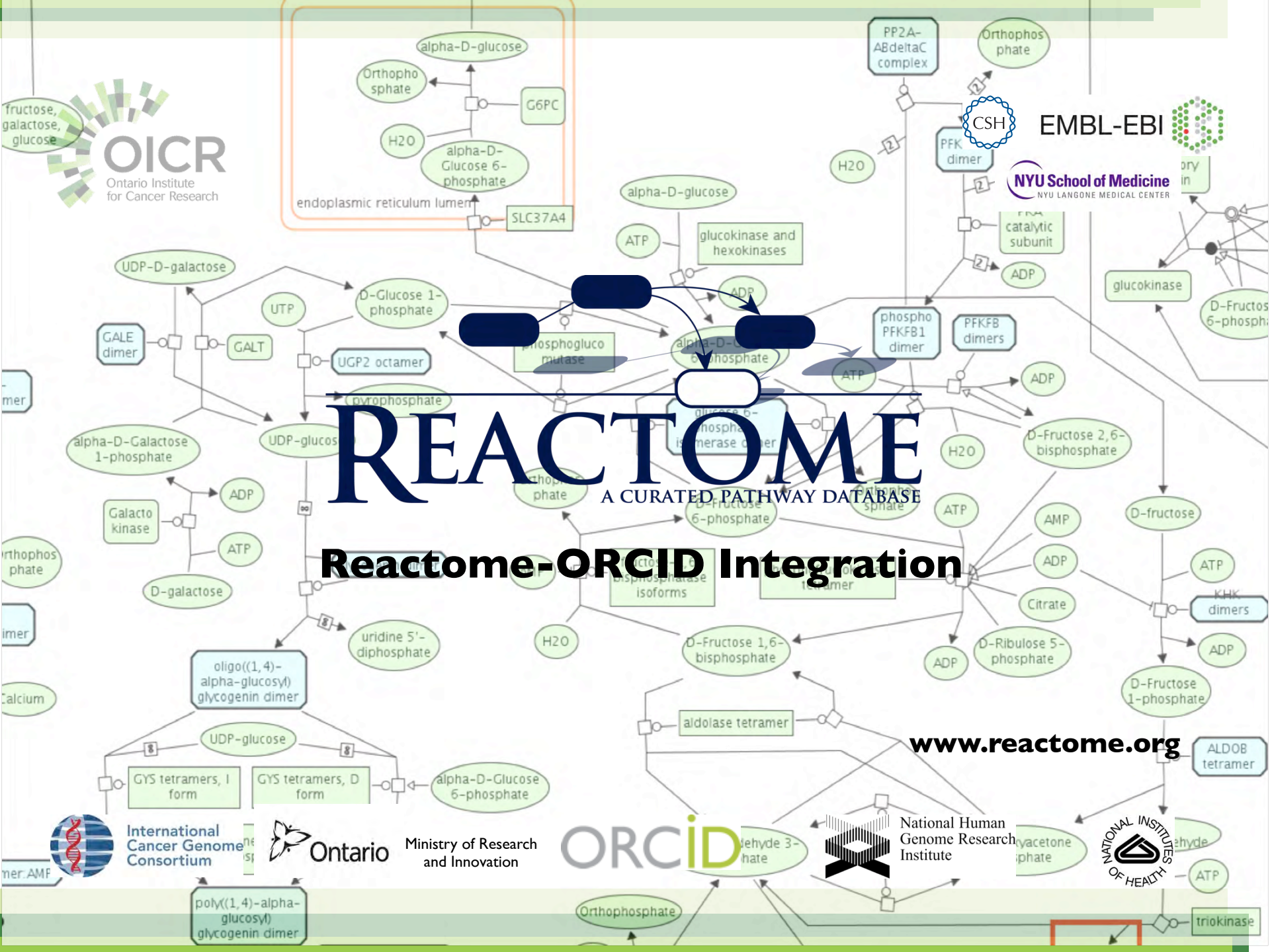

OICR
Ontario Institute for Cancer Research
CSH
EMBL-EBI
NYU School of Medicine
NYU LANGONE MEDICAL CENTER
REACTOME
A CURATED PATHWAY DATABASE
Reactome-ORCID Integration
www.reactome.org
International Cancer Genome Consortium
Ontario
Ministry of Research and Innovation
ORCID
National Human Genome Research Institute
NATIONAL INSTITUTES OF HEALTH
alpha-D-glucose
Orthophosphate
G6PC
H2O
alpha-D-Glucose 6-phosphate
endoplasmic reticulum lumen
SLC37A4
PP2A-ABdeltaC complex
PFK dimer
PFK catalytic subunit
ATP
ADP
glucokinase and hexokinases
glucokinase
UDP-D-galactose
D-Glucose 1-phosphate
UTP
GALE dimer
GALT
UGP2 octamer
pyrophosphate
phosphoglucomutase
phospho PFKFB1 dimer
PFKFB dimers
alpha-D-Galactose 1-phosphate
UDP-glucose
D-Fructose 2,6-bisphosphate
H2O
Galacto kinase
D-galactose
D-Fructose 6-phosphate
AMP
Citrate
D-fructose
KHK dimers
uridine 5'-diphosphate
D-Fructose 1,6-bisphosphate
D-Ribulose 5-phosphate
D-Fructose 1-phosphate
oligo((1,4)-alpha-glucosyl) glycogenin dimer
aldolase tetramer
ALDOB tetramer
UDP-glucose
GYS tetramers, I form
GYS tetramers, D form
alpha-D-Glucose 6-phosphate
poly((1,4)-alpha-glucosyl) glycogenin dimer
triokinase

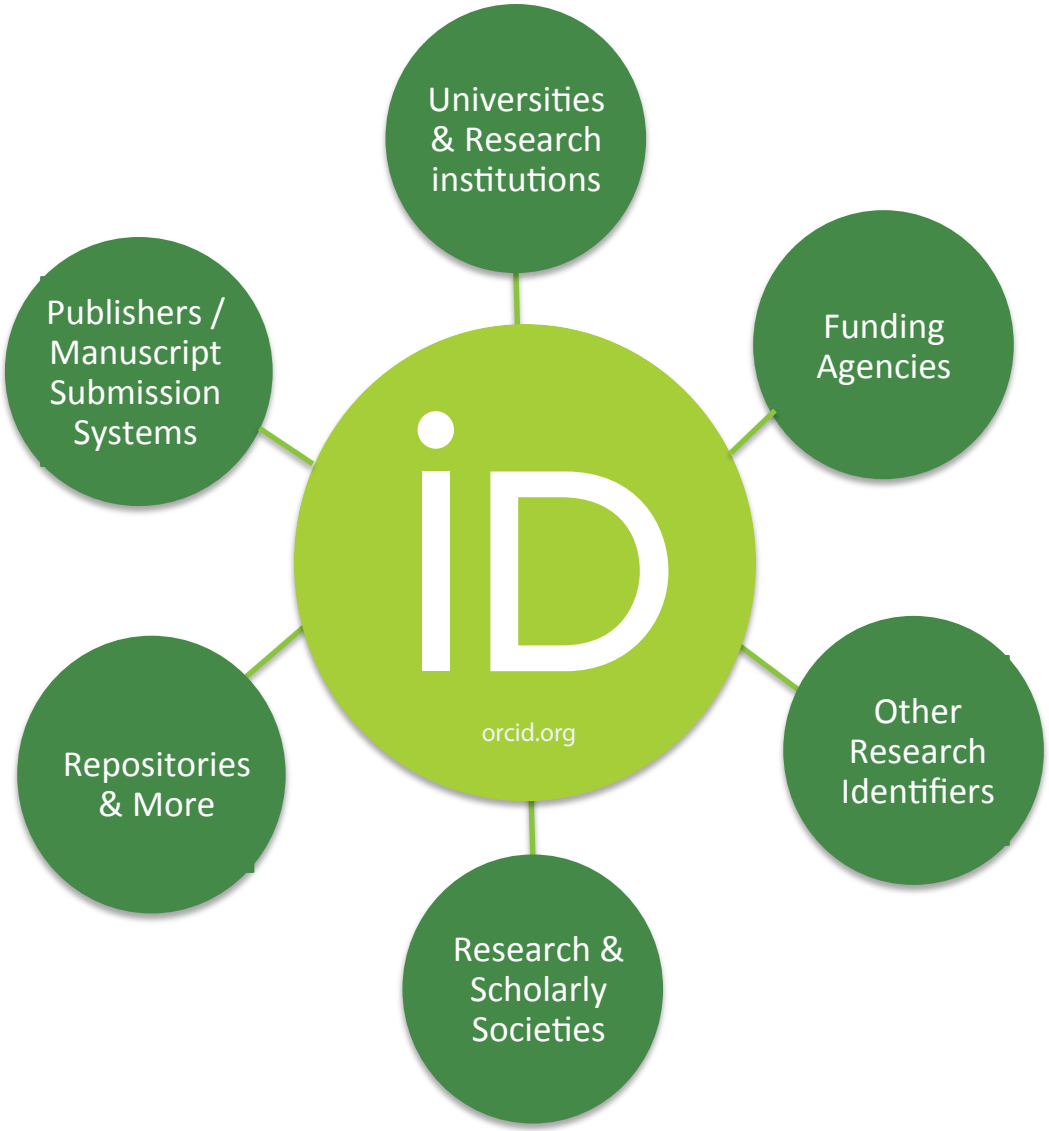
What is ORCID?

- ORCID is an **international, interdisciplinary, open, not-for-profit, community-driven** organization. We collaborate with researchers and organizations across the research community.
- Our core mission is to provide an **open registry of persistent unique identifiers for researchers and scholars** AND to automate **linkages to research works by embedding identifiers in research workflows.**

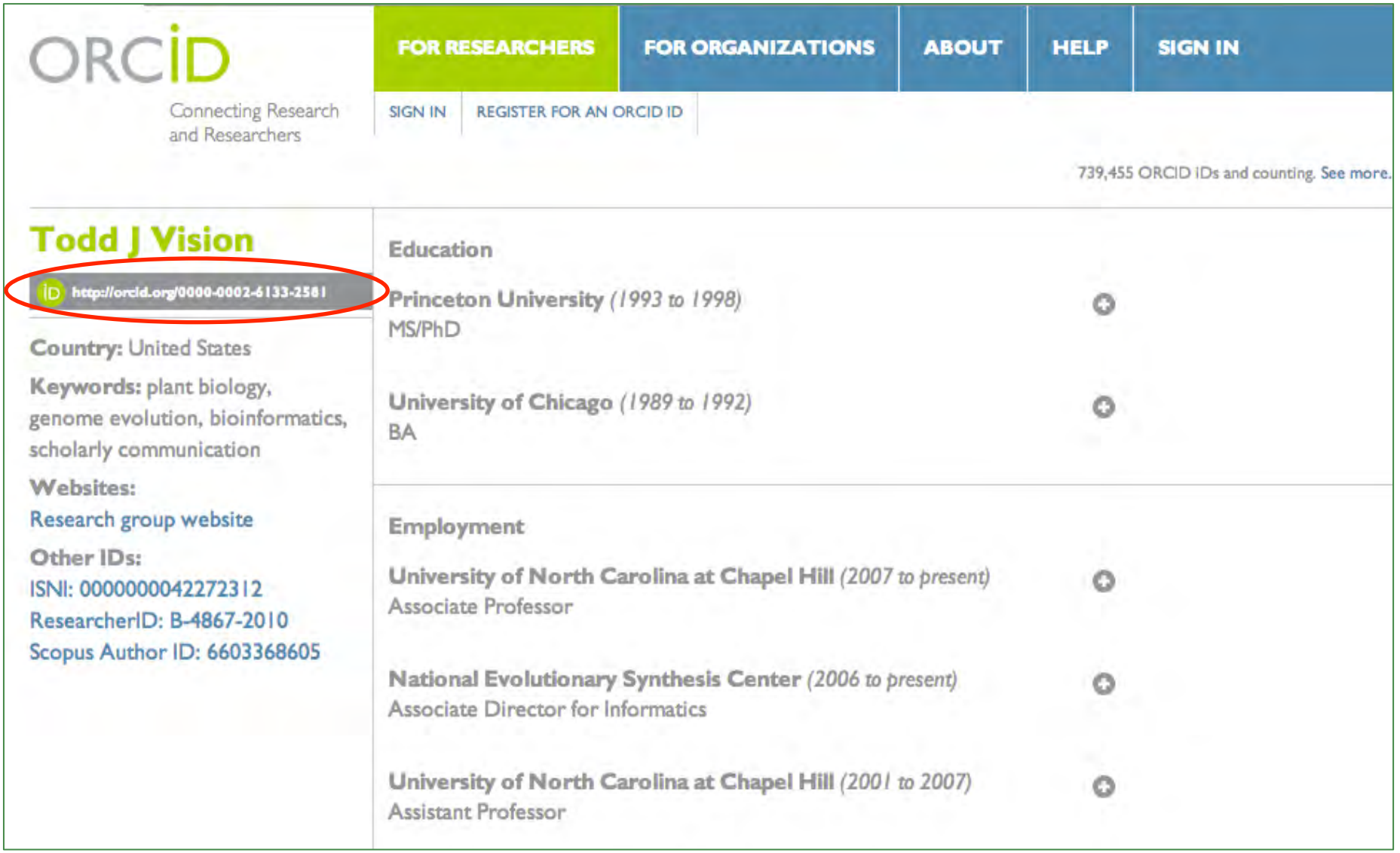
The Problem

- The research community has lacked the ability to link researchers with their professional activities.
- As a researcher, you want to
  - ✓ **ensure your work is discoverable** and **connected to you** throughout your career;
  - ✓ **minimize the time** you spend entering repetitive data online; and
  - ✓ **eliminate name ambiguity**, distinguishing you from other researchers and ensuring proper attribution.

ORCID is a hub connecting the research landscape



What does an ORCID record look like?

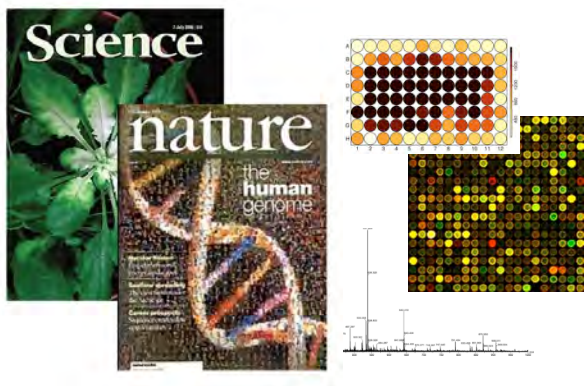


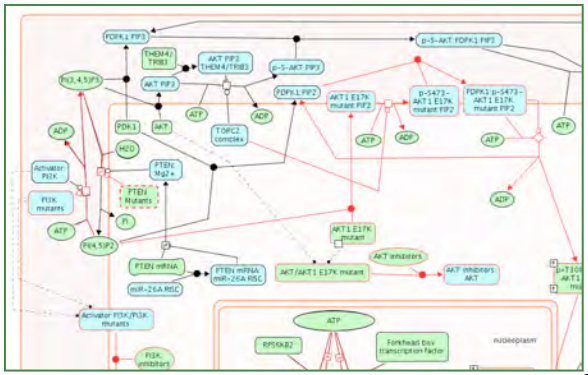
Registration is free and fast

- Registration is easy.
- Signing up for an ORCID iD only takes seconds.
- Enhance your ORCID record with your professional activities and begin to use your ORCID iD as you submit publications, apply for grants, and in any research workflow to ensure you get credit for your work.

What is Reactome?

- Open source and open access pathway knowledgebase
  - 1500 human pathways encompassing metabolism, signaling, and other biological processes.
  - Biological pathways that describe normal and disease-related events in the human cell.
  - Every pathway is traceable to primary literature.
- Pathway databases like Reactome satisfy common "use cases" in biological and clinical research:
  - Intuitive display of biological information.
  - Visualize multiple experimental data types on a pathway.
  - Computational methods available to automate analysis.
- Collaboration between CSHL, OICR, NYUMC, EBI (not a single institution!)





OICR Ontario Institute for Cancer Research

REACTOME

Reactome Homepage

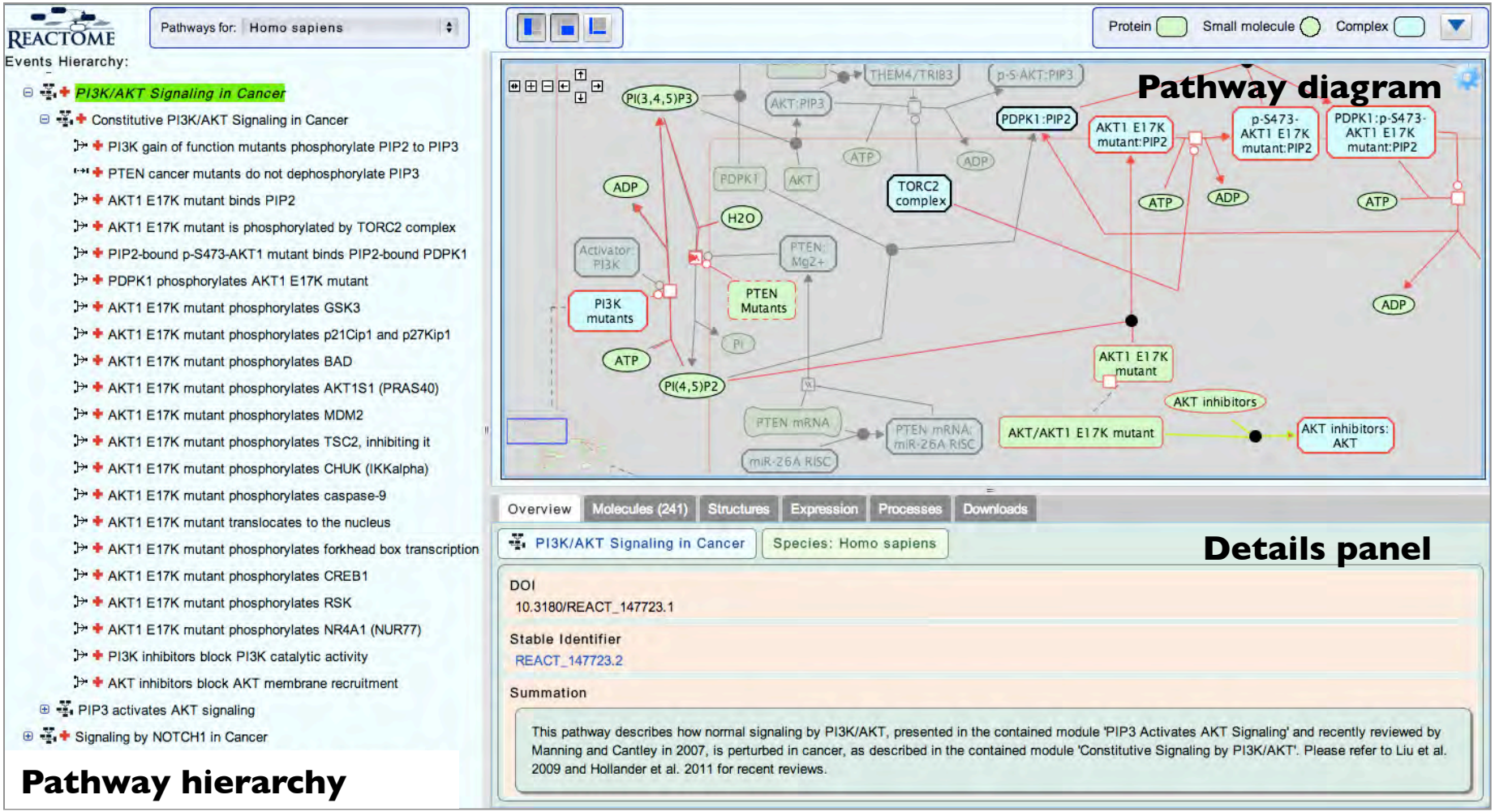
www.reactome.org

OICR Ontario Institute for Cancer Research

REACTOME

Pathway Browser

- Google-map style pathway diagrams



Data Curation Process

(10 Reactome staff)

- Pathway modules are expert authored, manually curated and peer-reviewed.
  - Recruit bench scientists to write pathway modules.
  - Curators work with authors to ensure consistency and completeness.
  - Module checked by peer review and software before publications.
  - Public Release of Curated data every 3 months.
  - Regular Pathway updates.

Reactome-ORCID Project Goals

- Stage I: Expand the Reactome data model and database to support ORCID iDs.
- Stage II: Integrate ORCID iD into Reactome software tools and website.
- Stage III: Import and deploy ORCID iD data within Reactome.
- Stage IV: Create documentation, training and outreach.

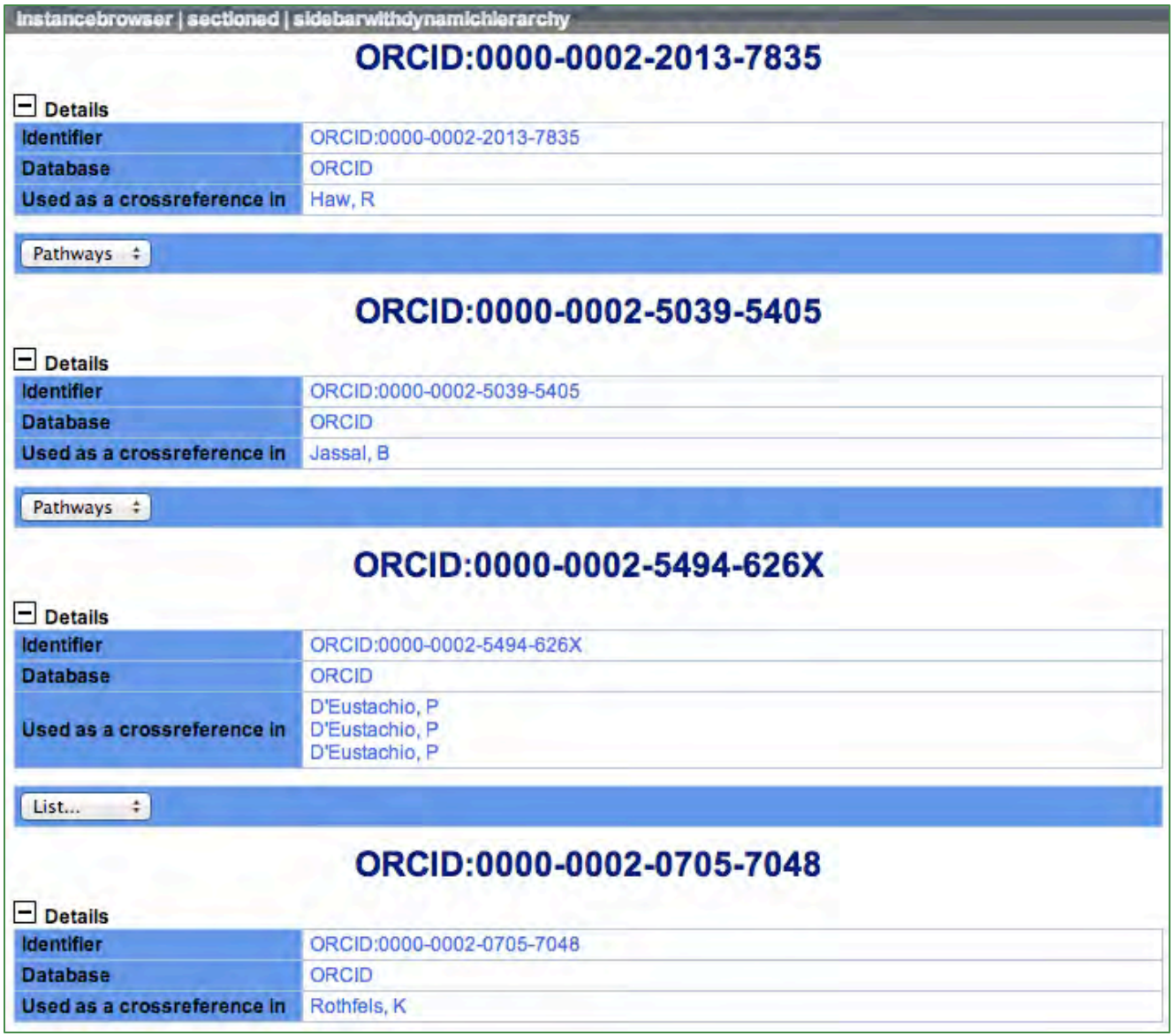
Stage I: Expand the Reactome data model and database to support ORCID iDs

- Updated "Person" class in Reactome database to include cross-reference to ORCID

Class:Id	Person:1169275
_displayName	Haw, Robin
_timestamp	2014-02-26 10:55:32
affiliation	[Affiliation:1169271] Ontario Institute for Cancer Research
created	[InstanceEdit:1169274] Haw, R, 2011-01-18
crossReference	[DatabaseIdentifier:5334735] ORCID:0000-0002-2013-7835
eMailAddress	robin.haw@oicr.on.ca
firstname	Robin
initial	R
modified	[InstanceEdit:5334736] Matthews, Lisa, 2014-02-26
surname	Haw
(author)	[InstanceEdit:1169274] Haw, R, 2011-01-18 [InstanceEdit:1990850] Haw, R, 2011-11-07 [InstanceEdit:2121207] Haw, R, 2012-02-06 [InstanceEdit:2252619] Haw, R, 2012-05-17 [InstanceEdit:3110296] Haw, R, 2013-02-10

Class:Id	InstanceEdit:3110296
_displayName	Haw, R, 2013-02-10
_timestamp	2013-02-11 09:05:20
author	[Person:1169275] Haw, Robin
created	▪ [InstanceEdit:3110295] Orlic-Milacic, M, 2013-02-11
dateTime	2013-02-10 00:00:00
(reviewed)	[Reaction:2220944] ADAM10/17 cleaves ligand-bound NOTCH1 PEST domain mutants to produce NEXT1 PEST domain mutants [Homo sapiens] [Reaction:2220957] NOTCH1 PEST domain mutants coactivator complex binds CDK8:CCNC [Homo sapiens] [Reaction:2220964] NICD1 PEST domain mutants in complex with RBPJ (CSL) bind MAML [Homo sapiens] [BlackBoxEvent:2220966] NOTCH1 PEST domain mutants stimulate HES5 transcription [Homo sapiens] [BlackBoxEvent:2220967] p-NICD1 PEST domain mutants do not bind FBXW7 [Homo sapiens] [Reaction:2220971] CDK8 phosphorylates NICD1 PEST domain mutants [Homo sapiens] [Reaction:2220976] NOTCH1 HD+PEST domain mutants are cleaved by ADAM10/17 irrespective of ligand binding [Homo sapiens] [BlackBoxEvent:2220978] FBXW7 WD mutants do not bind NICD1 [Homo sapiens] [BlackBoxEvent:2220979] NOTCH1 PEST domain mutants stimulate HES1 transcription [Homo sapiens] [BlackBoxEvent:2220981] NOTCH1 PEST domain mutants stimulate HEY transcription [Homo sapiens] List all 50 refering instances

All Reactome Curators have ORCID iDs

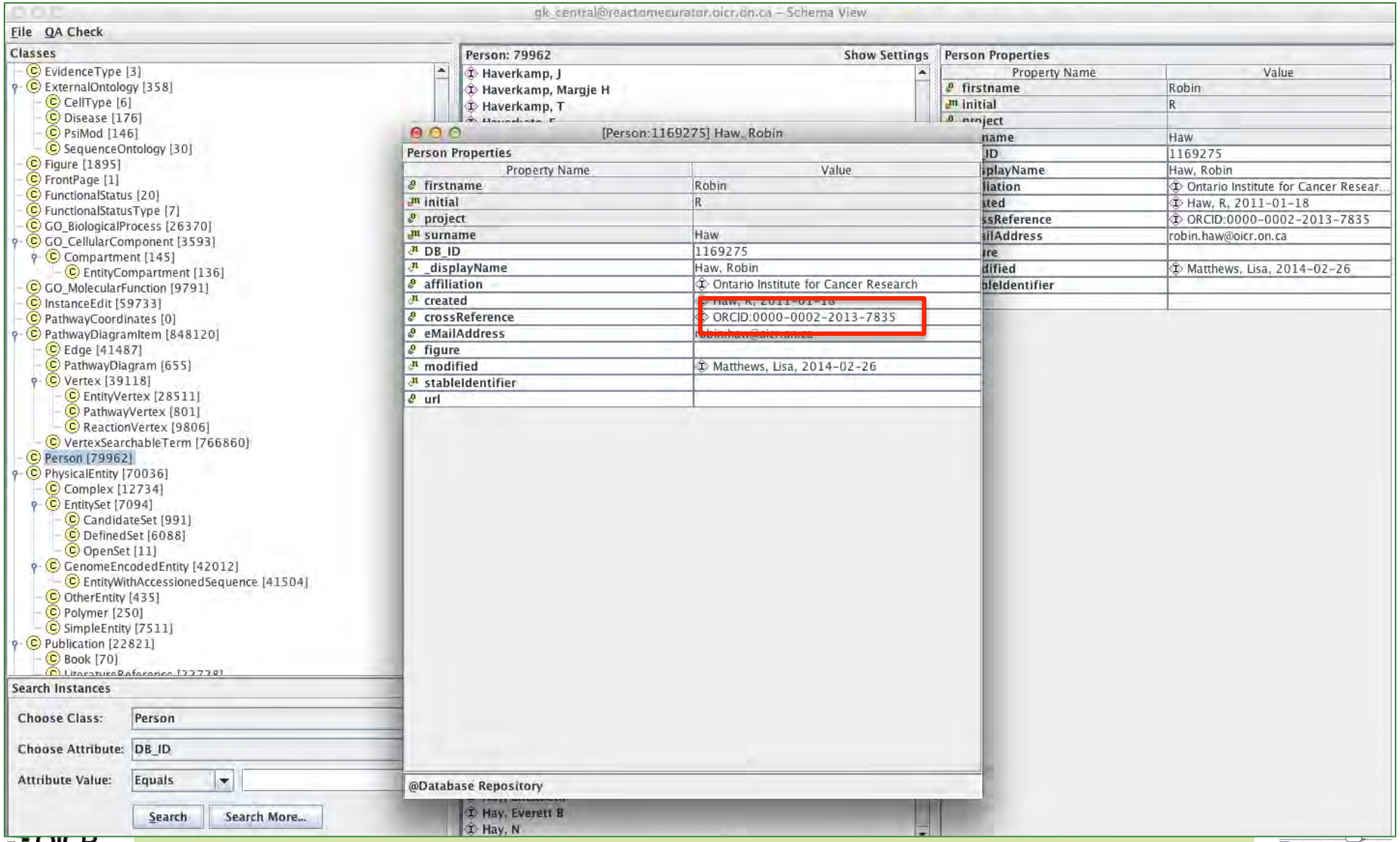


OICR Ontario Institute for Cancer Research

REACTOME

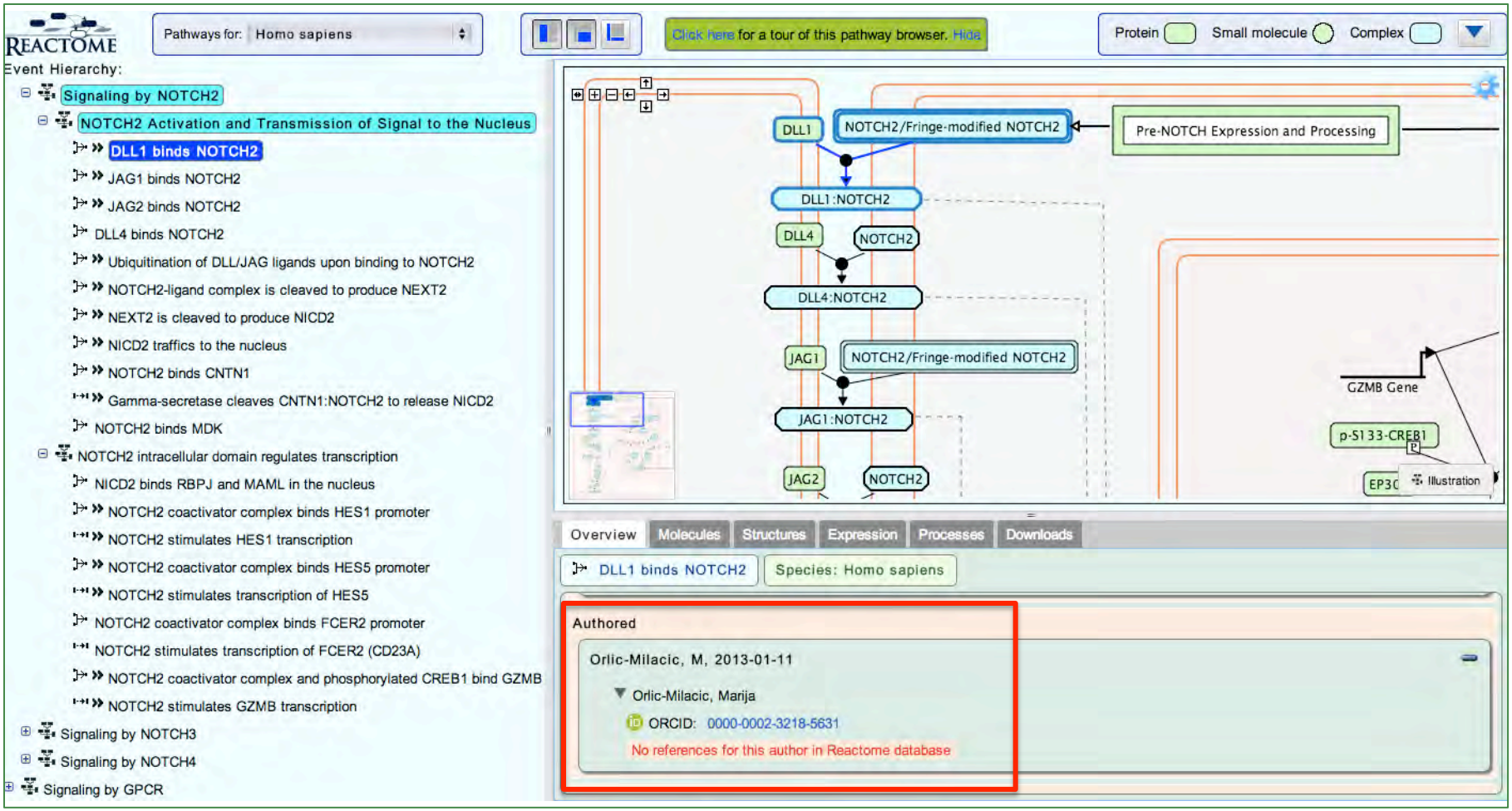
Stage II: Integrate ORCID iD into Reactome software tools and website.

Curators can easily add ORCID iDs to Reactome records as they curate pathway annotations.



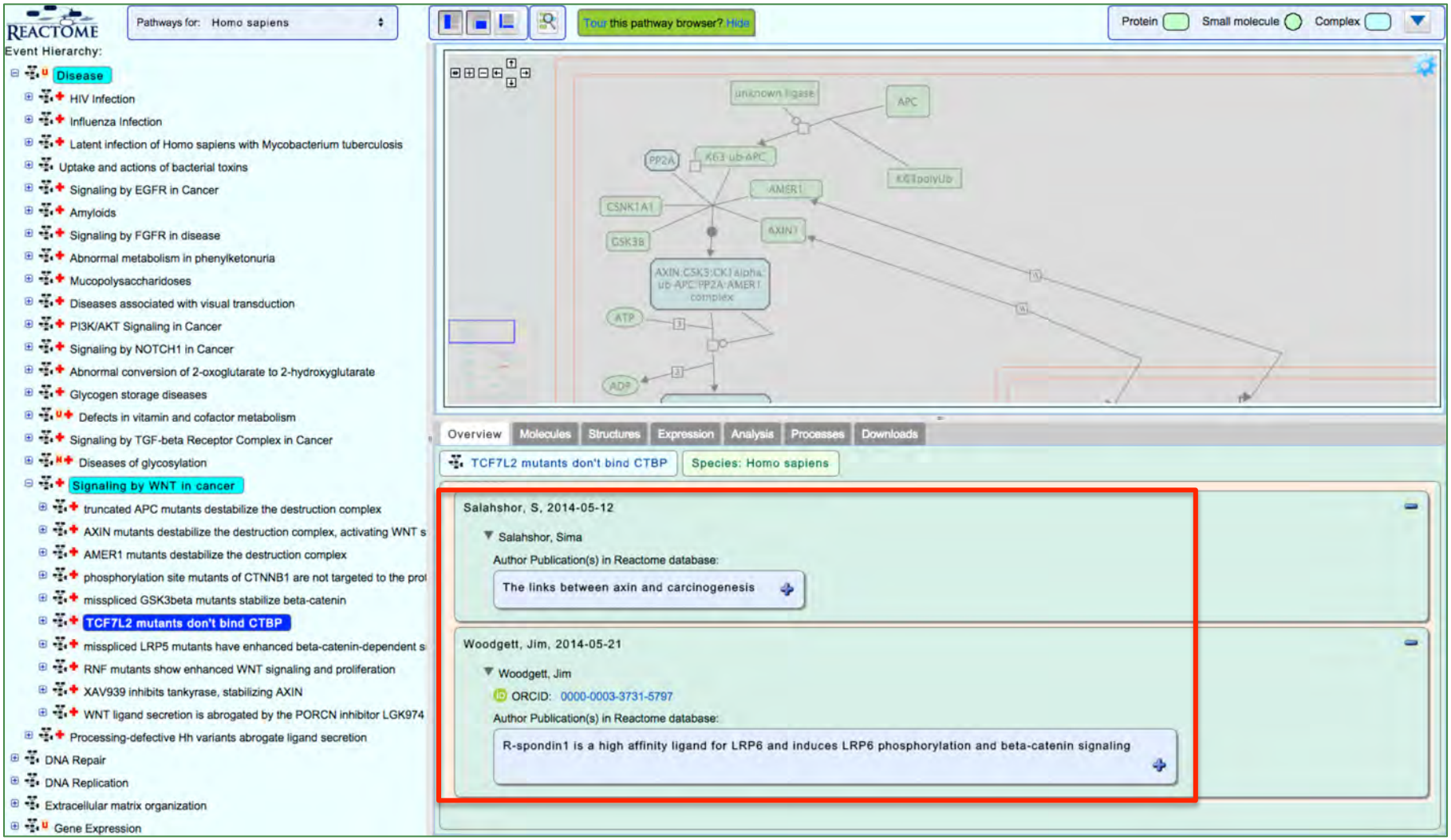
ORCID - Author Attribution

Users can see the ORCID iD to track author contributions and link out to ORCID registry.

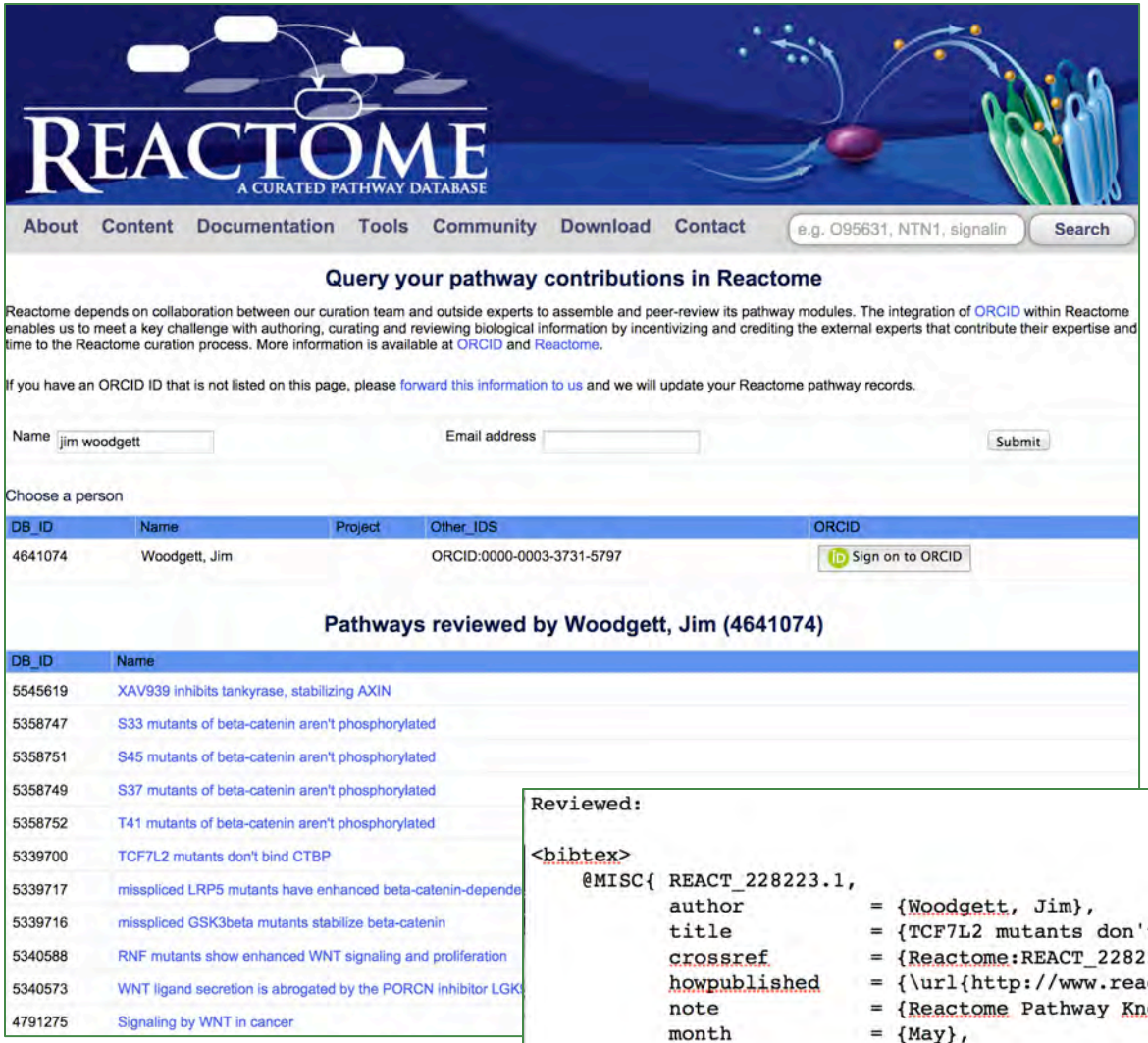


ORCID - Reviewer Attribution

Users can see their ORCID iD to track reviewer contributions and link out to ORCID registry.



Stage II: Integrate ORCID iD into Reactome software tools and website.



Authors/Reviewers can query their Reactome contributions using their name.

Authors/Reviewers can export their Reactome contributions in bibtex format.

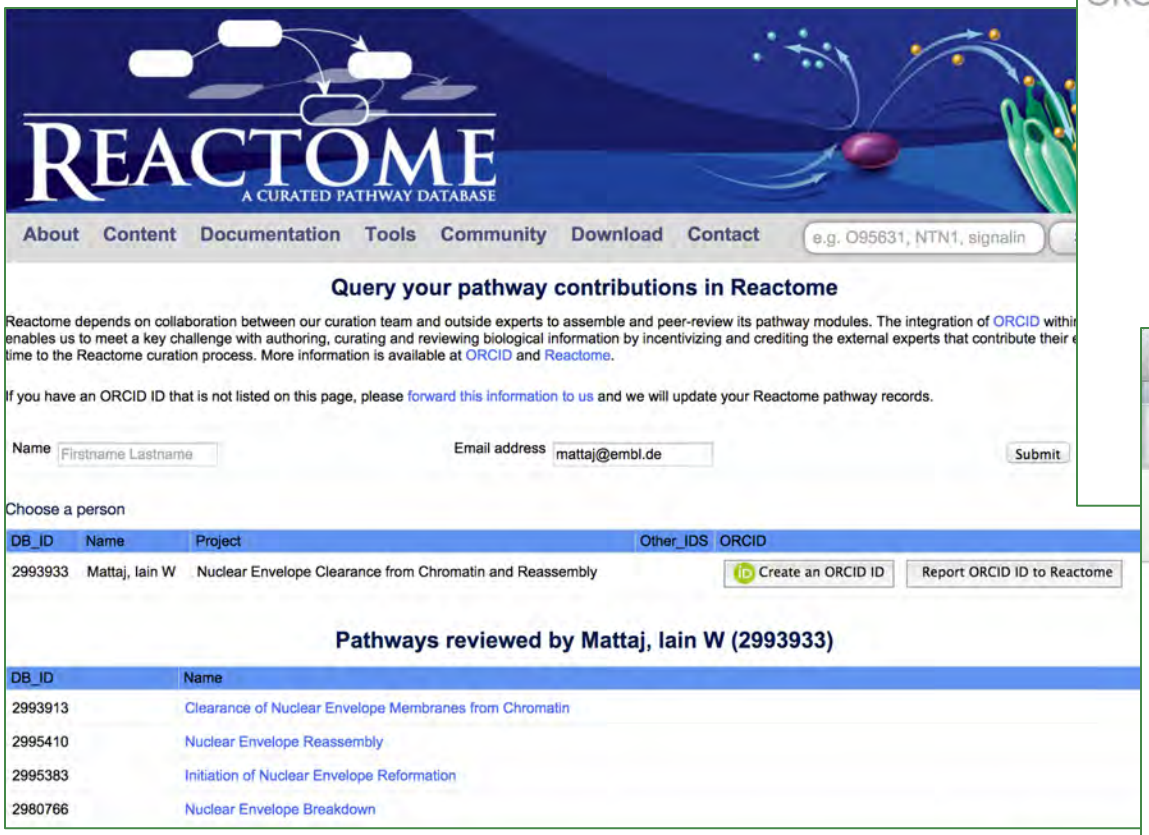
```
Reviewed:

<bibtex>
    @MISC{ REACT_228223.1,
           author          = {Woodgett, Jim},
           title           = {TCF7L2 mutants don't bind CTBP},
           crossref        = {Reactome:REACT_228223.1},
           howpublished    = {\url{http://www.reactome.org/PathwayBrowser/#REACT_228223.1}},
           note            = {Reactome Pathway Knowledgebase, http://www.reactome.org/},
           month           = {May},
           year            = {2014},
           }
</bibtex>
```

OICR Ontario Institute for Cancer Research

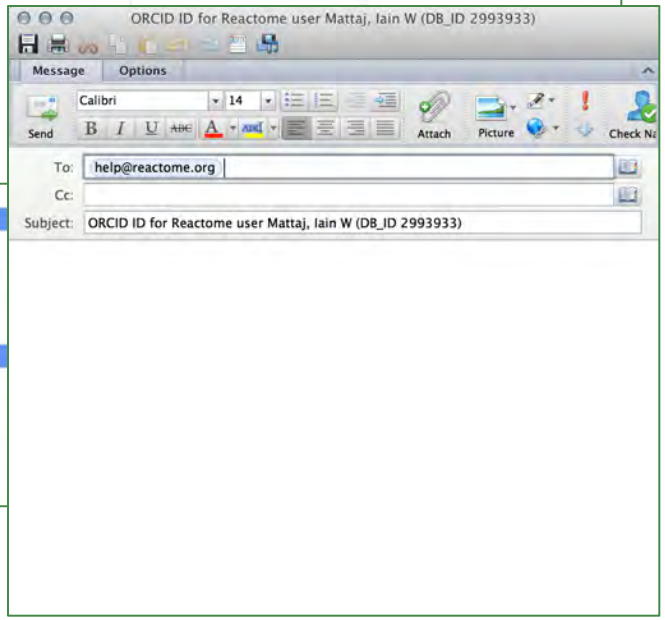
REACTOME

Stage II: Integrate ORCID iD into Reactome software tools and website cont'd.

Authors/Reviewers can query their Reactome contributions using their email address.

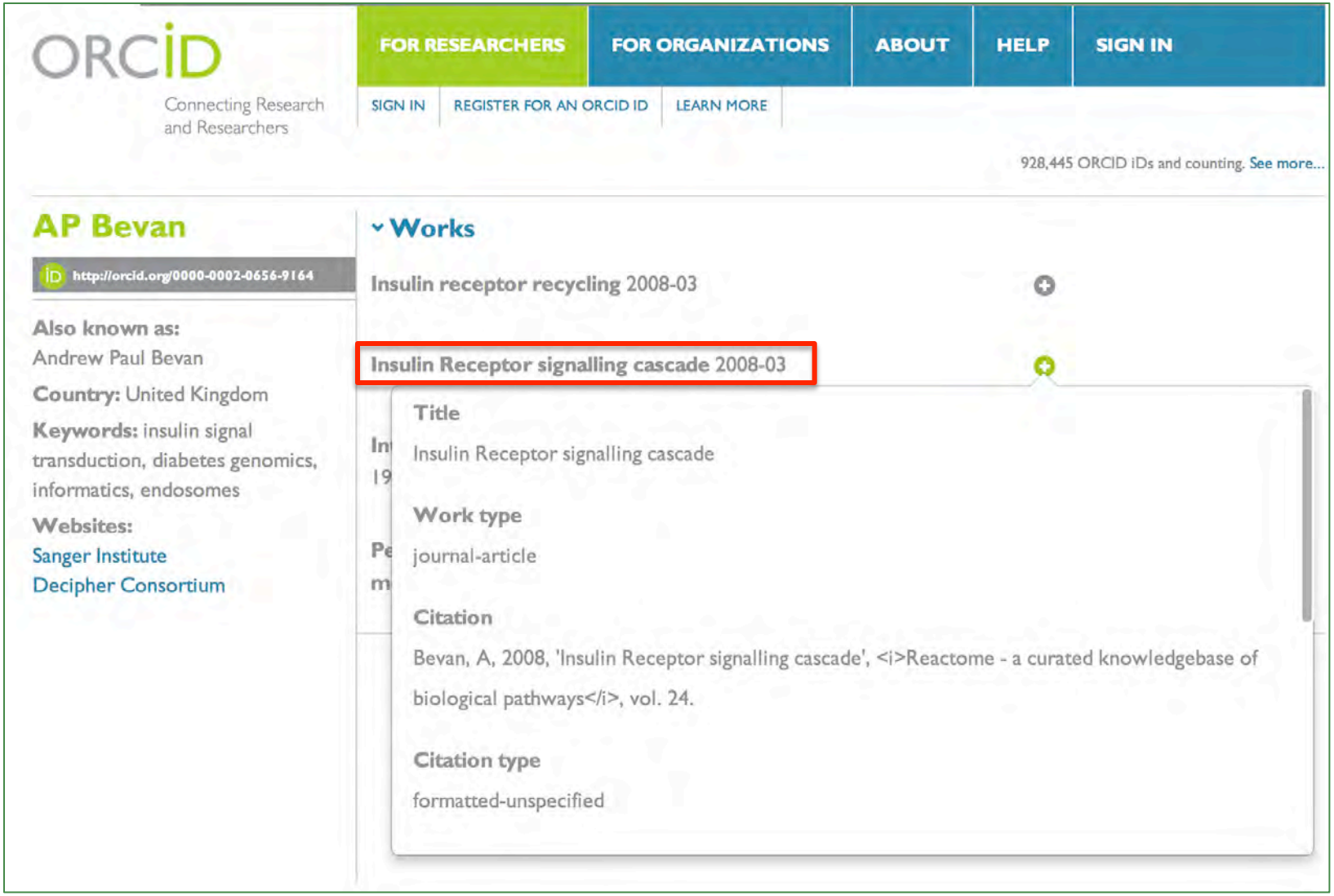


Authors/Reviewers can sign up for ORCID iD.

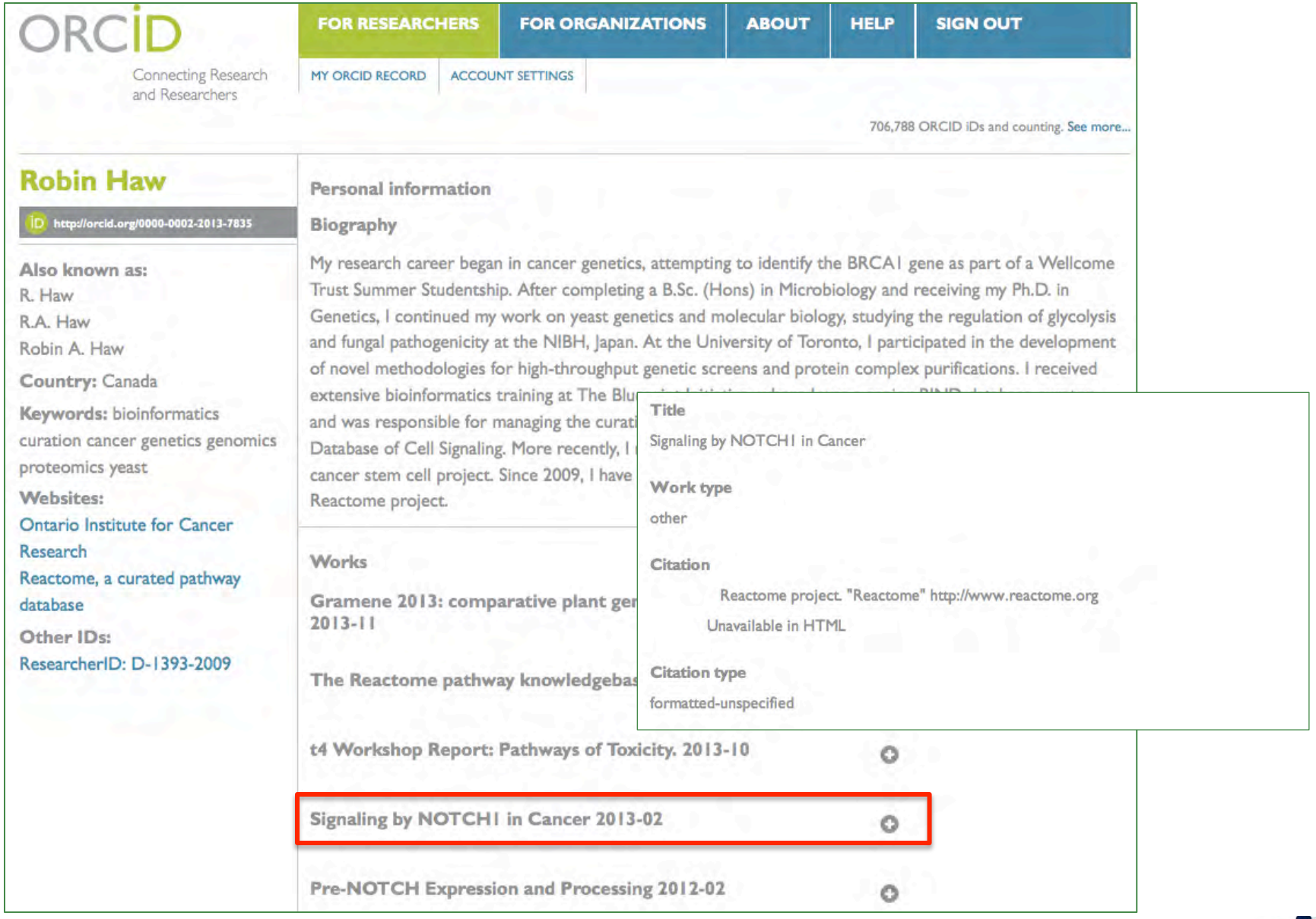


Authors/Reviewers can inform Reactome when they have an ORCID iD by email.

Authors's Reactome Contributions in ORCID



Reviewer's Reactome Contributions in ORCID



OICR Ontario Institute for Cancer Research

REACTOME

Stage IV: Stage IV: Create documentation, training and outreach.

- Presented Reactome-ORCID Integration at Biological Conferences and Worskhops.
- Created ORCID Integration content, use cases and presentations for Reactome website.
- Encouraging researchers to register for ORCID iD.
- In effect become a part of ORCID outreach.

Summary of Reactome-ORCID Project Status

- Stage I: Expand the Reactome data model and database to support ORCID iDs.
  - *Updated the Reactome data model.*
- Stage II: Integrate ORCID iD into Reactome software tools and website.
  - *Introduced ORCID annotations into the Reactome curator tools and website content.*
- Stage III: Import and deploy ORCID iD data within Reactome.
  - *Queried the ORCID registry with the Public API to identify Reactome contributors with ORCID iDs.*
  - *Contacted all previous Reactome contributors.*
  - *Author and Review letters now include ORCID recruitment information.*
  - *Encouraging those with ORCID iDs to add Reactome pathways to profile information using BibTeX format exchange.*
- Stage IV: Create documentation, training and outreach.
  - *Presented Reactome-ORCID Integration at Biological Conferences and Worskhops.*
  - *Created ORCID Integration content, use cases and PPT slides for Reactome website.*

Thoughts on ORCID-Reactome Integration

- We can't create ORCID iDs on behalf of individuals.
  - Reactome is not an institution!

- ORCID iD Recruitment
  - Researchers are reluctant to register or return email.
  - Many ORCID records contain no Institutional information to help distinguish between people with the same name.
  - Contributors have changed careers and no longer doing research.
  - <25% of contributors have ORCID iDs in Reactome, with more expected.

- How to allow Reactome authors and reviewers to append their ORCID Record with metadata associated with their Reactome records?
  - Reactome is not using the Member API.
  - Manual updating of ORCID by contributor.
  - Plan to support batch ORCID-BibTeX importer.

Summary

- Our open access and open source policies make this an attractive open data linkage between the scientist and pathway knowledge via the ORCID iD.
- ORCID iDs as a key mechanism for credit attribution for Reactome.
- A valuable route to increase visibility of the contributions of our external domain experts (authors and reviewers) and curators.
- We are keen to resolve the systemic naming ambiguity by implementing the ORCID.
- A great potential for other bioinformatics resources to adopt ORCID since they are also reliant on expert contributions and/or curators.

Acknowledgements

- Michael Caudy
- David Croft
- Eric Dawson
- Adrian Duong
- Phani Garapati
- Marc Gillespie
- Bijay Jassal
- Steve Jupe
- Irina Kalatskaya
- Maulik Kamdar
- Bruce May
- Sheldon MacKay
- Lisa Matthews
- Antonio Fabregat Mundo
- Marija Orlic-Milacic
- Karen Rothfels
- Veronica Shamovsky
- Heeyeon Song
- Joel Weiser
- Mark Williams
- Guanming Wu
- Christina Yung

- **Henning Hermjakob**
- **Peter D'Eustachio**
- **Lincoln Stein**