns we want
- Column Filter: Tidy Up: Remove Processing Columns Now
- Interactive Table: Node 31

Node Repository



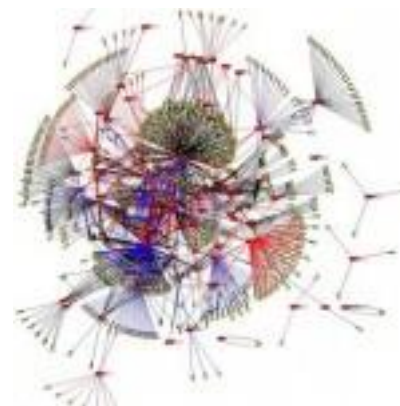


Sustaining Impact

✚ “Software is free like puppies are free - they both need money for maintenance”



✚ ...and more resource for future development





Open PHACTS Mission:
Integrate Multiple Research
Biomedical Data Resources
Into A Single Open & Free
Access Point



Open PHACTS Associate Partner Community



The Open PHACTS Foundation

OPF is a not-for-profit membership organisation, supporting the Open PHACTS Discovery Platform:

A sustainable, open, vibrant and interoperable information infrastructure for applied life science research and development.

To reduce the barriers to drug discovery in industry, academia and for small businesses, the **Open PHACTS Discovery Platform** provides tools and services to interact with multiple integrated and publicly available data sources. To integrate this data, extensive cross-referencing of scientific concepts is needed across all databases.

The Open PHACTS Foundation ensures the sustainability of the **Open PHACTS Discovery Platform** infrastructure and acts as a hub for relevant scientific research and development.



ChEMBL



The free chemical database

**DRUGBANK**
Open Data Drug & Drug Target DatabaseWikiPATHWAYS
Pathways for the People

Key Resources

 [Open PHACTS API](#) [Open PHACTS Repository](#)

Subscribe to the Foundation Newsletter

Subscribe

Contact us

Email:
info@openphactsfoundation.org

Twitter: [@Open PHACTS](#)

Membership Benefits



The not-for-profit Foundation maintains the Open PHACTS Discovery Platform, a versatile infrastructure of integrated biomedical data, and actively engages an ecosystem of industry and academic semantic web experts.

Integrated data:

- Pharmacological
- Physicochemical
- Disease
- Gene
- Pathways

Steer the direction

- Prioritise new projects
- Get involved with Foundation governance
- Identify development opportunities
- Propose new data sources to include
- Develop new use-cases and workflows
-

Training opportunities

Enjoy training opportunities by experts.

Early access to releases

Members have early access to infrastructure and platform updates and new releases, including a locally installable system

Engage a community of experts and peers

The Foundation serves a unique and vibrant scientific community, facilitating collaboration between the pharma industry, academia & SMEs.

Influence the security policy

Membership Levels

Full

Nominate and vote for the Board of Trustees

Contributing

Vote for the Board of Trustees

Individual

Non-voting

Get involved in projects and collaborate

turnover. Pay in cash or by donating people-hours to the Foundation.

www.openphactsfoundation.org

info@openphactsfoundation.org

Open PHACTS Foundation
c/o Royal Society of Chemistry,
Thomas Graham House,
Science Park, Cambridge, CB4 0WF



Acknowledgements



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Consorti Mar Parc de Salut de Barcelona
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Royal Society of Chemistry
Vrije Universiteit Amsterdam
Novartis
Merck Serono
H. Lundbeck A/S
Eli Lilly
Netherlands Bioinformatics Centre
Swiss Institute of Bioinformatics
ConnectedDiscovery
EMBL-European Bioinformatics Institute
Janssen Esteve Almirall
OpenLink Scibite
The Open PHACTS Foundation
Spanish National Cancer Research Centre
University of Manchester
Maastricht University
Aqnowledge
University of Santiago de Compostela
Rheinische Friedrich-Wilhelms-Universität Bonn
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Pfizer



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