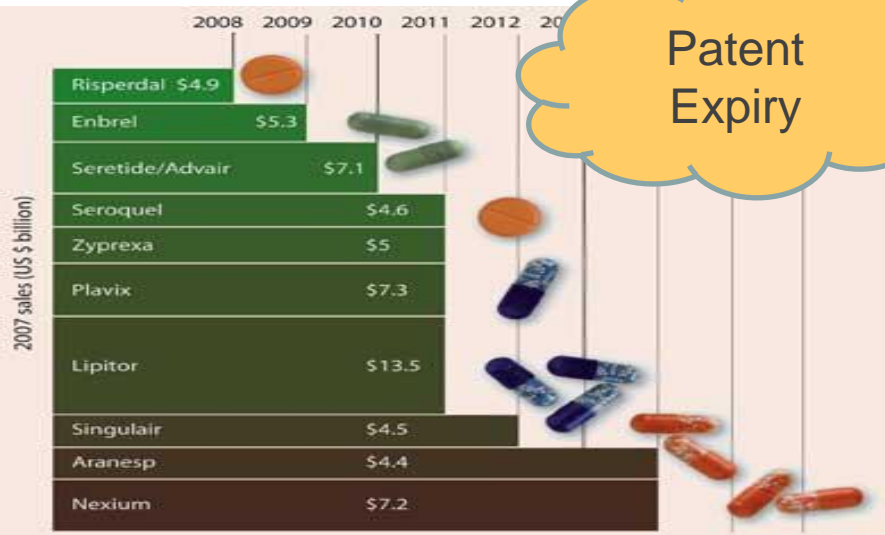


The Open PHACTS Discovery Platform

Semantic Data Integration for Life Sciences

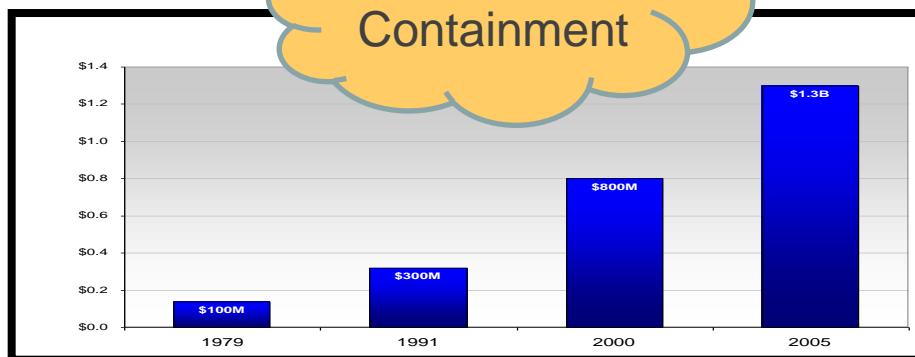


Patent Expiry



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

Cost Containment



Generic Competition

Resulting in a sales revenue

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



PricewaterhouseCoopers LLP

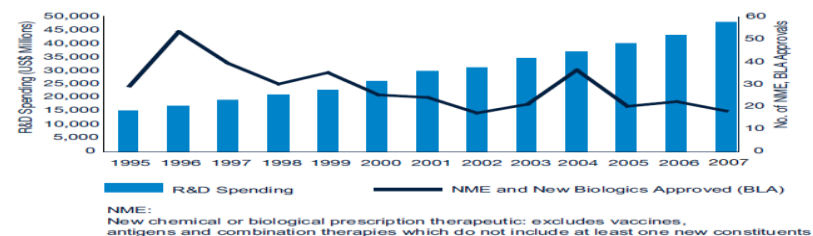
Source: IMS Health Midas

7

PwC - Pharma 2020 - Value of Patent Expiries

Improve R&D Productivity

Figure 1: The decline in R&D productivity



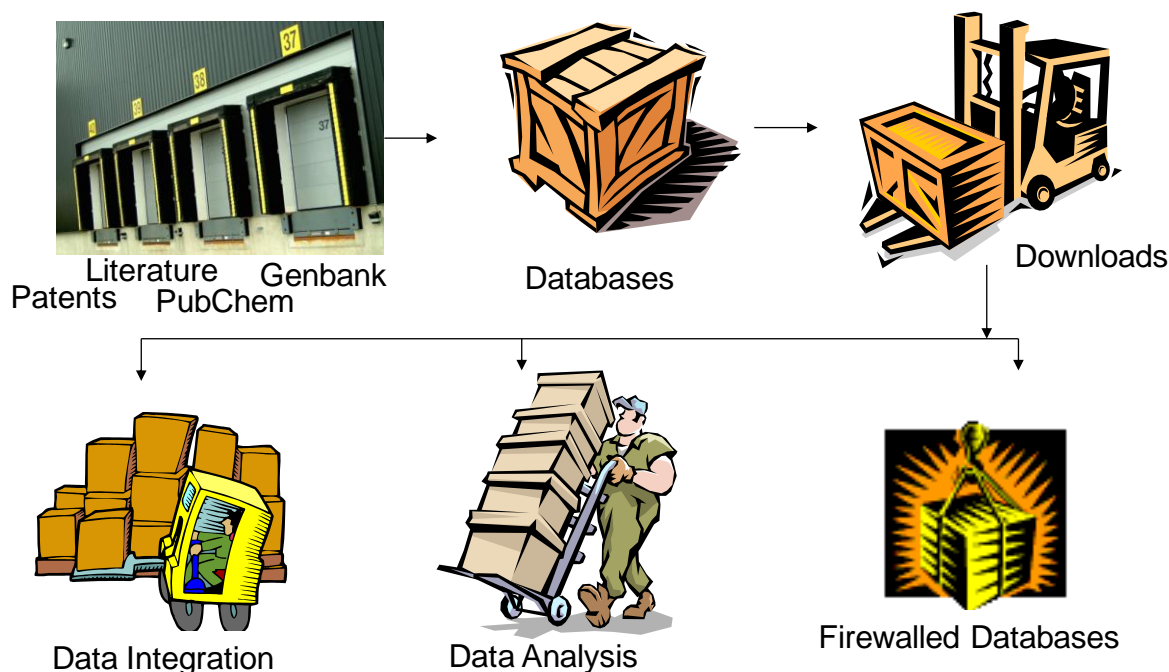
Source: FDA CDER, PhRMA and PricewaterhouseCoopers analysis

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



**X Repeat @
each
company**

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

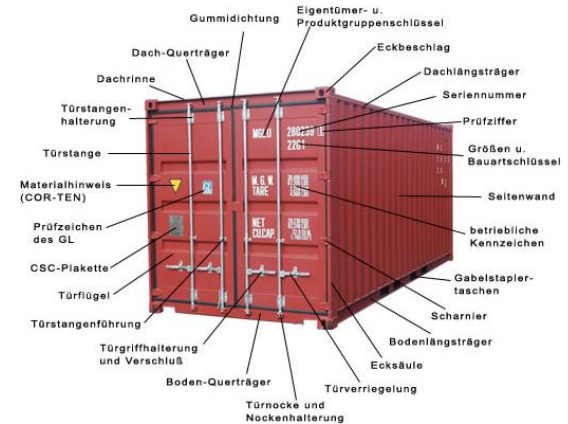


Over the last decade

- 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

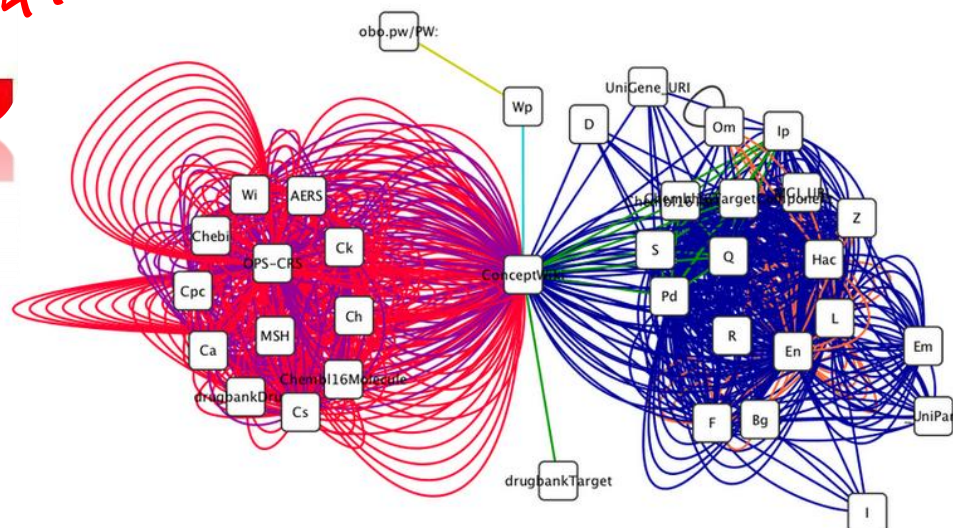
~~RS_2353~~

~~GB:29384~~

~~P12047~~

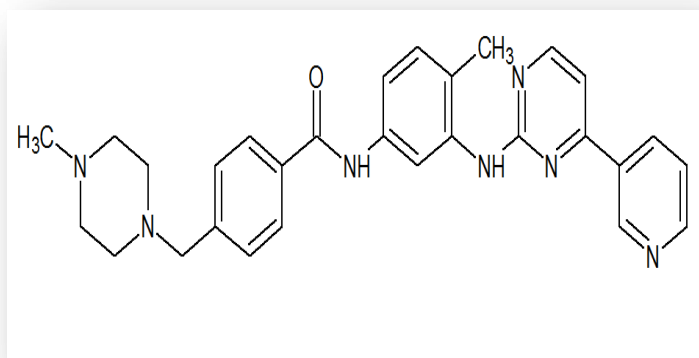
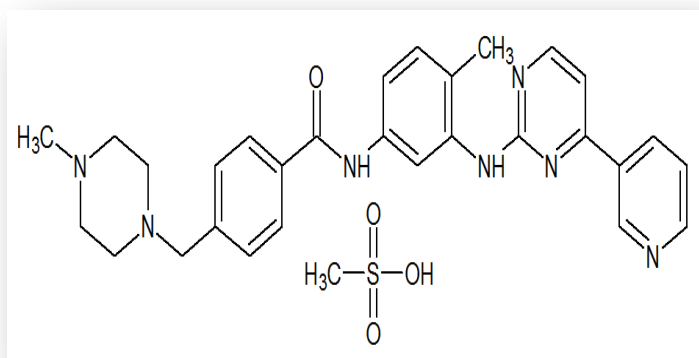
~~X31045~~

P12047





Are These Two Molecules The Same(*)



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



Data Licensing Solution

Chose John Wilbanks as consultant

A framework built around STANDARD well-understood Creative Commons licences – and how they interoperate

Deal with the problems by:



- ✦ Interoperable licences
- ✦ Appropriate terms
- ✦ Declare expectations to users and data publishers
- ✦ One size won't fit all requirements

Compatibility chart		Terms that may be used for a derivative work or adaptation						
		BY	BY-NC	BY-NC-ND	BY-NC-SA	BY-ND	BY-SA	PD
Status of original work	PD							
	BY							
	BY-NC							
	BY-NC-ND							
	BY-NC-SA							
	BY-ND							
	BY-SA							

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

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:

- We are currently in beta. [Let us know](#) if you have a feature request or bug report.
- 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:





**Open PHACTS** **Open PHACTS Support Portal**

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

How can we help you today?

Enter your search term here...[SEARCH](#)

[+ New support ticket](#)
[Check ticket status](#)

Knowledge base

General

FAQ (7)

- [How do I get access to the API?](#)
- [Whats the current production version of the ...](#)
- [Whats the version of data source X in Open ...](#)
- [How do I download your data?](#)
- [What data is in the system exactly?](#)

[» See all 7 articles](#)


API FAQs


[General API Questions \(1\)](#)[API Guide \(3\)](#)

Community forums


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

Open PHACTS Forums


 [Announcements \(3\)](#)

[Developers Mailing List](#)


Posted by **Open PHACTS**, a month ago


[Staying Up To Date](#)

Posted by **Open PHACTS**, a month ago

[Using This Site](#)

Posted by **Open PHACTS**, a month ago

 [General Discussion \(3\)](#)

[README FIRST!](#)

Posted by **Open PHACTS**, a month ago

support.openphacts.org



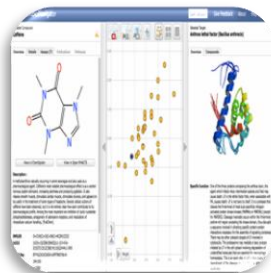
Explorer



Explorer2



ChemBioNavigator



Target Dossier



Pharmatrek



Helium



MOE



Collector



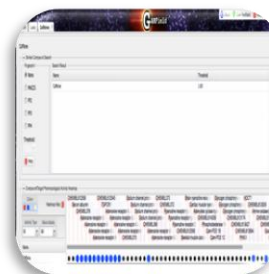
Cytophacts



Utopia



Garfield



SciBite



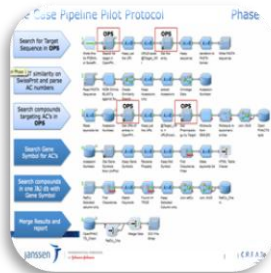
KNIME



Mol. Data Sheets



PipelinePilot



scinav.it



Taverna





KNIME

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

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

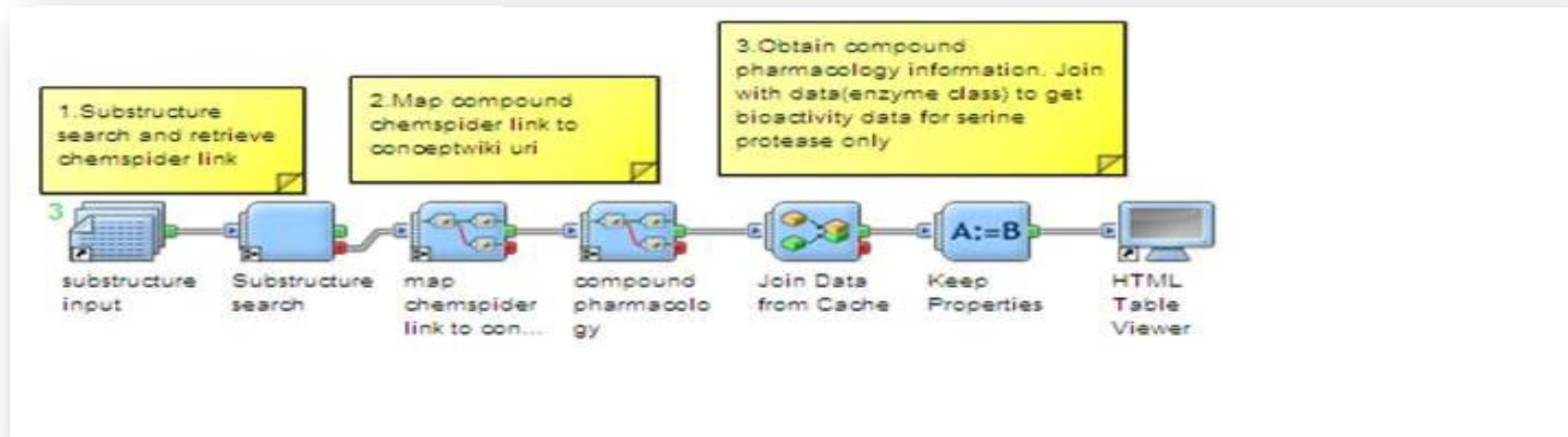
Workflow Diagram:

```

graph LR
    FileReader[File Reader] --> JavaSnippet[Java Snippet]
    JavaSnippet --> GetNameInchi[Get Name and Inchi]
    GetNameInchi --> GetActivity[Get Activity]
    GetActivity --> ActivityParser[Activity Parser]
    ActivityParser --> ColumnFilter[Column Filter]
    ColumnFilter --> InteractiveTable[Interactive Table]
  
```

Node Descriptions:

- 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



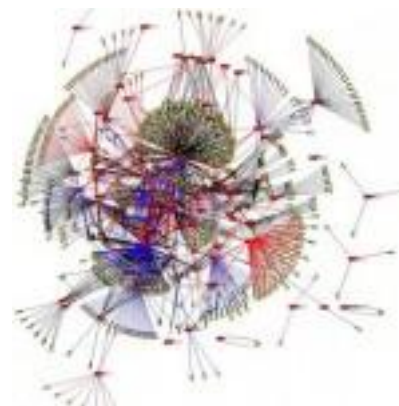


Sustaining Impact

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



✚ ...and more resource for future development

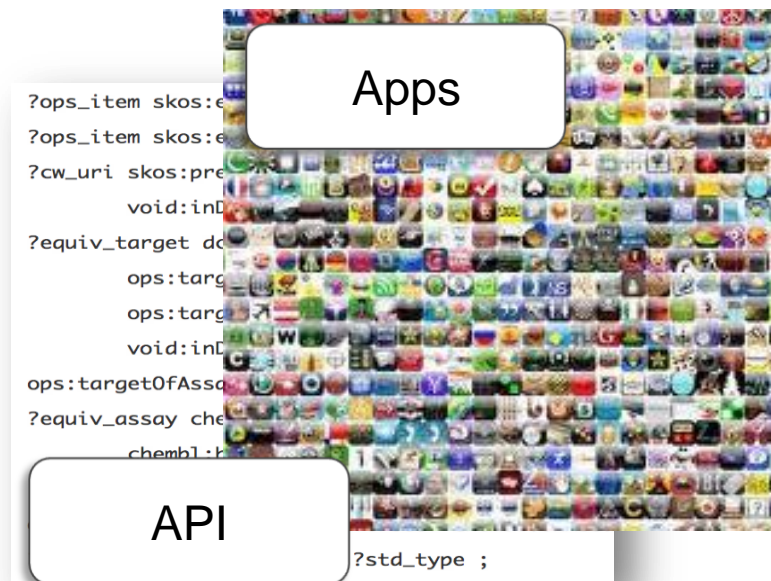
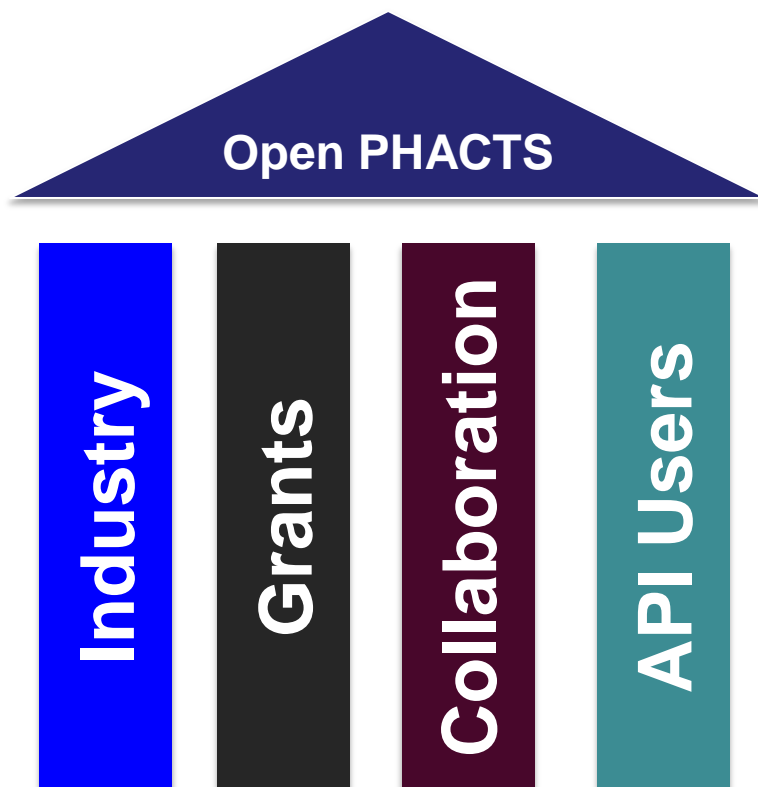




Open PHACTS Mission:
Integrate Multiple Research
Biomedical Data Resources
Into A Single Open & Free
Access Point



Kick-Starting Sustainability





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](#)

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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

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

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

www.openphactsfoundation.org

info@openphactsfoundation.org

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Thomas Graham House,
Science Park, Cambridge, CB4 0WF



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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

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University of Manchester

Maastricht University

Aknowledge

University of Santiago de Compostela

Rheinische Friedrich-Wilhelms-Universität
Bonn

AstraZeneca

Pfizer



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