2018 IPA 系統生物學分析軟體暨資料庫
基礎操作課程

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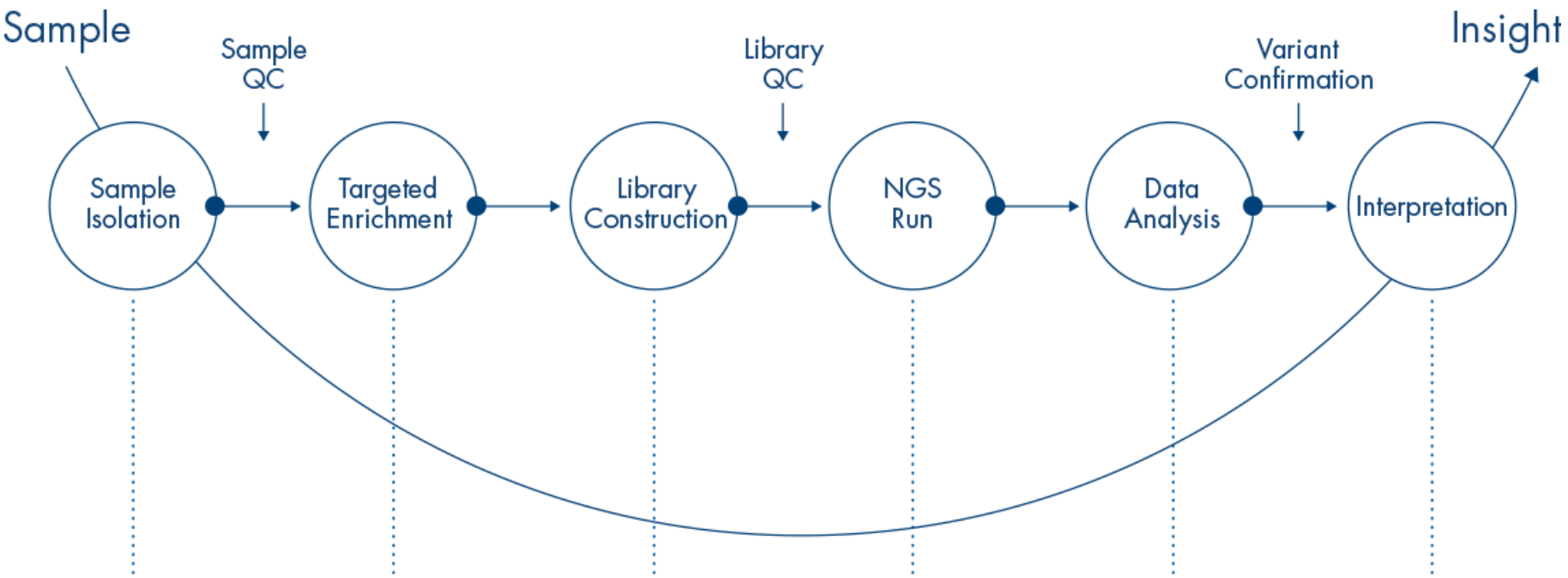
QIAGEN Bioinformatics Solution



QIAamp DNA kits

PAXgene RNA/DNA kits

GeneRead DNA FFPE Kit

QIAamp Circulating NA Kit

exoRNeasy Kits

RNeasy Kits

QIAseqTargeted RNA Panels

QIAseq DNAseq Panels v3

QIAseq FX Library Kits

QIAseq 1-step Amplicon KIt

QIAseq Ultralow Input Kit

REPLI-g® Single Cell Kits

Biomedical Genomics Workbench & Biomedical Genomics Server Solution

QIAGEN® Clinical Insight Analyze (QCI-A)

Ingenuity Variant Analysis

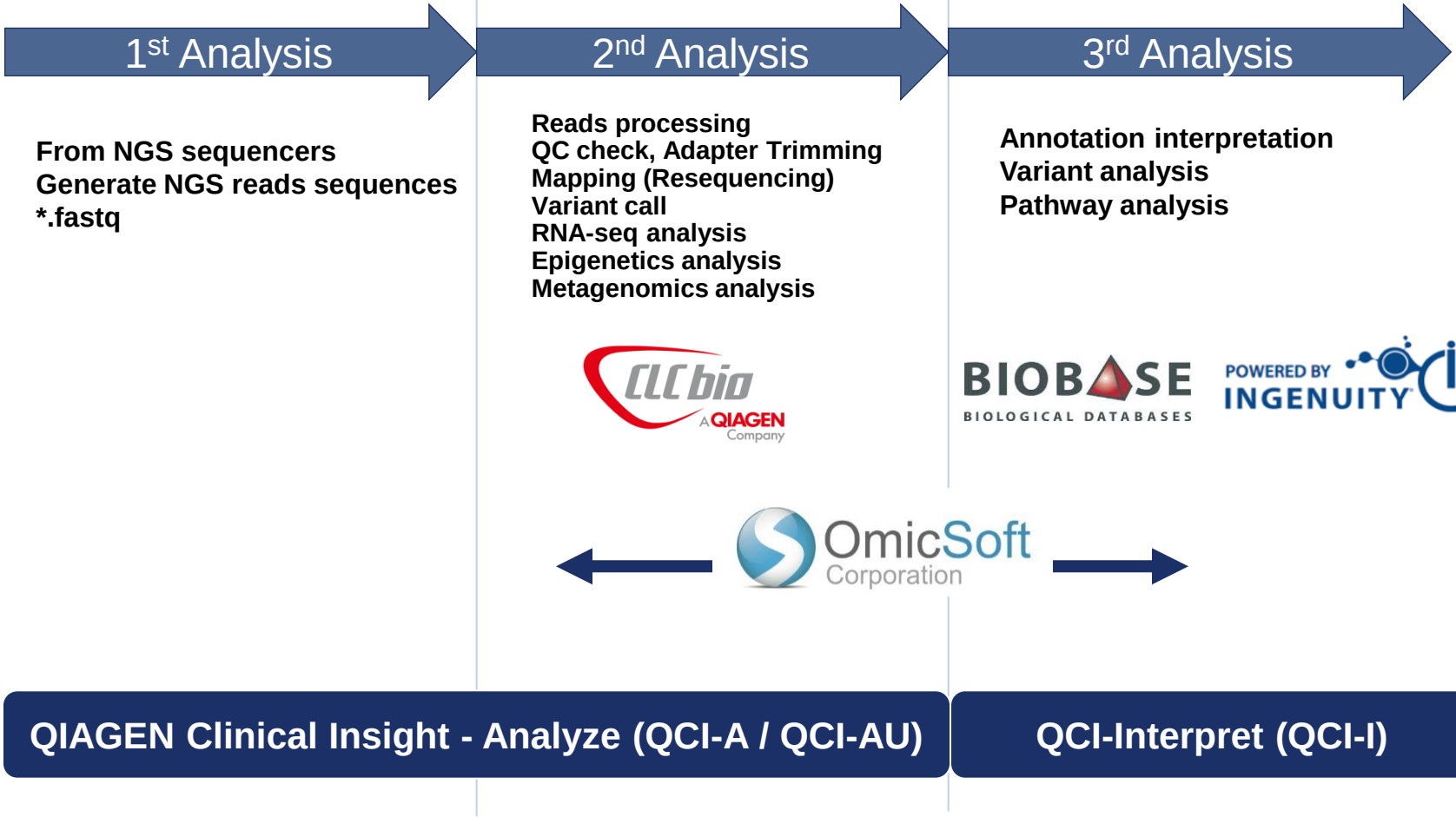
QIAGEN® Clinical Insight Interpret (QCI-I)

Ingenuity Pathway Analysis

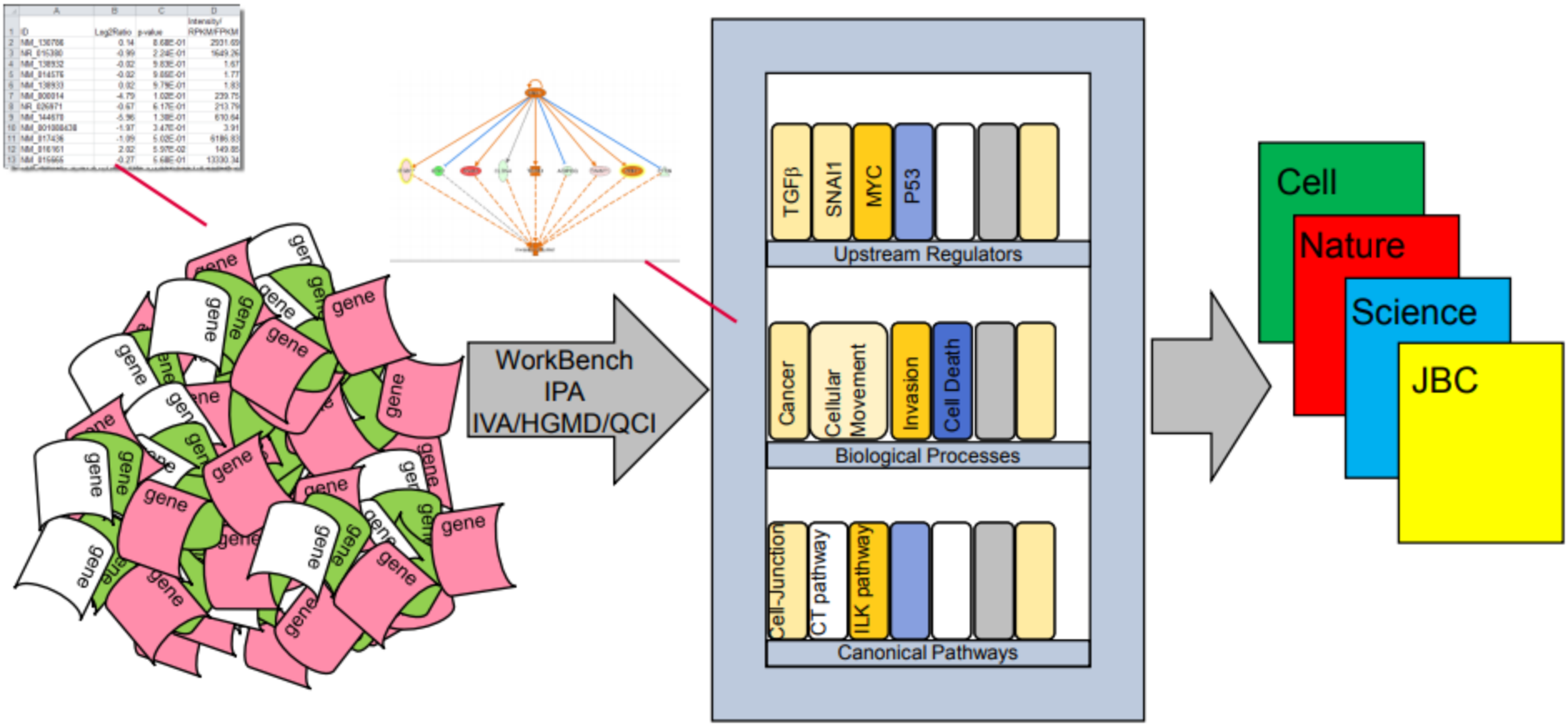
HGMD®

QIAGEN BioX Product Portfolio

By NGS Data analysis workflow



What can Qiagen bioinformatics products do for you?



大綱

A. Expression Application – Ingenuity Pathway Analysis

1. **What's New in IPA 2017 Winter Release**
2. **Getting Start with IPA**

IPA介紹與啟動IPA

B. Searching and Accessing the Knowledge Base

1. **Introduction for Search Tools**
2. **My List**

利用IPA進行搜尋

C. Building and Editing a Pathway for Publication

1. **My Pathway**
2. **Path Designer**

使用IPA進行分子模型建構並繪製訊息傳遞路徑

D. Q & A

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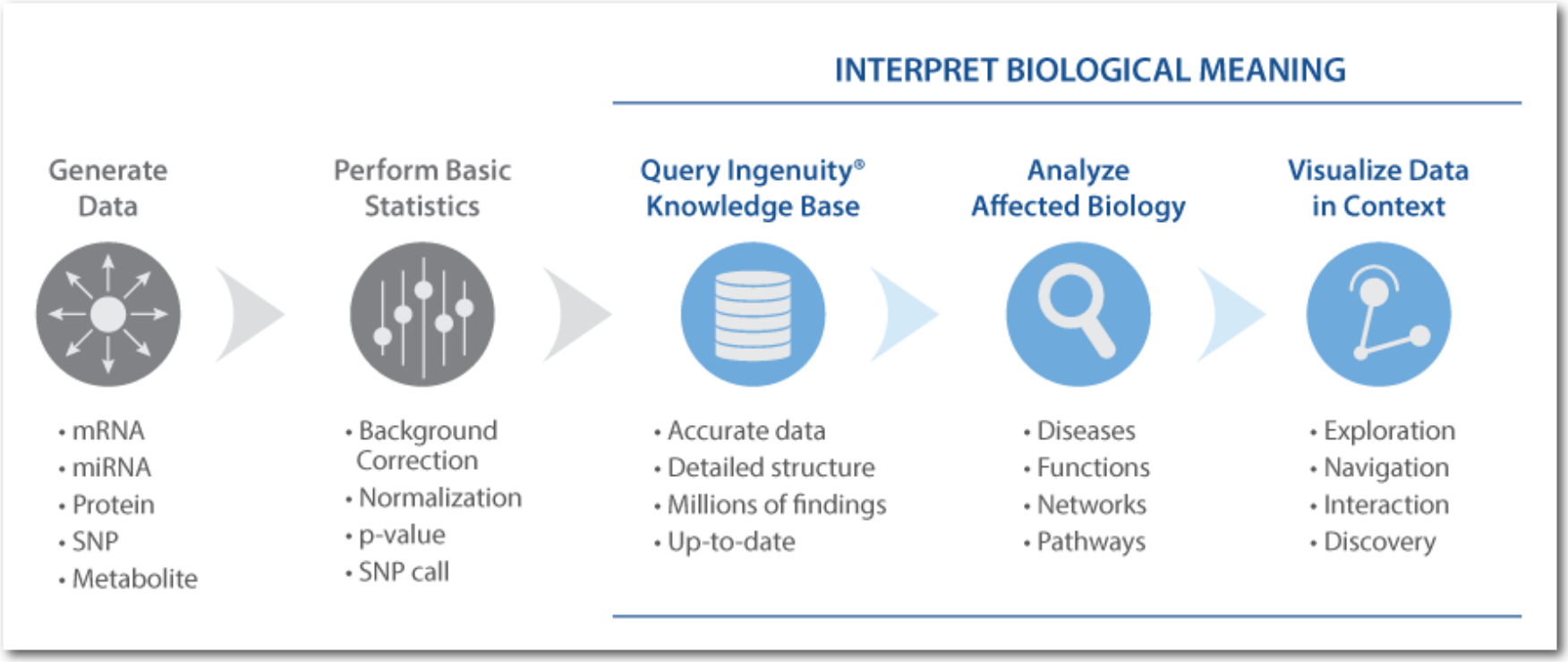
D. Q & A

What's Ingenuity Pathway Analysis

IPA是 All-in-one, web-based 的分析軟體與資料庫，幫助研究人員分析手上分子生物學實驗後的資料，可以快速提供研究人員更多的證據與文獻去解釋複雜的實驗背景與實驗成因並建構可以延伸的假設。



IPA 支援的物種(orthologous):

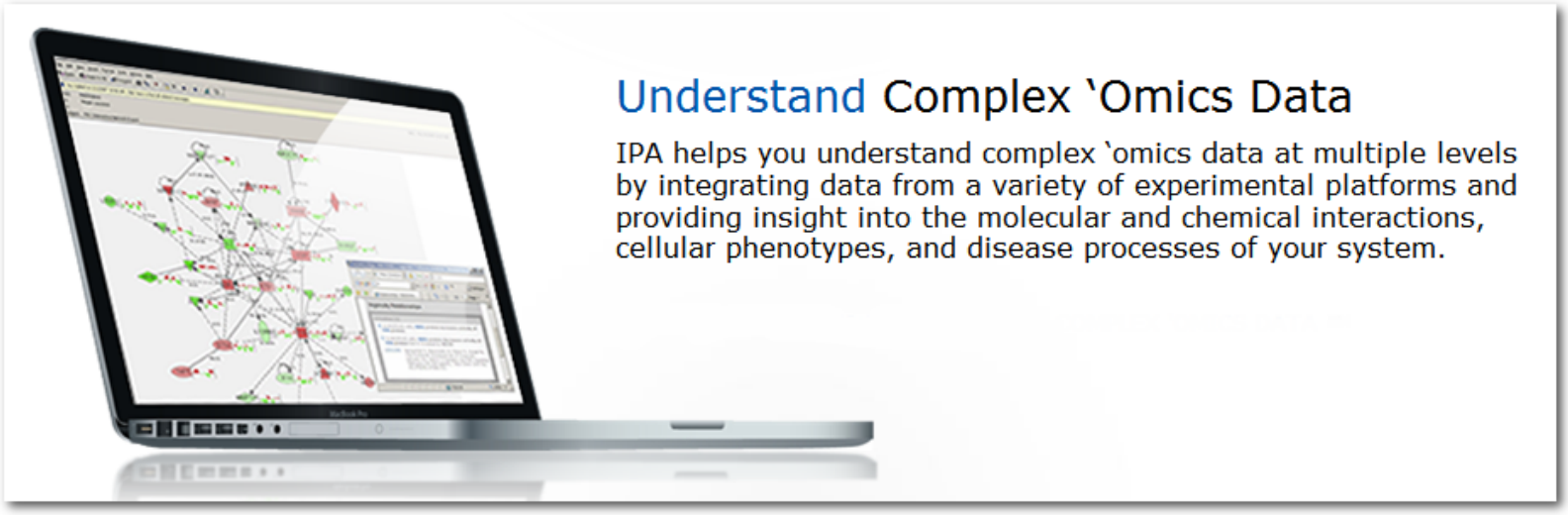
Arabidopsis thaliana
Bos taurus (bovine)
Caenorhabditis elegans
Gallus gallus (chicken)
Pan troglodytes (chimpanzee)
Danio rerio (zebrafish)
Canis lupus familiaris (canine)
Drosophila melanogaster
Macaca mulatta (Rhesus Monkey)
Saccharomyces cerevisiae
Schizosaccharomyces pombe

IPA 支援的實驗平台與技術:

- **基因表現實驗:**
  - qPCR analysis
  - Microarray
  - RNA-Seq (NGS)
  - microRNA
  - mRNA
- **蛋白質體實驗**
  - PhosphoProteomics New
- **代謝體實驗**

IPA 的應用:

- 生物標記開發研究
- 藥物活性機轉研究
- 藥物毒性機制研究
- 疾病發生機制研究



Peer-reviewed publications citing Ingenuity apps

>14,000 publications that used IPA -- and growing!

Format: Summary Sort by: Best Match Per page: 20 Send to

Search results

Items: 1 to 20 of 1707

<< First < Prev Page 1 of 86 Next > Last >>

1. Causal **analysis** approaches in **Ingenuity Pathway Analysis**.
Krämer A, Green J, Pollard J Jr, Tugendreich S.
Bioinformatics. 2014 Feb 15;30(4):523-30. doi: 10.1093/bioinformatics/btt703. Epub 2013 Dec 13.
PMID: 24336805 **Free PMC Article**
Similar articles

2. Genome-wide **analysis** of genetic variations assisted by **Ingenuity Pathway Analysis** to comprehensively investigate potential genetic targets associated with the progression of hepatocellular carcinoma.
Yu F, Shen XY, Fan L, Yu ZC.
Eur Rev Med Pharmacol Sci. 2014;18(15):2102-8.
PMID: 25070813 **Free Article**
Similar articles

3. Potential predictive plasma biomarkers for cervical cancer by 2D-DIGE proteomics and **Ingenuity Pathway Analysis**.
Guo X, Hao Y, Kamilijiang M, Hasimu A, Yuan J, Wu G, Reyimu H, Kadeer N, Abudula A.
Tumour Biol. 2015 Mar;36(3):1711-20. doi: 10.1007/s13277-014-2772-5. Epub 2014 Nov 27.
PMID: 25427637
Similar articles

4. Gene set enrichment **analysis** and **ingenuity pathway analysis** of metastatic clear cell renal cell carcinoma cell line.
Khan MI, Dębski KJ, Dabrowski M, Czarnecka AM, Szczylik C.
Am J Physiol Renal Physiol. 2016 Aug 1;311(2):F424-36. doi: 10.1152/ajprenal.00138.2016. Epub 2016 Jun 8.
PMID: 27279483
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Filters: Manage Filters

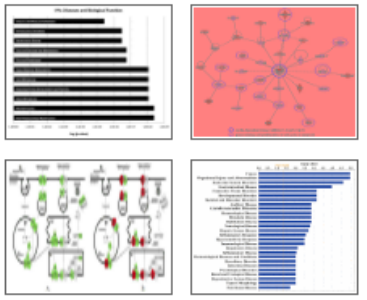
Results by year

Download

Related searches

ingenuity pathway analysis gene
ingenuity pathway analysis mirna
ingenuity pathway analysis network
ingenuity pathway analysis proteomics

PMC Images search for *ingenuity pathway analysis*



Proven Value Throughout Research and Discovery

>10,000 publications that used IPA -- and growing!

Discovery

nature
LETTERS **Genomic analysis of increased host immune and cell death responses induced by 1918 influenza virus**

Biomarkers

nature medicine
Classification and prediction of clinical Alzheimer's diagnosis based on plasma signaling proteins

Toxicology

TOXICOLOGICAL SCIENCES
Correlation between protein accumulation profiles and conventional toxicological findings using a model antiandrogenic compound, flutamide.

Mechanism of Action

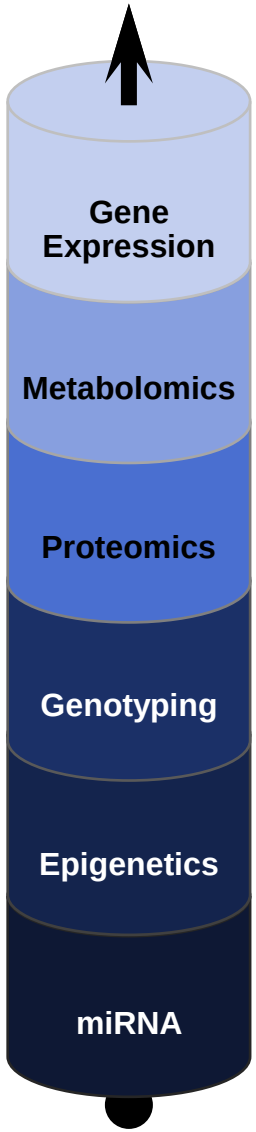
Proceedings of the National Academy of Sciences of the United States of America PNAS
MYC inhibition induces metabolic changes leading to accumulation of lipid droplets in tumor cells

Disease Models

Cell PRESS **An iPSC Line from Human Pancreatic Ductal Adenocarcinoma Undergoes Early to Invasive Stages of Pancreatic Cancer Progression**

Pharmacogenomics

NEUROBIOLOGY of AGING
Pharmacogenomics in Alzheimer's disease: a genome-wide association study of response to cholinesterase inhibitors



Multi-Omics Analysis using IPA

Integrate and compare genomics, transcriptomics, proteomics and metabolomics data to see the big picture on your focus research

RESEARCH ARTICLE

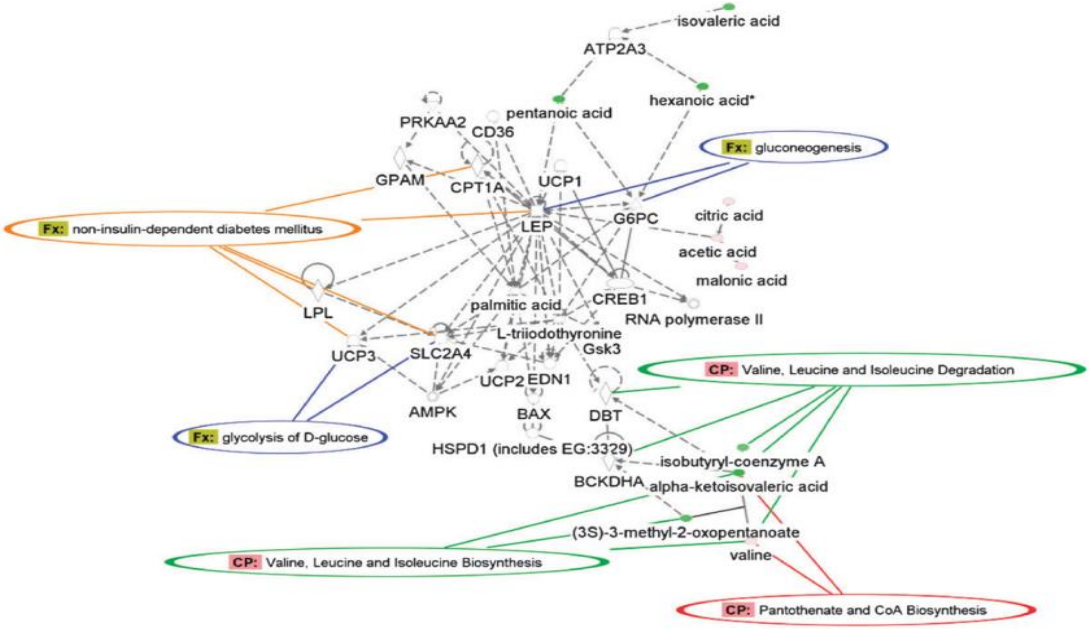
A Multi-Omics Approach Identifies Key Hubs Associated with Cell Type-Specific Responses of Airway Epithelial Cells to Staphylococcal Alpha-Toxin

Erik Ric … ukoti[3], …
Jan-Pe…

Integ… … id bi…
disco…

Susan …
Terence…

Received …
First pub…
DOI: 10…



Multi Experiment

↓

Phosphorylation

+

Protein Expression

+

mRNA Expression

+

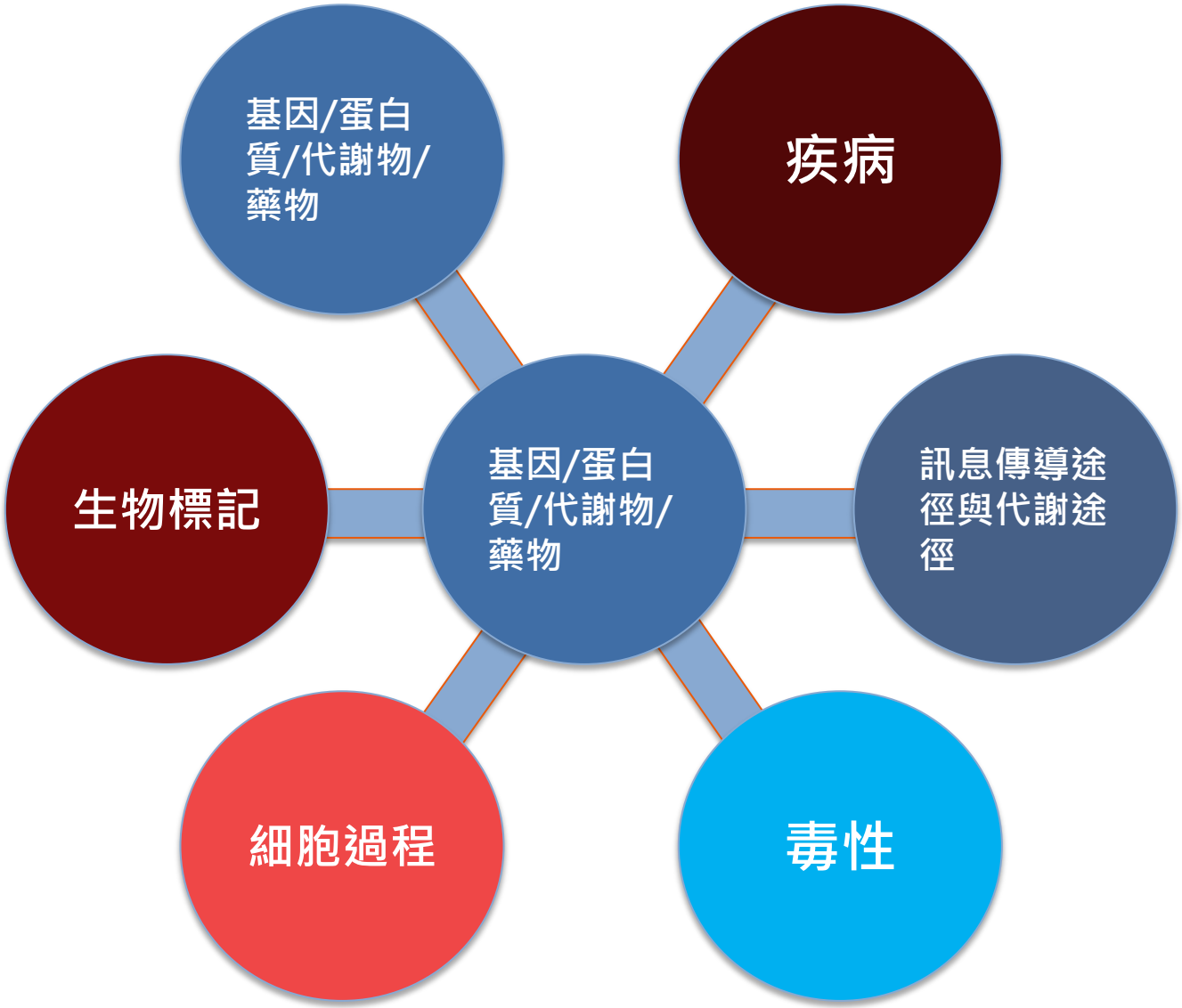
miRNA Expression

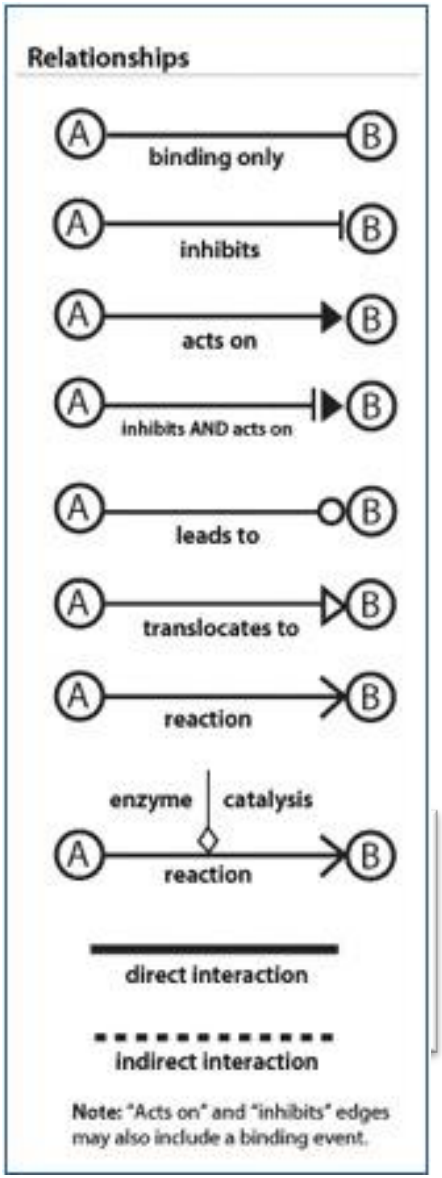
↓

IPA analysis

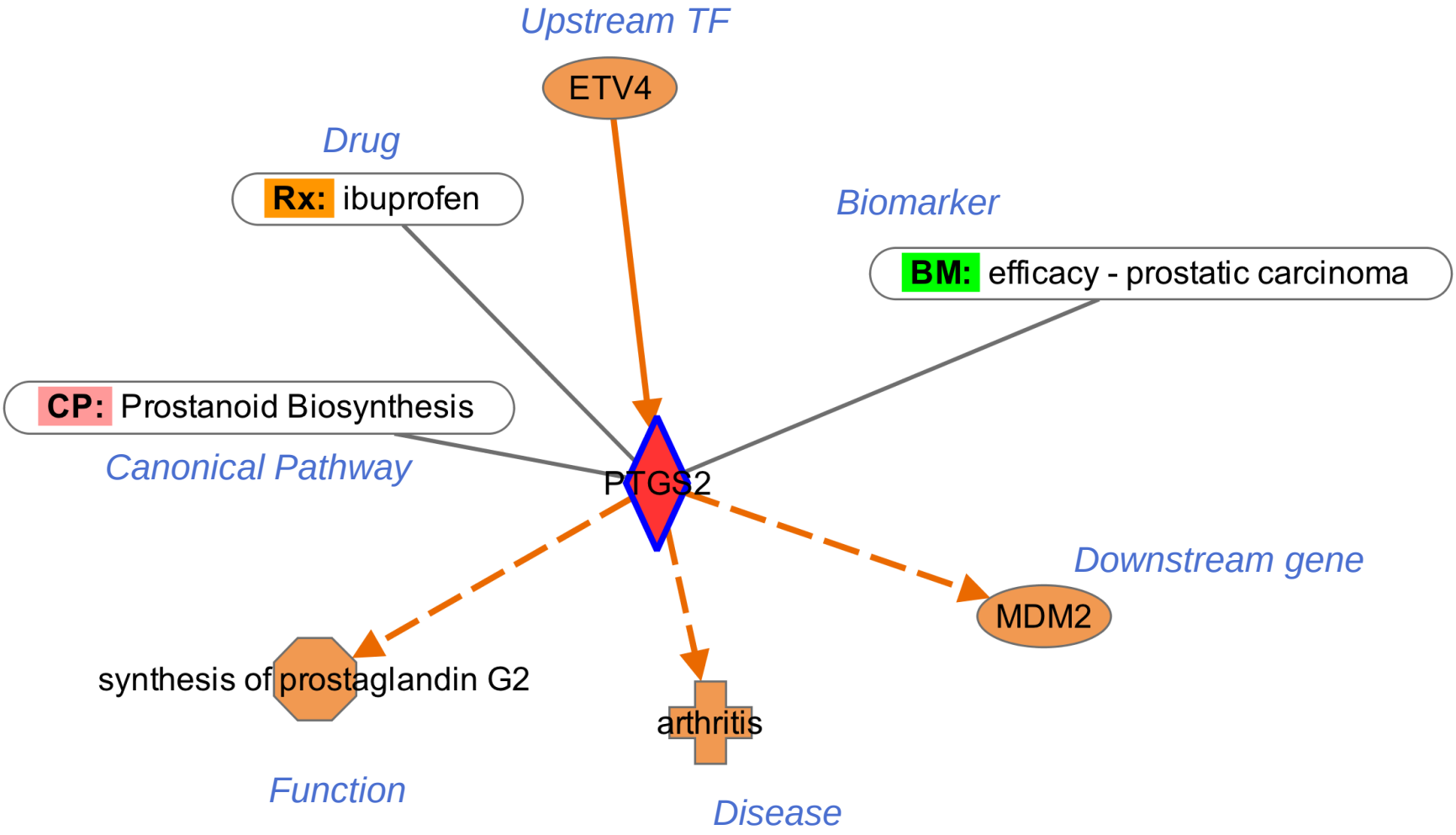
Sample t…

用IPA來發掘實驗資料中各類型關係





Capturing molecular information from the literature



Gather this type of information for nearly every gene. Inferences can be made from the resulting networks.

Third Party Database

- **Synonyms, Protein Family, Domains**
  - GO, Entrez Gene, Pfam
- **Tissue and Biofluid Expression & Location**
  - GNF, Plasma Proteome
- **Molecular Interactions**
  - BIND, DIP, MIPS, IntAct, Biogrid[New], MINT, Cognia, etc.
- **miRNA/mRNA target databases**
  - TarBase, TargetScan, miRecords
- **Gene to Disease Associations**
  - OMIM, GWAS databases
- **Metabolomics**
  - HumanCyc[New]
- **Clinical Trial information**
  - ClinicalTrials.gov

Ingenuity Expert Findings

From full text, contextual detail, experimentally demonstrated

Original sentence from publication	Ingenuity Expert Findings
nNOS overexpression mice showed reduced myocardial contractility.	Transgenic nNOS in myocardium from mouse heart decreases the contractility of myocardium in left ventricle from mouse heart.
Francisella organisms efficiently induce IL-1beta processing and release.	Francisella tularensis subsp. novicida U112 increases (in a time-dependent manner) release of human IL1B protein from human monocytes.

- **Contextual details**: Manual curation process captures relevant details
- **Experimentally demonstrated:** Findings are from full text articles – includes tables and figures
- **Structured:** Supports computation and answering in-depth biological questions in the relevant context
- **High quality:** QC'd to ensure accuracy
- **Timely information:** Weekly updates so up to date information is captured

How IPA content is different: context and direction of effect

In 129S1/Sv * 129X1/SvJ * Swiss Webster mouse, mutant **mouse Pex2 gene** (allele Pex2^{tm1Plf}/Pex2^{tm1Plf}) (homozygous knockout) **increases cholestasis in** mouse.

12746876 Faust PL. Abnormal cerebellar histogenesis in PEX2 Zellweger mice reflects multiple neuronal defects induced by peroxisome deficiency. J Comp Neurol. 2003 Jun 30;461(3):394-413.

MGI allele: 2180128

MGI phenotype: 0000610

Source: Mouse Genome Database (MGD)

disease/ phenotype

species

strain

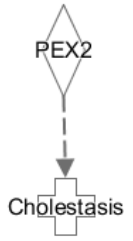
gene

zygosity

mutation type

Direction of effect on disease / phenotype

Activity of the molecule in this finding (decreased)

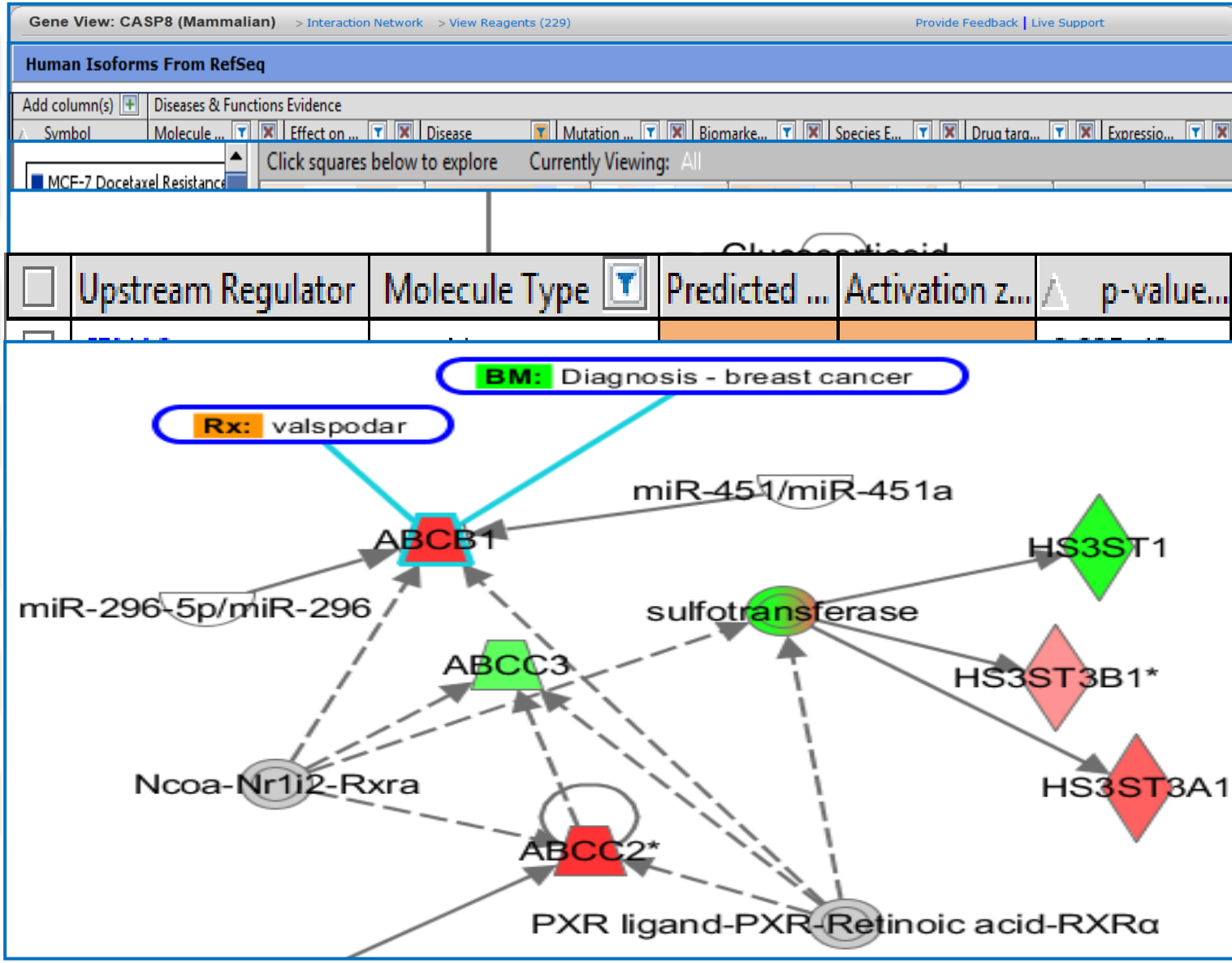


This structure provides **rich contextual detail**

and powers the algorithms for **causal analysis in IPA**

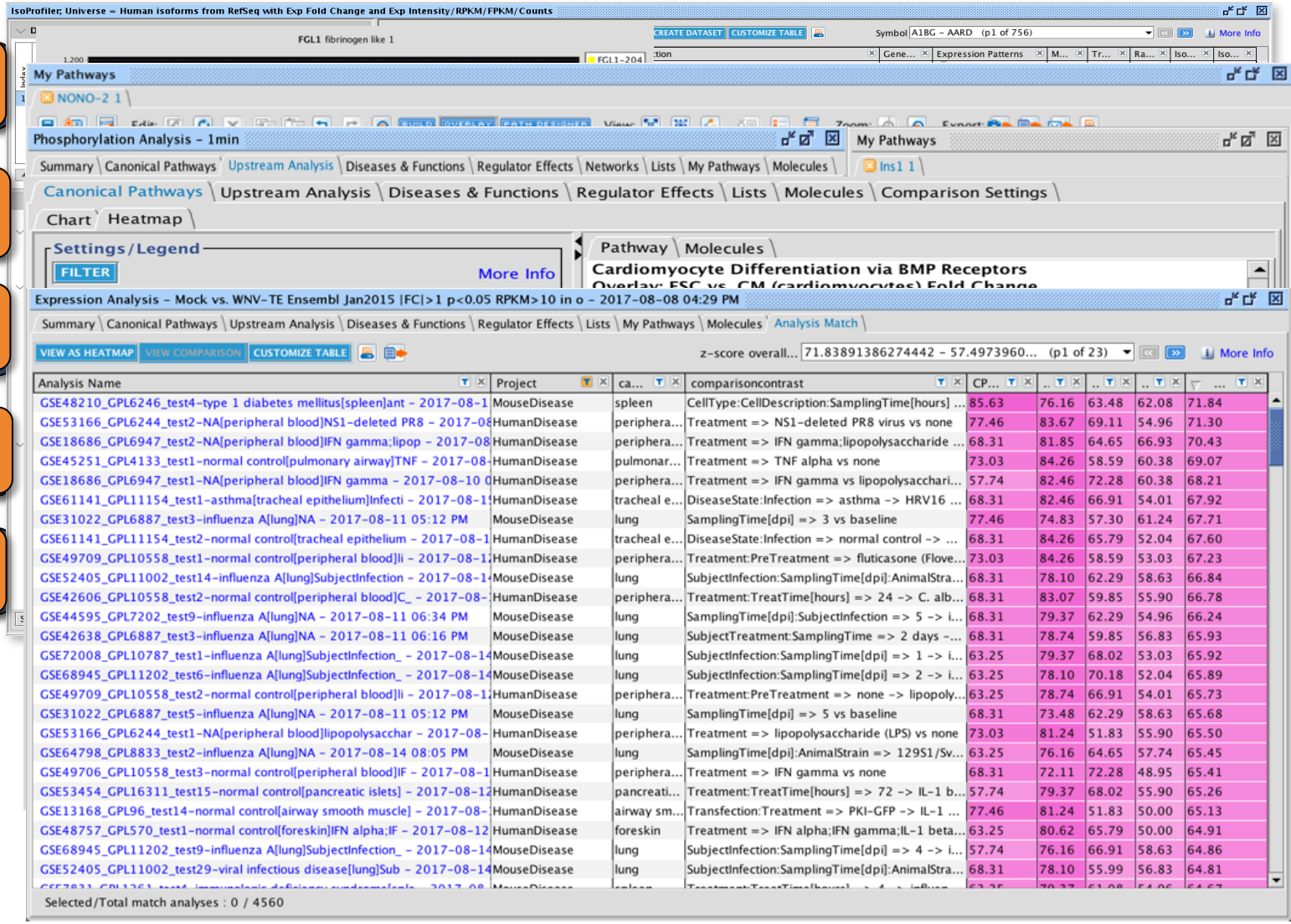
Unique Tools for Biological Analysis and Interpretation

- Gene View Summaries
- Human & Mouse Isoform Views
- BioProfiler
- Diseases & Bio Functions
- Canonical Pathways
- Upstream Regulator Analysis
- Build & Overlay and Interactions



Unique Tools for Biological Analysis and Interpretation

- IsoProfiler
- Multi-omics Overlay
- Phosphorylation Analysis
- Comparison Analysis
- Analysis Match* w/ OmicSoft Lands

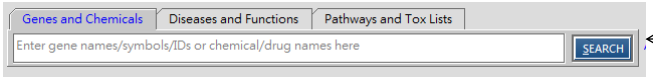


*Q4 2017

Entry Points in IPA

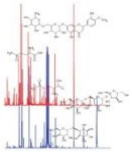
Biological Questions

Search



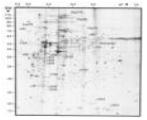
Experiment Data

Expression arrays



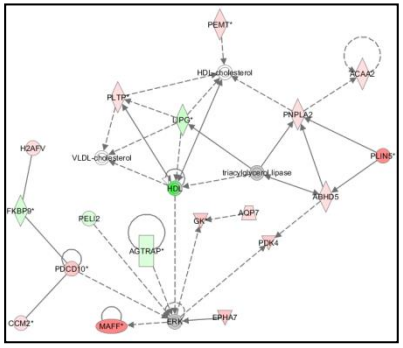
Mass spec

Protein arrays



2D Gel electrophoresis

Custom Pathway



Networks

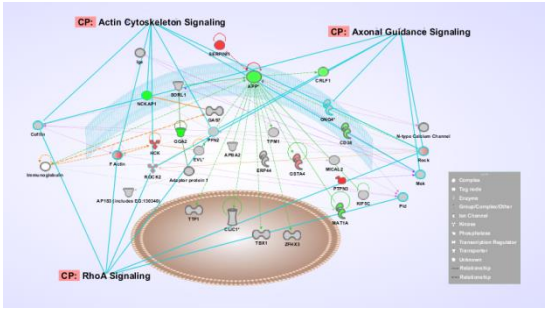
Core

IPA-Biomarker

IPA-Tox

IPA-Metabolomics

Bio/Tox Functions
Diseases/Disorders
Canonical Pathways
Upstream regulators
Mechanistic/Casual Network
Interaction Network



Communicate & Collaborate

Basic Module and Advanced module on IPA

Basic Module

- Canonical Pathway
- Molecule Activity Predictor (MAP)
- Mechanistic Network
- Upstream regulator Analysis
- Downstream Effects Analysis
- Regulator Effects
- Network Analysis
- Comparison Analysis
- MicroRNA Target Filter
- Isoform View
- Disease View
- Tox Lists and Tox Functions
- Gene and Chem View
- Interactive Disease and Functions Nodes
- Biomarker filter
- Path Designer

https://www.qiagenbioinformatics.com/products/features/

Advanced Analytics (AA)

- Causal Network Analysis
- BioProfiler
- Relationship Export
- IsoProfiler
- PhosphoProteomics Analysis

- Analysis Match (Pay extra)

https://www.qiagenbioinformatics.com/files/flyers/IPA_Advanced_Analytics_WEB.pdf

Content Updates Time Line

Summer Release (June 2017)

- IsoProfiler with new GTEx human tissue expression data.
- Easily navigate to each of your open windows in IPA
- ~120,000 new findings (bringing total to greater than 6 million findings)
- New Canonical Pathway: Osteoarthritis Pathway

Winter Release (2017 December)

- Enhancements to Analysis Match—updated additional analyses from OmicSoft
- Focus on the most important z-scores in the heat map by setting a threshold
- Entering metadata for a dataset—help you quickly find and search those datasets
- New criteria to select, highlight or trimming nodes on networks and pathways
- New findings, including 120,000 (bringing total to over 6.3 million findings
- New Canonical Pathways—Opioid Signaling Pathway

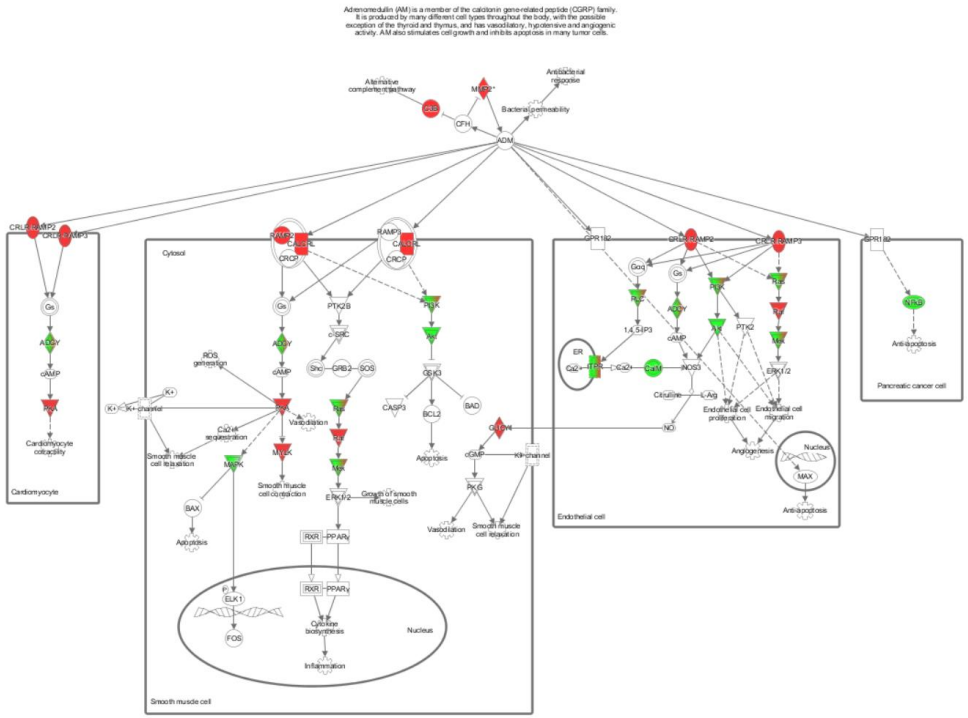
Spring Release (March 2018)

- Predict Activity of Metabolic Pathways
- New Datasets for Analysis Match
- 130,000 new findings (bringing total to over 6.4 million findings)
- New Canonical Pathways
  —Adrenomedullin signaling pathway, Iron homeostasis signaling pathway

Content Updates

- Predict Activity of Metabolic Pathways
- New Datasets for Analysis Match
- Content Updates
- New Canonical Pathways
  - Adrenomedullin signaling pathway
  - Iron homeostasis signaling pathway

~130,000 new findings (bringing total to over 6.4 million findings), including:
~40,000 new Expert findings
~62,000 new mutation-to-disease findings from ClinVar
~14,000 new cancer mutation disease association findings from COSMIC
~1,800 drug-to-disease findings from ClinicalTrials.gov
~1,700 new disease-to-target findings from ClinicalTrials.gov
~2,000 new functional annotations from Gene Ontology
~11,500 new protein-protein interactions from the BioGRID database
~1,000 new protein-protein interactions from the IntAct database
~600 new mouse knockout-to-phenotype findings from MGD (JAX Labs)



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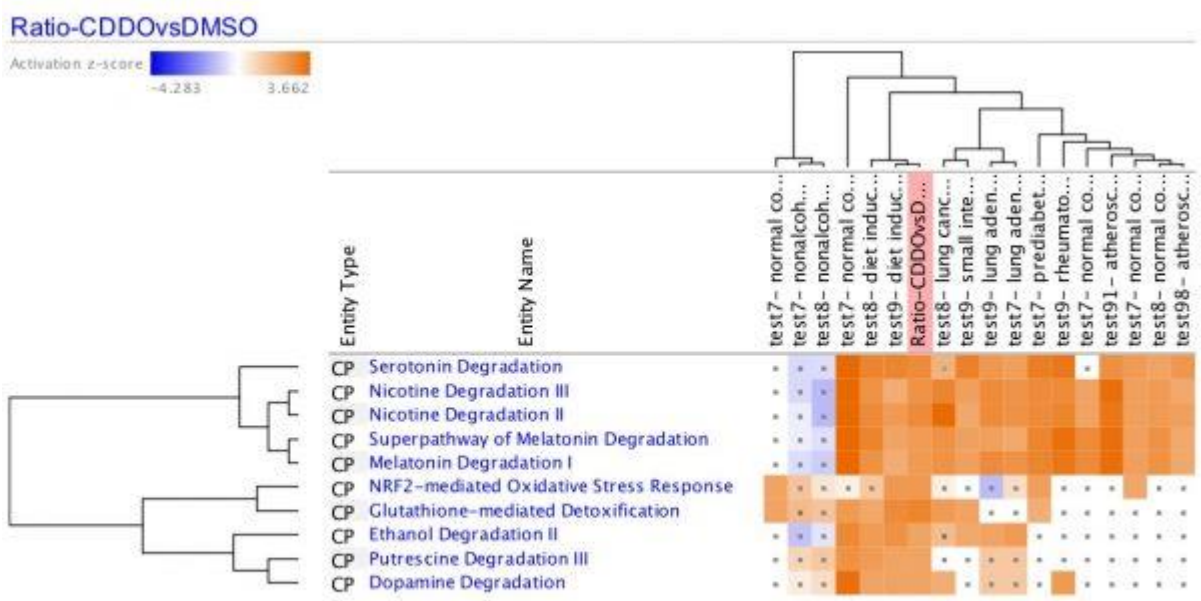

Content Updates

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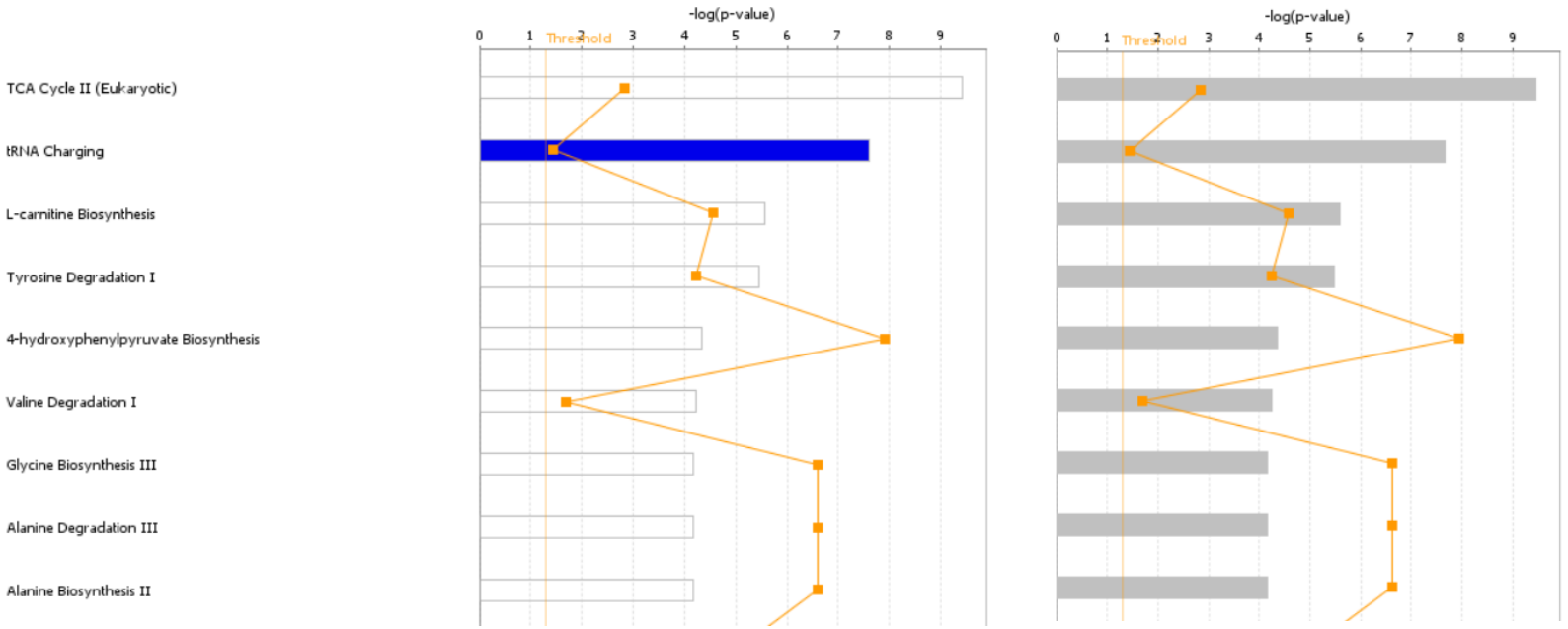

2018 Spring Release

Before

Content Updates

- Predict Activity of Metabolic Pathways
- New Datasets for Analysis Match
- Content Updates
- New Canonical Pathways
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  - Iron homeostasis signaling pathway

Land	Repository	Q4 2017 (December)	Q1 2018 (March)	Increase
DiseaseLand	HumanDisease	3239	3762	523
	MouseDisease	2516	2798	282
	Hematology	108	108	0
	RatDisease (New)	0	124	124
OncoLand	OncoGEO	1028	1169	141
	TCGA	24	24	0
	MetastaticCancer	53	53	0
	Pediatrics (New)	0	127	127

There are 1,100+ new datasets for Analysis Match in this release, bringing the total available in IPA to >8,000. This includes two new repositories, RatDisease (under DiseaseLand) and Pediatrics (under OncoLand). Table 1 compares the repositories and their respective sizes in this release versus the prior one.

Content Updates

- Predict Activity of Metabolic Pathways
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- New Canonical Pathways
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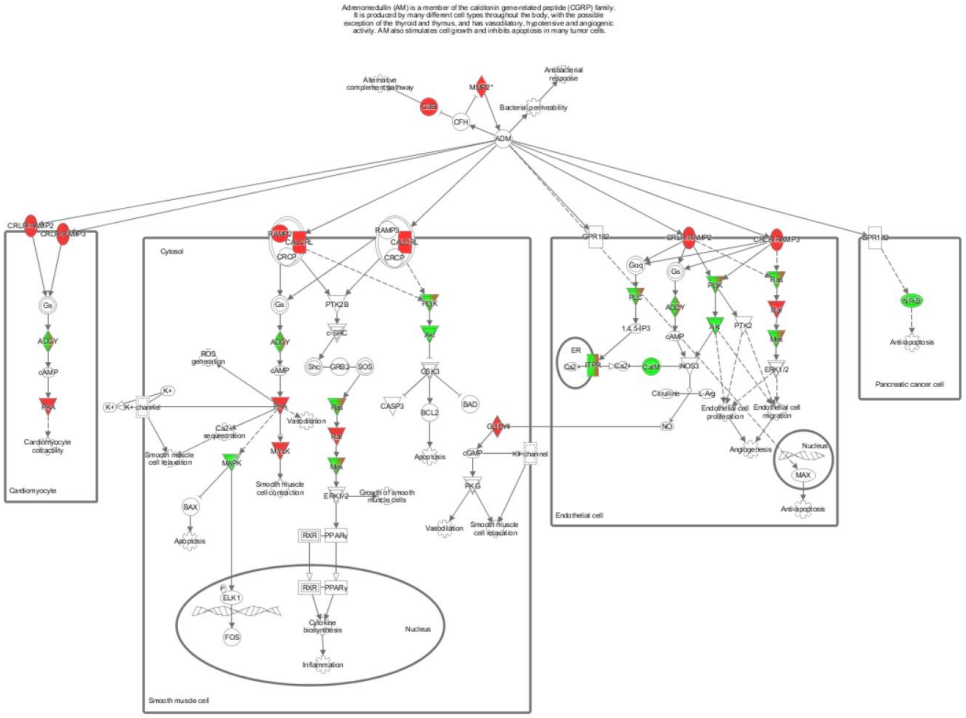
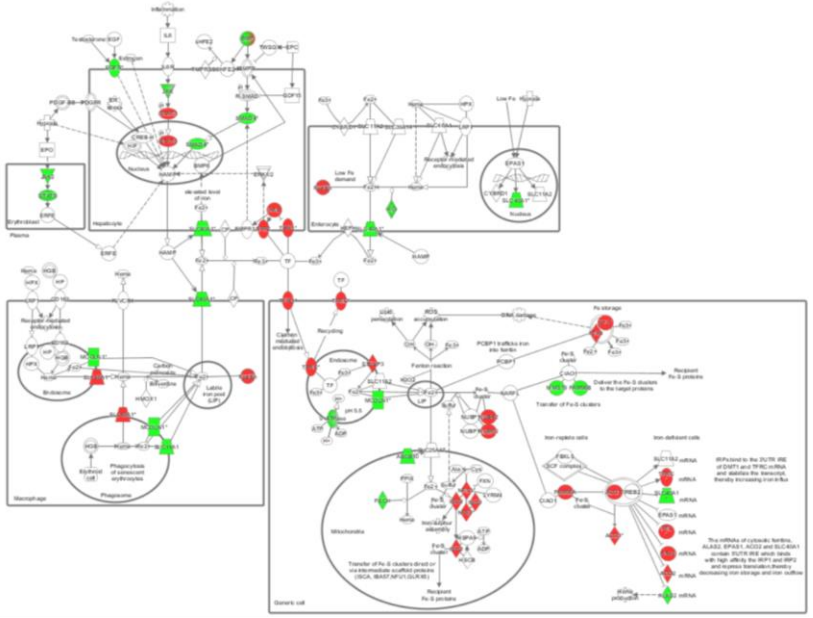




Unprecedented discovery, together

Array Express
GEO
TCGA
SRA
Etc.

Journal articles

Clinical Trials
COSMIC
MGD
OMIM
Etc.

Curation, Processing, & QA

Curation & QA

Datasets integrated into OmicSoft Lands

Curated Findings

OmicSoft Array Suite

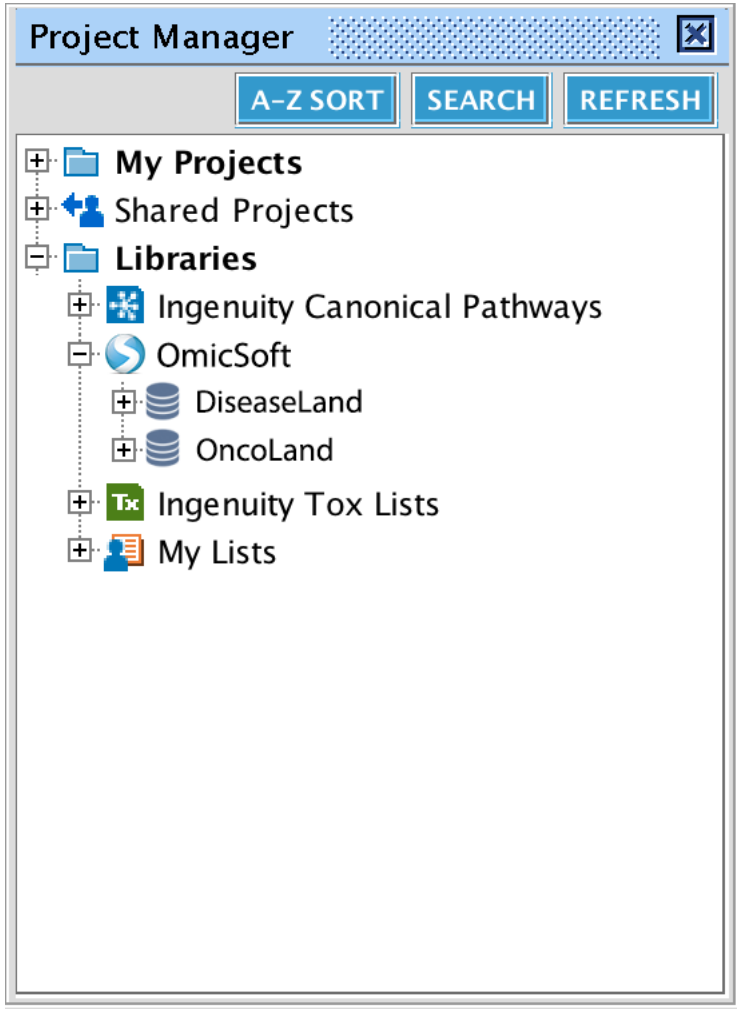
OncoLand
DiseaseLand

6000+ Expression comparison datasets

INGENUITY PATHWAY ANALYSIS

- Biological analyses of each dataset
- Compare your analysis to all OmicSoft analyses

OmicSoft Datasets Stored and Analyzed in IPA



- DiseaseLand
  - HumanDisease (2,929)
  - MouseDisease (2,257)
- OncoLand
  - OncoGEO (986)
  - TCGA (25)
  - Hematology (68)

Total datasets for release: 6000+

What do the Lands represent?

Human DiseaseLand

- 350 diseases
- 185 tissues of origin
- 48 expression platforms (primarily array), >450 RNA-seq studies

Mouse DiseaseLand

- 194 diseases
- 145 tissues of origin
- 39 expression platforms (primarily array), >500 RNA-seq studies

OncoGEO

- 98 cancers
- 49 tissues of origin
- 27 expression platforms (primarily array), >160 RNA-seq studies

TCGA

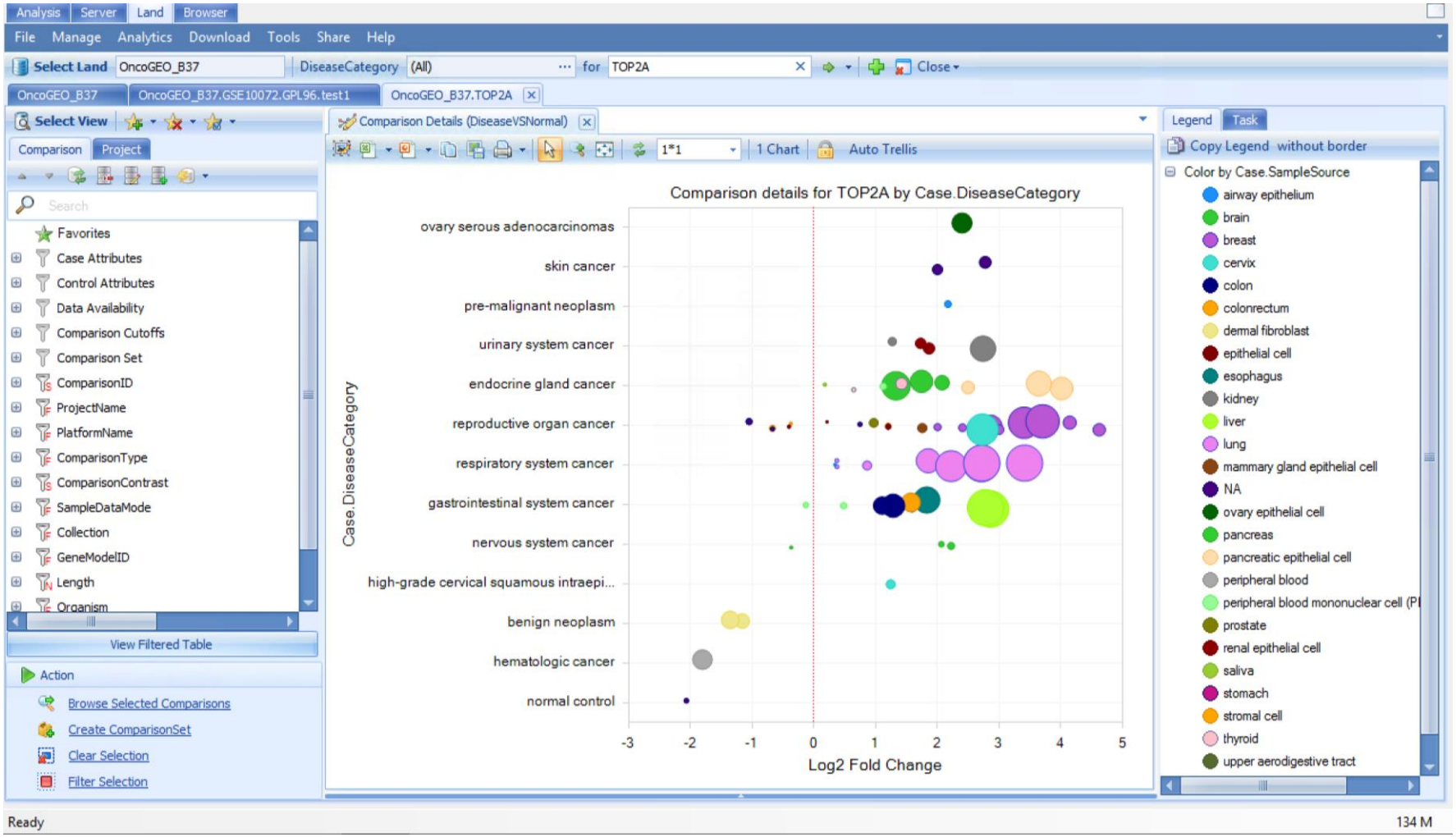
- 23 cancers (23 tissues)

Hematology

- 7 tissues of origin
- 16 diseases

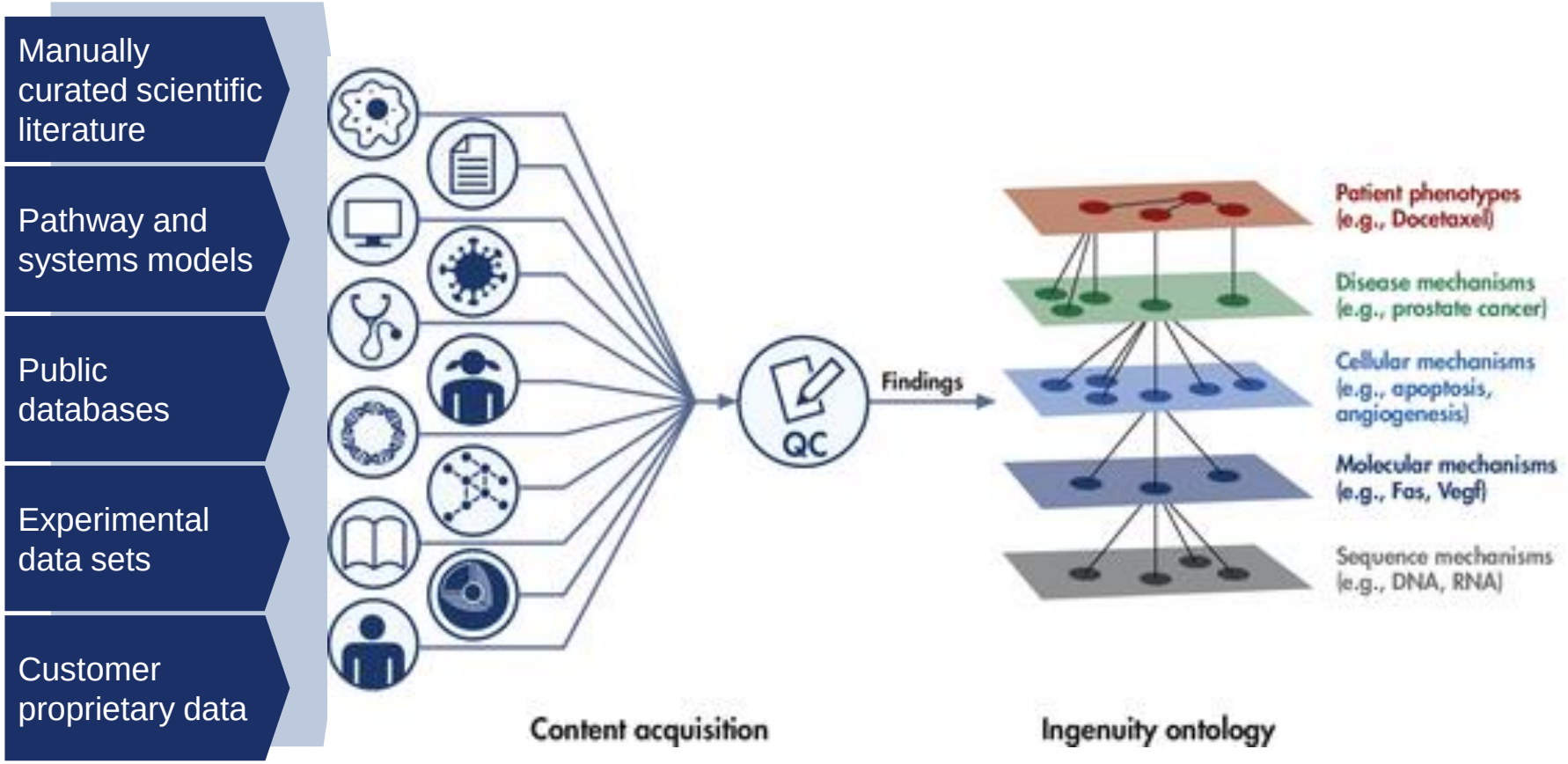
OmicSoft Array Suite provides detailed view of underlying data

Visualizing an individual gene across comparisons



Ingenuity Platform: 15-years, massive investment

Highest-quality interpretation of genomics and sequencing data



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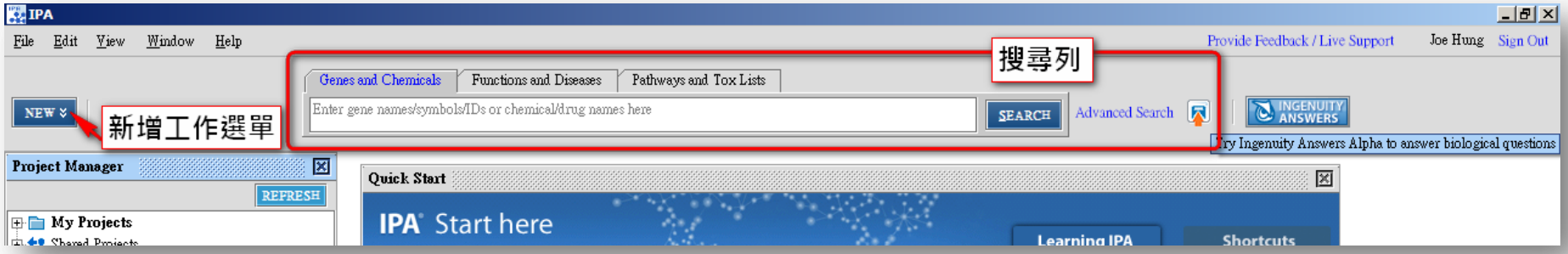
D. Q & A

Searching

- Searching Basics
- **Gene/chemical search and results**
- **Function/Disease search and results**
- **Pathway tox list search and results**
- Advanced search: Limiting results to a molecule type, family or subcellular location



Key Terminology

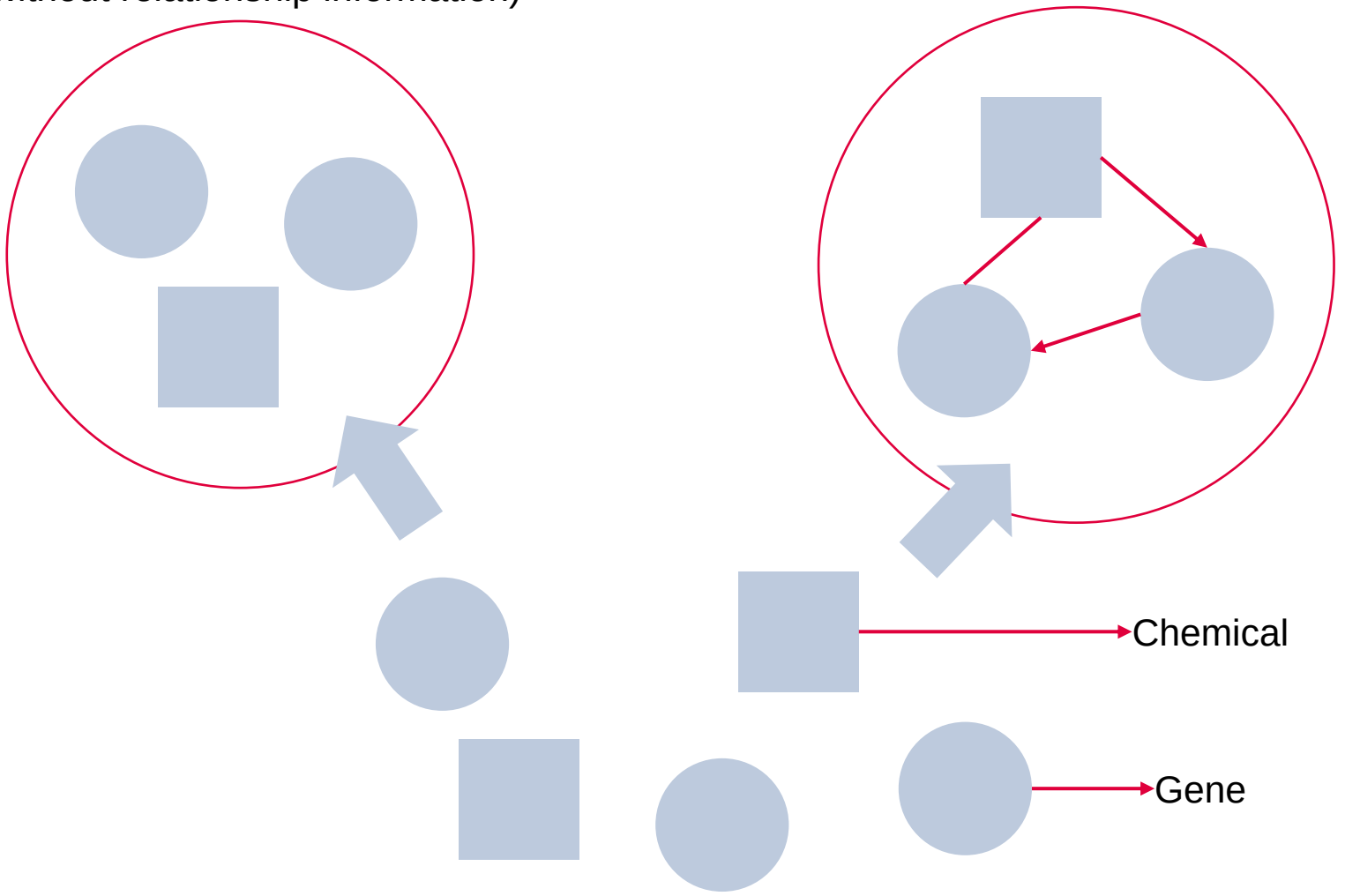
- **Finding:**
  - A single piece of evidence from a literature source or database in the **Ingenuity Knowledge Base**
  - Includes context of the fact such as experiment type, species, tissue/cell location, etc.

- **Canonical Pathway (Signaling and Metabolic)**
  - Are generated prior to data input, based on the literature
  - Do NOT change upon data input
  - Do have directionality

Scales for Gene/Chemical, Disease, Pathway

Set of Genes and Chemicals associated with Disease/Function (without relationship information)

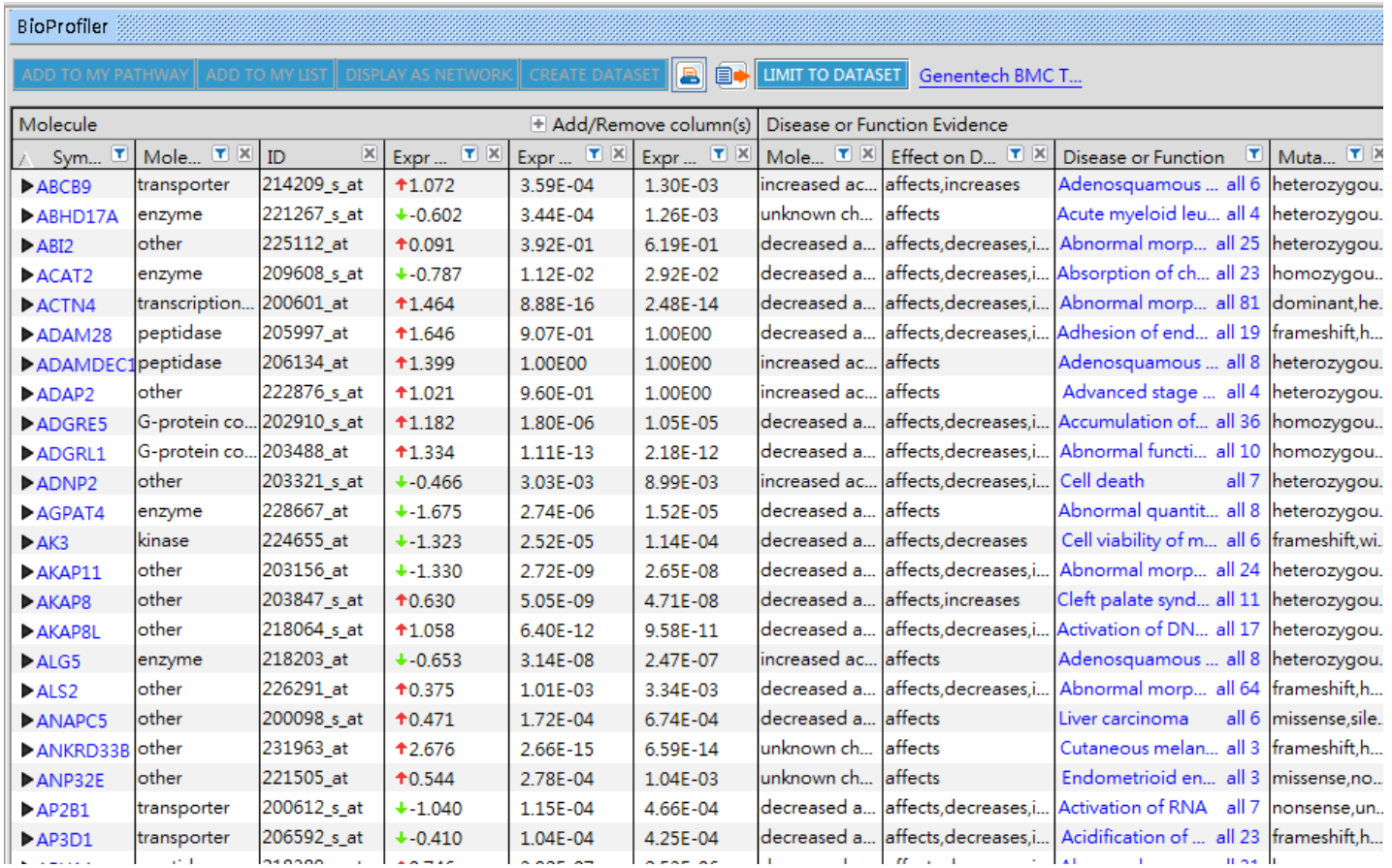
Set of Genes and Chemicals associated with Disease/Function (with relationship information)



Live Demo

BioProfiler

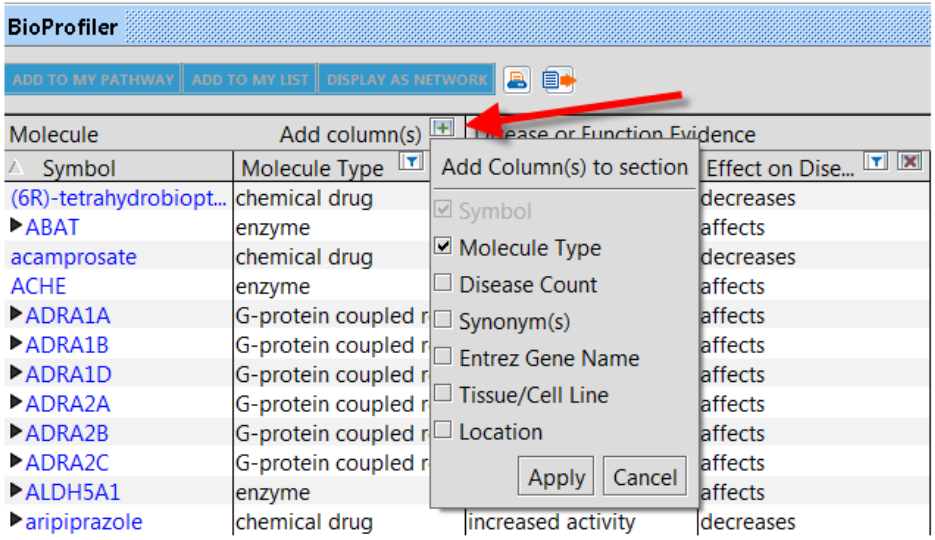
BioProfiler allows you to make novel discoveries by providing you the ability to filter the fine-grained relationships between molecules (genes, RNAs, proteins, and chemicals) and diseases or functions.

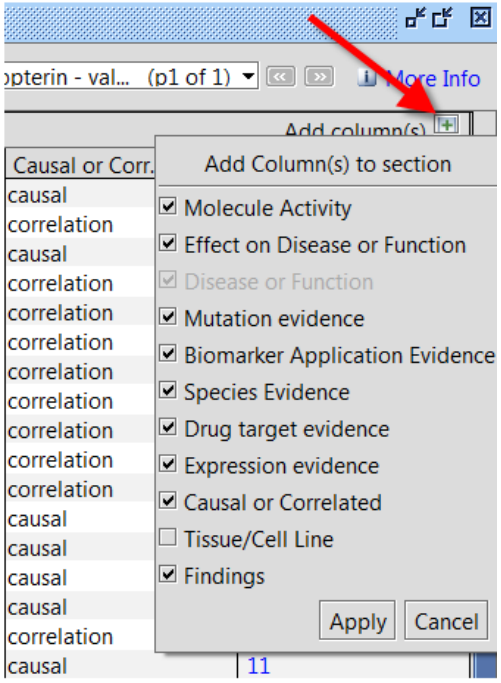


Sym...	Mole...	ID	Expr ...	Expr ...	Expr ...	Mole...	Effect on D...	Disease or Function	Muta...
ABCB9	transporter	214209_s_at	↑1.072	3.59E-04	1.30E-03	increased ac...	affects,increases	Adenosquamous ... all 6	heterozygou.
ABHD17A	enzyme	221267_s_at	↓-0.602	3.44E-04	1.26E-03	unknown ch...	affects	Acute myeloid leu... all 4	heterozygou.
ABI2	other	225112_at	↑0.091	3.92E-01	6.19E-01	decreased a...	affects,decreases,i...	Abnormal morp... all 25	heterozygou.
ACAT2	enzyme	209608_s_at	↓-0.787	1.12E-02	2.92E-02	decreased a...	affects,decreases,i...	Absorption of ch... all 23	homozygou..
ACTN4	transcription...	200601_at	↑1.464	8.88E-16	2.48E-14	decreased a...	affects,decreases,i...	Abnormal morp... all 81	dominant,he.
ADAM28	peptidase	205997_at	↑1.646	9.07E-01	1.00E00	decreased a...	affects,decreases,i...	Adhesion of end... all 19	frameshift,h...
ADAMDEC1	peptidase	206134_at	↑1.399	1.00E00	1.00E00	increased ac...	affects	Adenosquamous ... all 8	heterozygou.
ADAP2	other	222876_s_at	↑1.021	9.60E-01	1.00E00	increased ac...	affects	Advanced stage ... all 4	heterozygou.
ADGRE5	G-protein co...	202910_s_at	↑1.182	1.80E-06	1.05E-05	decreased a...	affects,decreases,i...	Accumulation of... all 36	homozygou..
ADGRL1	G-protein co...	203488_at	↑1.334	1.11E-13	2.18E-12	decreased a...	affects,decreases,i...	Abnormal functi... all 10	homozygou..
ADNP2	other	203321_s_at	↓-0.466	3.03E-03	8.99E-03	increased ac...	affects,decreases,i...	Cell death all 7	heterozygou.
AGPAT4	enzyme	228667_at	↓-1.675	2.74E-06	1.52E-05	decreased a...	affects	Abnormal quantit... all 8	heterozygou.
AK3	kinase	224655_at	↓-1.323	2.52E-05	1.14E-04	decreased a...	affects,decreases	Cell viability of m... all 6	frameshift,wi.
AKAP11	other	203156_at	↓-1.330	2.72E-09	2.65E-08	decreased a...	affects,decreases,i...	Abnormal morp... all 24	heterozygou.
AKAP8	other	203847_s_at	↑0.630	5.05E-09	4.71E-08	decreased a...	affects,increases	Cleft palate synd... all 11	heterozygou.
AKAP8L	other	218064_s_at	↑1.058	6.40E-12	9.58E-11	decreased a...	affects,decreases,i...	Activation of DN... all 17	heterozygou.
ALG5	enzyme	218203_at	↓-0.653	3.14E-08	2.47E-07	increased ac...	affects	Adenosquamous ... all 8	heterozygou.
ALS2	other	226291_at	↑0.375	1.01E-03	3.34E-03	decreased a...	affects,decreases,i...	Abnormal morp... all 64	frameshift,h...
ANAPC5	other	200098_s_at	↑0.471	1.72E-04	6.74E-04	decreased a...	affects	Liver carcinoma all 6	missense,sile.
ANKRD33B	other	231963_at	↑2.676	2.66E-15	6.59E-14	unknown ch...	affects	Cutaneous melan... all 3	frameshift,h...
ANP32E	other	221505_at	↑0.544	2.78E-04	1.04E-03	unknown ch...	affects	Endometrioid en... all 3	missense,no..
AP2B1	transporter	200612_s_at	↓-1.040	1.15E-04	4.66E-04	decreased a...	affects,decreases,i...	Activation of RNA all 7	nonsense,un..
AP3D1	transporter	206592_s_at	↓-0.410	1.04E-04	4.25E-04	decreased a...	affects,decreases,i...	Acidification of ... all 23	frameshift,h...

When will I use BioProfiler?

- Targets of toxicity: Which genes when [decreased] in activity [increase][liver cholestasis]? What types of [genetic] evidence support this?
- Target discovery:- What [heterozygous knockouts] in [mouse] can [decrease] [asthma]?
- Which drugs or which targets have been in late stage clinical trials or approved to decrease [diabetes]?
- Biomarker research: Which genes are potential [diagnosis OR prognosis] biomarkers of [breast cancer] and are [upregulated] in breast cancer?





Hands-on Exercises I

1. What **disease** is **BCR (the kinase)** associated with? Please list one of them.

2. How many categorized literature findings are in Ingenuity knowledge base on BCR (the kinase)?

3. Search for genes associated with the function antigen presentation in IPA. How many genes are associated with the function **activation of antigen presenting cells**?

4. Find the common genes between Diabetes mellitus and Alzheimer disease

Hands-on Exercises

1. What **disease** is **BCR (the kinase)** associated with? Please list one of them.

Chronic myeloid leukemia, adenocarcinoma, epithelial cancer, hyperactive behavior, leukemogenesis, hemangioblastoma, capillary hemangioma, squamous-cell carcinoma, melanoma, melanoma cancer, gliosis, edema, squamous cell cancer, weight loss, bipolar disorder, acute lymphocytic leukemia, sepsis, T-cell leukemia, ectopia, B-cell leukemia, Philadelphia-positive acute lymphoblastic leukemia, acute myeloid leukemia, carcinoma, hypertrophy, productive infection by HIV-1, tumorigenesis, Parkinson's disease, serous ovarian carcinoma, serous ovarian adenocarcinoma

2. How many categorized literature findings are in Ingenuity knowledge base on BCR (the kinase)?

1,569

3. Search for genes associated with the function antigen presentation in IPA. How many genes are associated with the function **activation of antigen presenting cells**?

671

4. Find the common genes between Diabetes mellitus and Alzheimer disease

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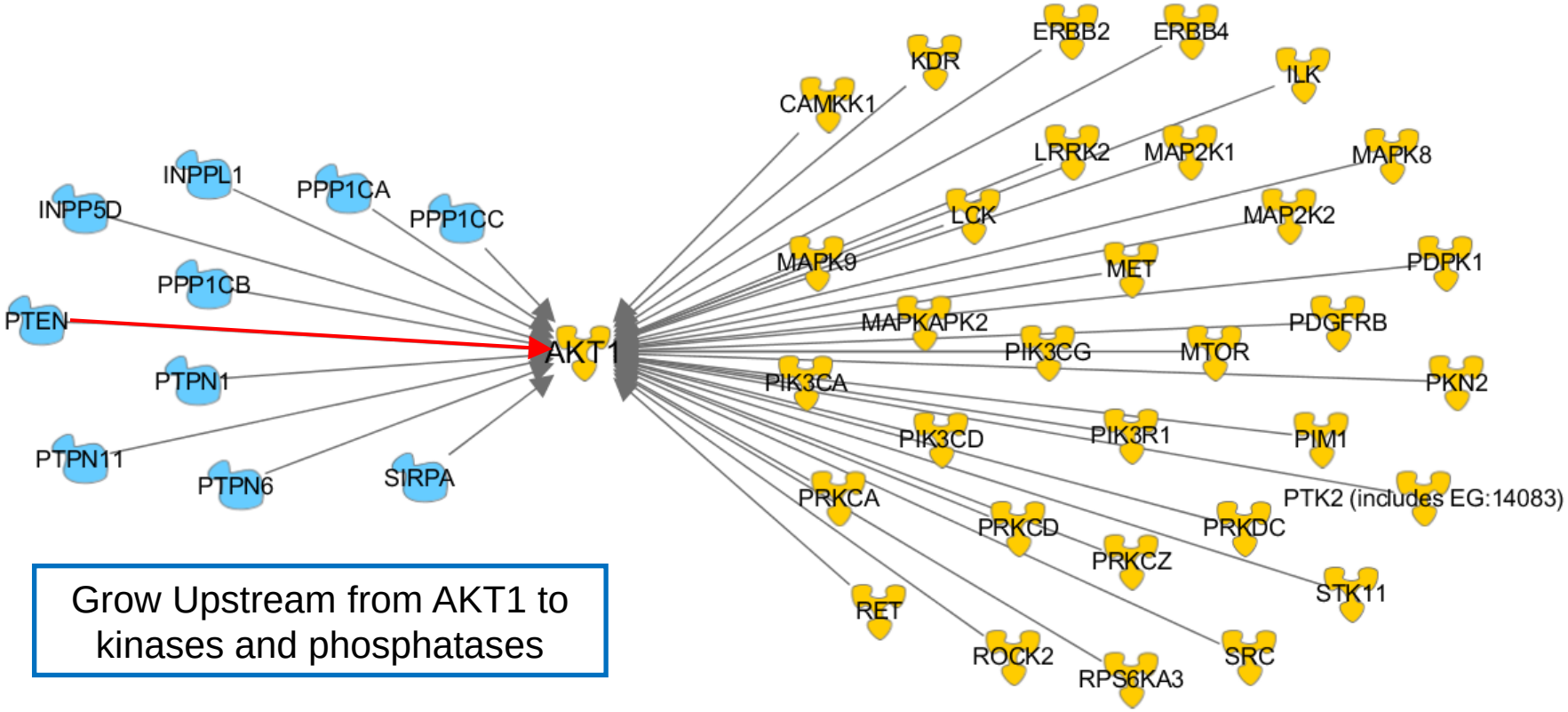
Build and Grow Networks of Molecules



Grow Upstream from AKT1 to kinases and phosphatases

Ingenuity Relationships

phosphorylation [9]

In Pc 3 cells, **PTEN protein decreases** (in a dose-dependent manner) **phosphorylation of human PKB [AKT1] protein to** phosphorylated (S473) **human PKB [AKT1] protein.**

10716737 Persad S, Attwell S, Gray V, Delcommenne M, Troussard A, Sanghera J, Dedhar S. Inhibition of integrin-linked kinase (ILK) suppresses activation of protein kinase B/Akt and induces cell cycle arrest and apoptosis of PTEN-mutant prostate cancer cells. Proc Natl Acad Sci U S A 2000 Mar 28;97(7):3207-12.

Source: Ingenuity Expert Findings

In U87MG cells, **human PTEN protein decreases phosphorylation of human PKB/AKT [AKT1] protein.**

10554022 Maier D, Jones G, Li X, Schonthal AH, Gratzl O, Van Meir EG, Merlo A. The PTEN lipid phosphatase domain is not required to inhibit invasion of glioma cells. Cancer Res 1999 Nov 1;59(21):5479-82.

Source: Ingenuity Expert Findings

Building Pathways

Introduction to Pathway Building

Key Terminology

Adding Molecules to a New Pathway

General pathway navigating

Using the Build Tools

Understanding the legend

Using the Overlay tools

Saving work for future analyses

How to build pathway

Key Terminology

Networks:

- Generated de novo based upon input data
- Do NOT have directionality

Canonical Pathways (Signaling and Metabolic):

- Are pre-built and generated prior to data input, based on the literature
- Do have directionality (proceed “from A to Z”)

My Pathways and **Path Designer Pathways**:

- Custom built pathways manually created based on user input

Relationship Type:

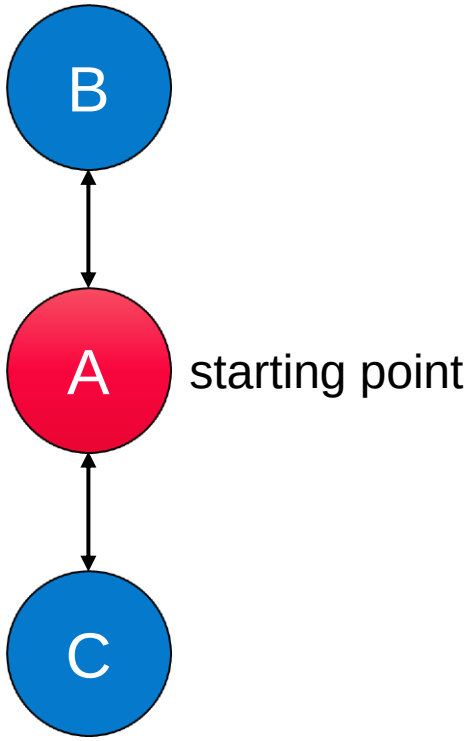
- An interaction between two molecules in IPA (seen as a line)
- Direct (physical contact) and Indirect (do NOT require physical contact)

Node

- Single molecule in Network such as Gene, Chemicals, Disease, and Pathway

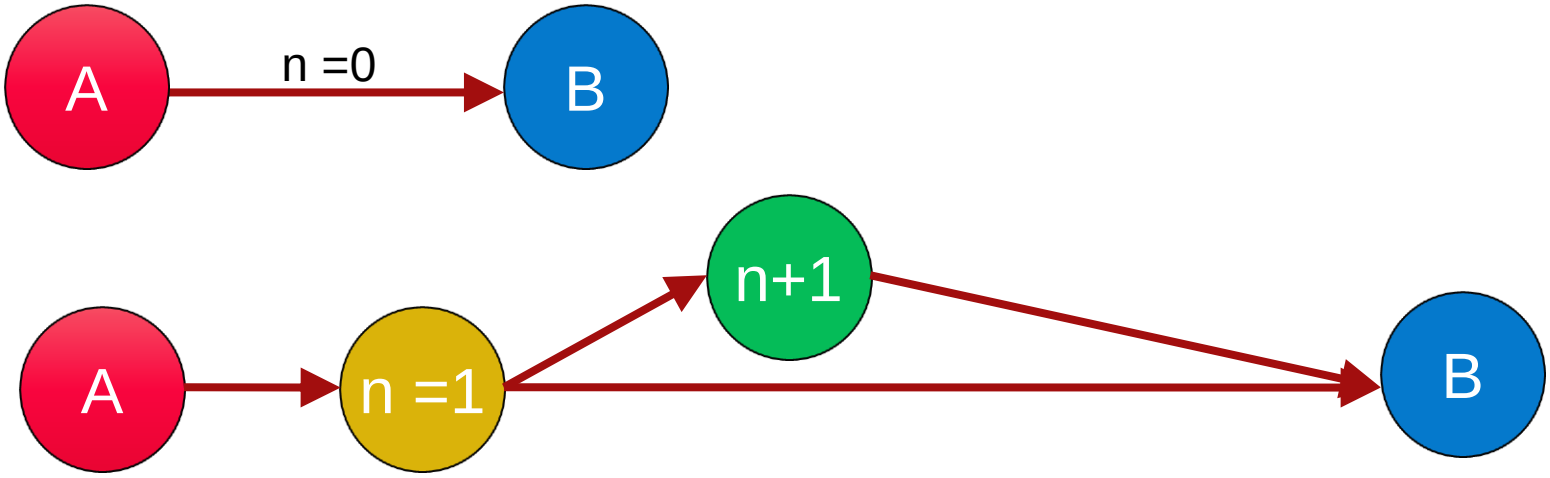
Grow

- Using one molecule of interest as a starting point, the Grow feature allows you to find (and add) other molecules of interest to a pathway. You can also grow to functions and diseases.



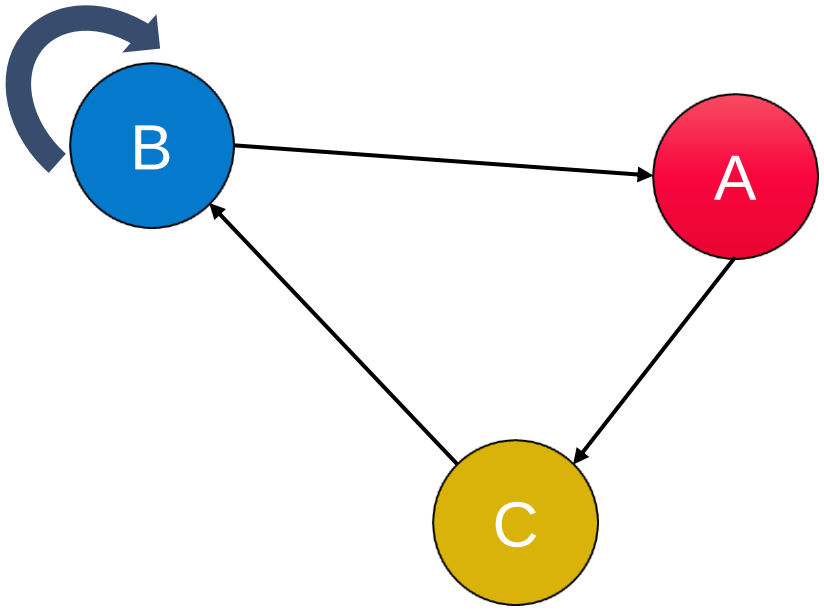
How Path Explorer Works

- Calculates the “Shortest Path” between 2 molecules or 2 sets of molecules
- If 2 molecules/sets don’t have specific connections in IPA, Path Explorer will find how many and which molecules can be added to this pathway to create the shortest path
  - Shortest Path (n)
  - Shortest Path + 1 (n+1)

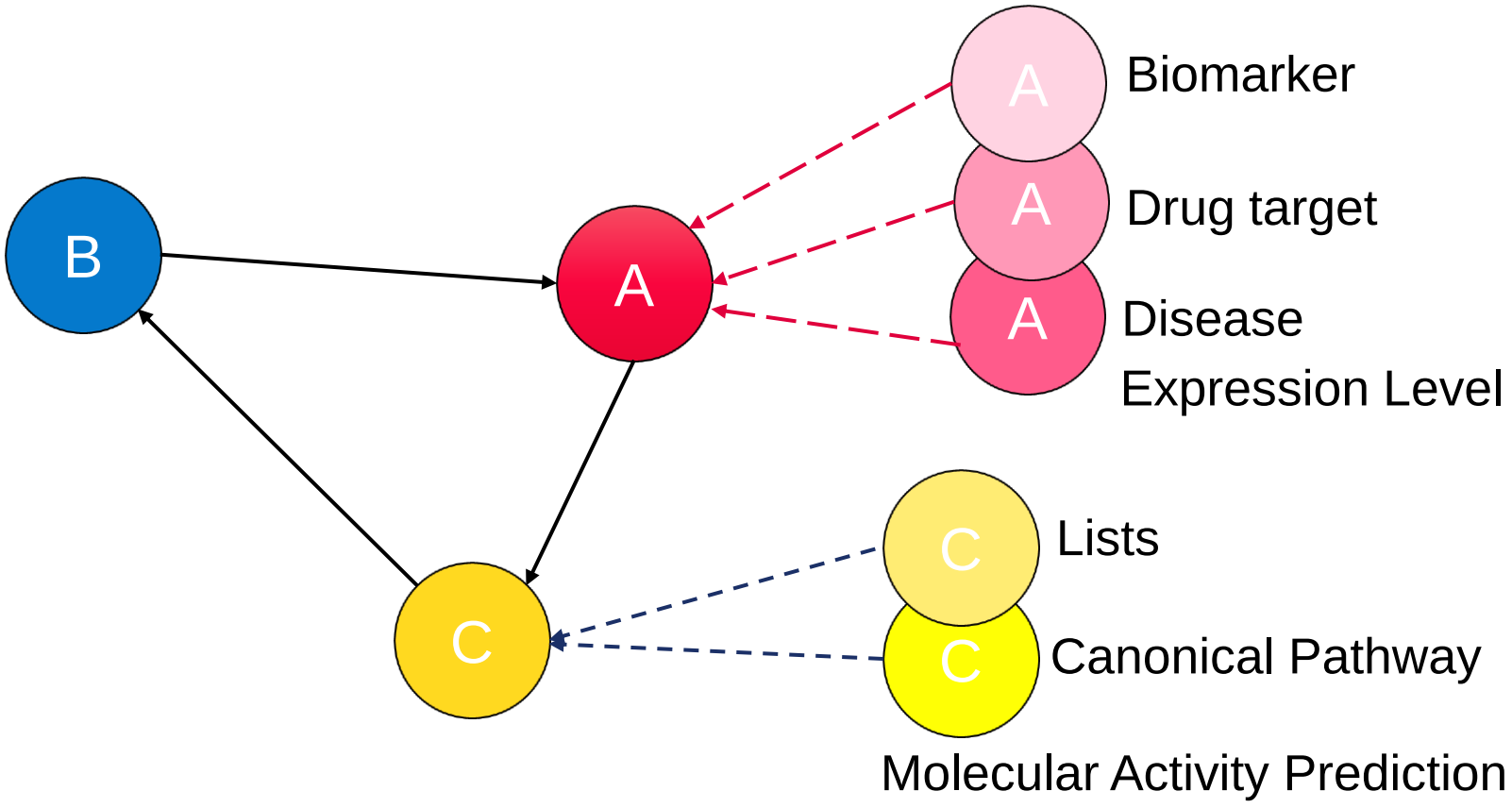


Connect

- Connect allows you to see specific molecular interactions between nodes or groups of nodes.

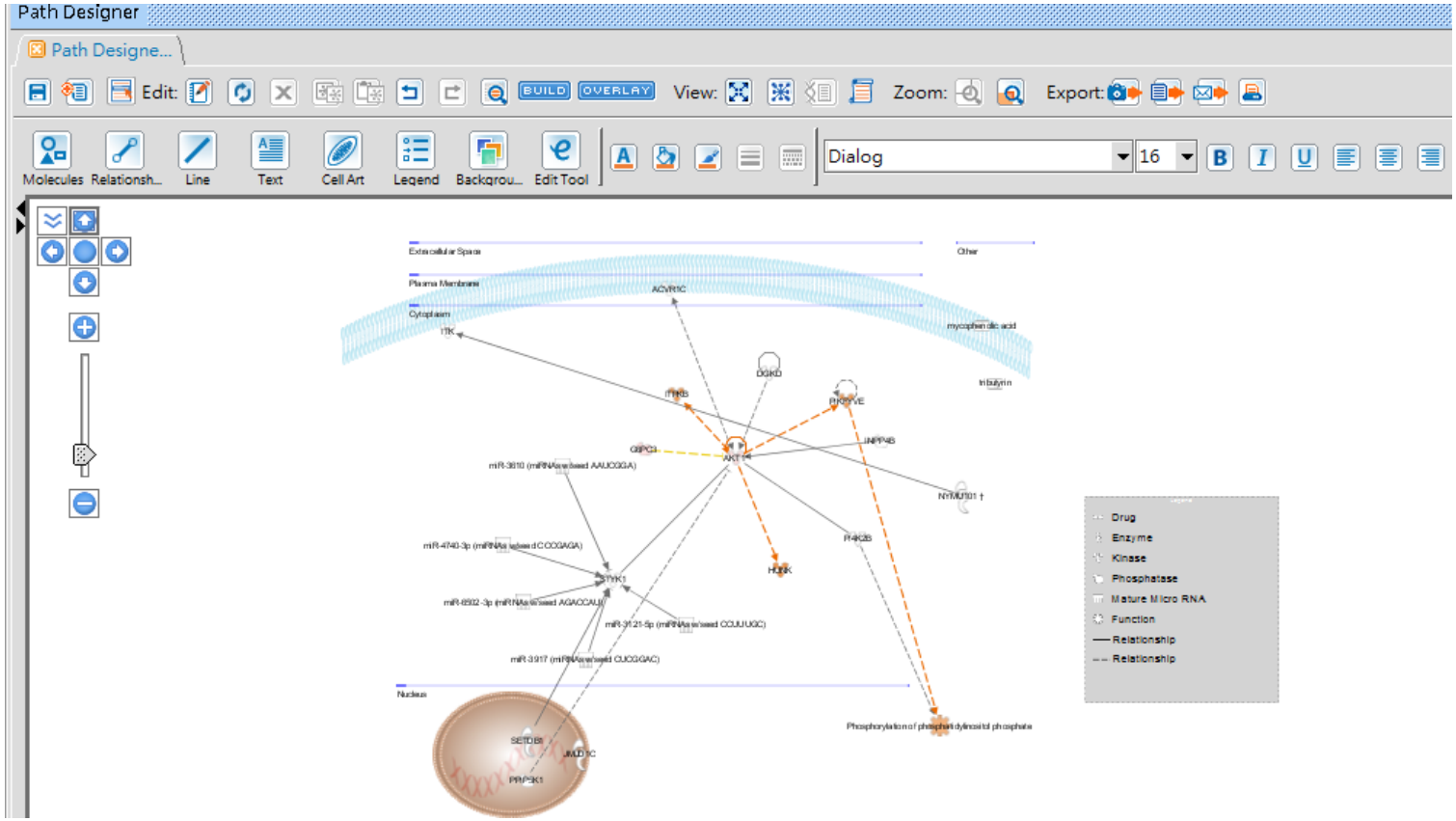


- Overlay tools allows you to compare and contrast different kinds of information within networks



Path Designer

- Use Path Designer to transform your networks and pathways in IPA into publication quality pathway graphics rich with color, customized text and fonts, biological icons, organelles, and custom backdrops.



Hands-on Exercises II

1. Search for the following genes in IPA and add them to a pathway:
   A2M, APOE, APP, HFE2, LRP1, PSEN1, PSEN2, SLC40A1, TRF2

2. What are the connections between these molecules that occur in nervous system tissues and CNS cell lines?

3. Are these molecules involved in any Canonical Pathways?

4. Add at least one organelle or other cellular structure to your pathway and move the molecules on your pathway to the appropriate location.

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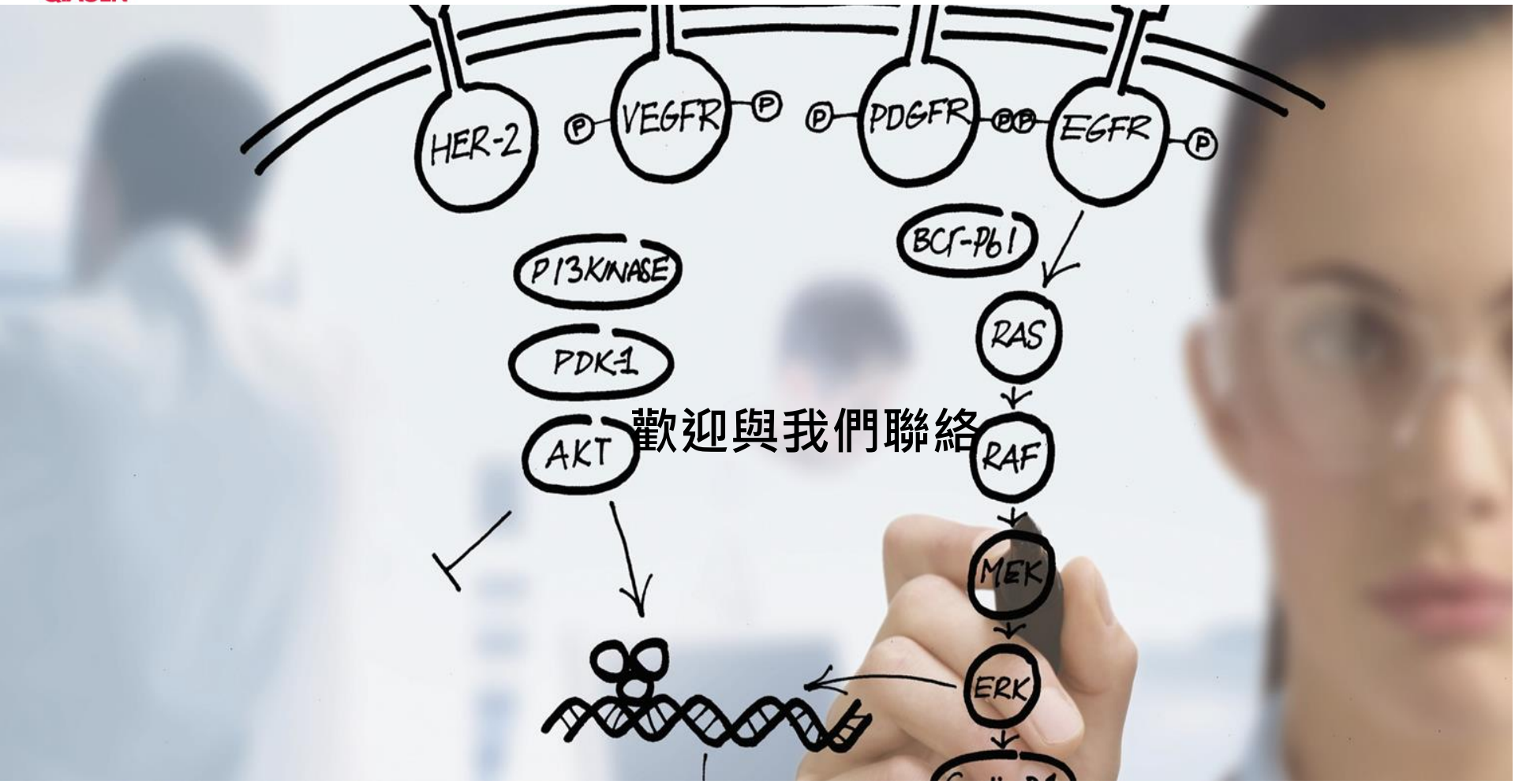

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