

QIAGEN Ingenuity Pathway Analysis (IPA): Biological Interpretation & Analysis of NGS data



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QIAGEN Digital Insights

Agenda

Introduction to Ingenuity Pathway Analysis

Gaining biological insights through interpretation of omic data

- Identify pathways and biological mechanism
- Discover key regulators and targets
- Study impacted biological functions and diseases

Generating hypothesis without a dataset

- Build custom networks and in-silico predictions

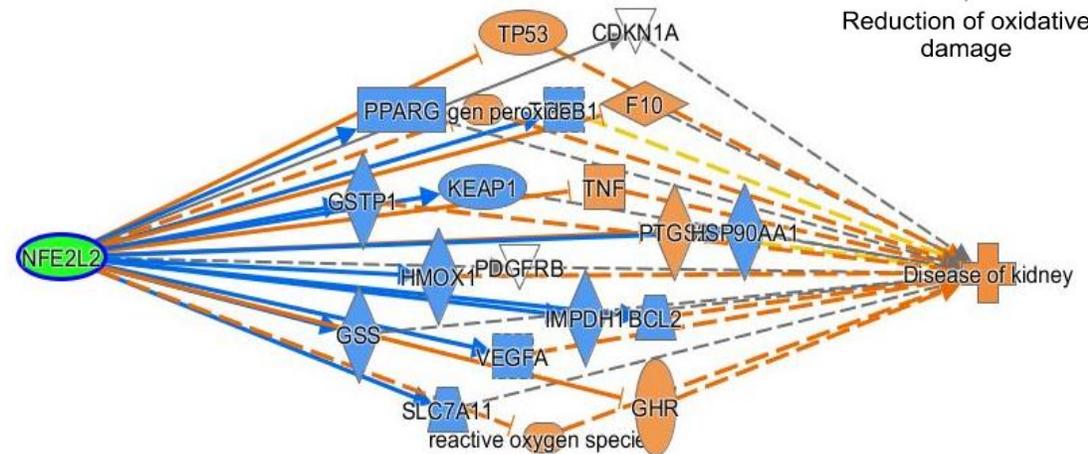
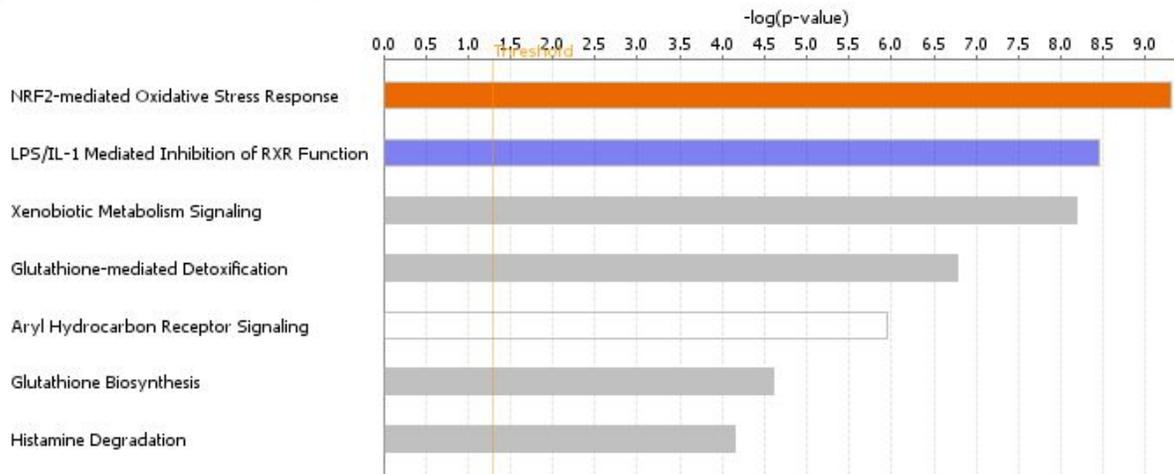
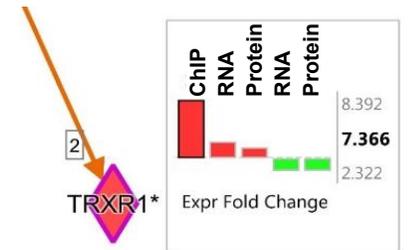


Perform analysis and interpretation of 'omics data within the context of various biological systems

Study biological mechanisms underlying disease pathology, drug treatment or cellular functions

Identify biomarkers and key regulators associated with your experimental data

Investigate gene/disease interactions by generating custom networks



Studies using QIAGEN Ingenuity Pathway Analysis (IPA)



Google Scholar "ingenuity pathway analysis" About 6,260 results (0.08 sec)

Articles

Any time
Since 2025
Since 2024
Since 2021
Custom range...

Sort by relevance
Sort by date

Any type
Review articles

include patents
 include citations

Create alert

[HTML] Transcriptomic profiling of lactotroph pituitary neuroendocrine tumors via RNA sequencing and ingenuity pathway analysis
[Y Hattori](#), [S Tahara](#), [H Ozawa](#), [A Morita](#), [H Ishii](#) - *Neuroendocrinology*, 2024 - karger.com
... **Ingenuity Pathway Analysis** Functional pathways and gene networks of the identified DEGs were investigated by **ingenuity pathway analysis** (IPA) (Qiagen, CA, USA). We used default ...
☆ Save Cite Cited by 2 Related articles All 7 versions

Ingenuity pathway analysis of gingival epithelial cells stimulated with estradiol and progesterone
[N Sugiyama](#), [O Uehara](#), [Y Kawano](#), [D Paudel](#)... - *Journal of Oral ...*, 2024 - Elsevier
Ingenuity pathway analysis of gingival epithelial cells stimulated with estradiol and progesterone - ScienceDirect ...
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Multiple Molecular Pathways Discriminate Sarcoidosis From TB Granulomas
[PJ Kramer](#), [ED Crouser](#), [MW Julian](#)... - *American Journal of ...*, 2025 - atsjournals.org
... and upstream regulator modules in **Ingenuity Pathway Analysis**® and network analysis using ... **Ingenuity Pathway Analysis**® identified multiple pro-inflammatory pathways (eg, neutrophil ...

> Cells. 2020 Oct 29;9(11):2374. doi: 10.3390/cells9112374.

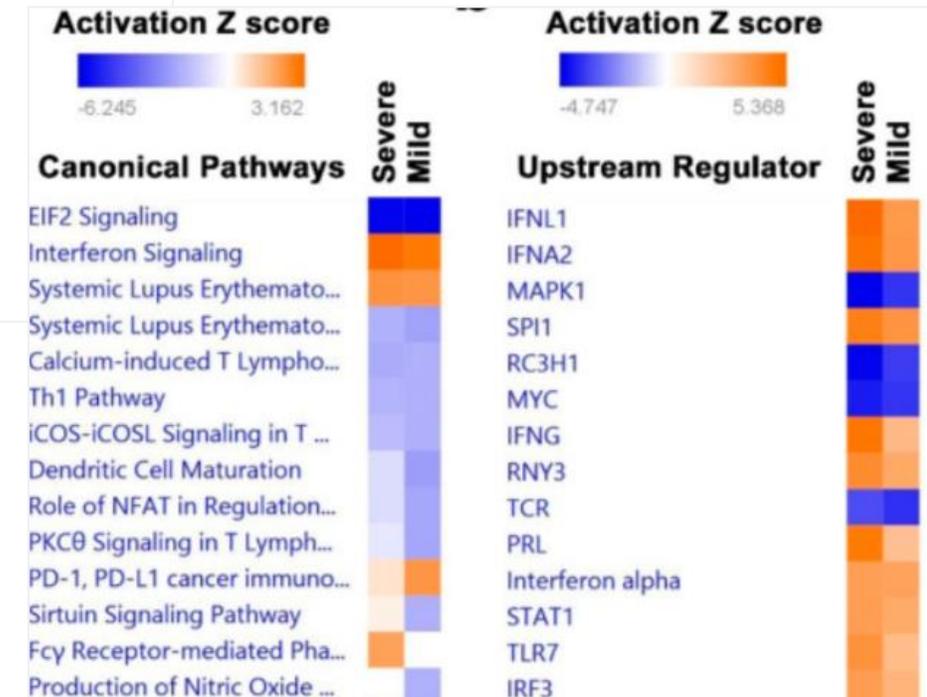
Single-Cell Transcriptome Analysis Highlights a Role for Neutrophils and Inflammatory Macrophages in the Pathogenesis of Severe COVID-19

Hibah Shaath ^{1 2}, Radhakrishnan Vishnubalaji ¹, Eyad Elkord ^{1 2}, Nehad M Alajez ^{1 2}

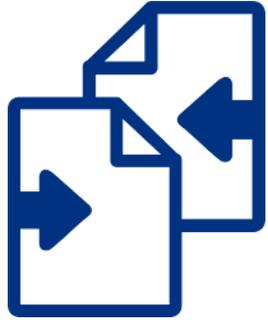
Affiliations + expand

PMID: 33138195 PMCID: PMC7693119 DOI: 10.3390/cells9112374

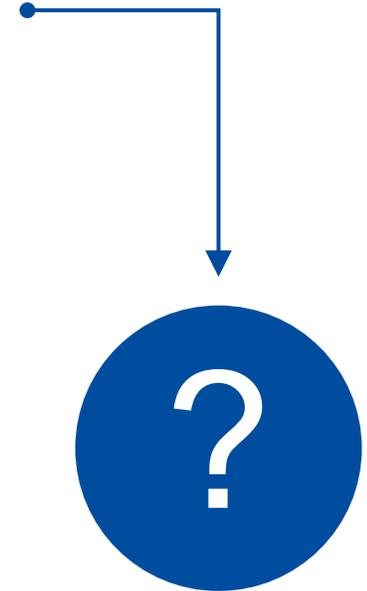
[Free PMC article](#)



CASE
VS
CONTROL



	A	B	C
1	geneid	Log2FoldChange	p-value
2	DDX11L1	-0.1067	0.2878
3	WASH7P	-0.1883	0.0097
4	FAM138F	-0.0761	0.4699
5	OR4F5	0.1474	0.5311
6	LOC729737	0.4789	0.0017
7	LOC100133331	0.4789	0.0017
8	LOC100132062	0.4789	0.0017
9	OR4F29	0.2495	0.2389
7920	CMTM2	0.4726	0.0001
7921	CMTM3	0.6099	0.000097742
7922	CMTM4	-0.815	1.5825E-07
7923	DYNC1LI2	-0.3924	7.2017E-10
7924	CCDC79	0.0023	0.9635
7925	NAE1	-0.2599	0.0098
7926	CA7	-1.8165	3.6214E-06
7927	PDP2	-0.6373	2.4407E-10
7928	CDH16	-0.0415	0.5431
7929	RRAD	0.2049	0.0106
7930	FAM96B	-0.1019	0.0571
7931	CES2	-1.1852	2.6332E-09
7932	CES3	-1.2535	1.0865E-07
7933	CES4A	0.0457	0.4449
7934	CBFB	0.8449	1.0268E-14
7935	C16orf70	-0.2996	1.1793E-07
7936	B3GNT9	0.3413	0.000032084
7937	BC007896	0.3413	0.000032084
7938	TRADD	0.0882	0.1007
7939	FBXL8	-0.073	0.2312
7940	HSF4	-0.2543	0.0015
7941	NOL3	-0.0595	0.2532
7942	KIAA0895L	-0.2385	0.001
7943	EXOC3L1	-0.2385	0.001
7944	E2F4	-0.0401	0.454
7945	ELMO3	-0.3649	0.0004
7946	LRRC29	-0.0481	0.5241
7947	TMEM208	0.2094	0.0005
7948	FHOD1	0.233	0.0024
7949	SLC9A5	-0.1668	0.0205
7950	PLEKHG4	-0.3191	2.1437E-06
7951	KCTD19	-0.095	0.062



Interpret your data with causal analytics and find key pathways



Expression Analysis - 3- glioblastoma (GBM) [brain] NA CMP_AD1btL3637LT



Summary Graphical Summary **Pathways** Upstream Analysis Diseases & Functions Regulator Effects Networks Lists Analysis Match Molecules

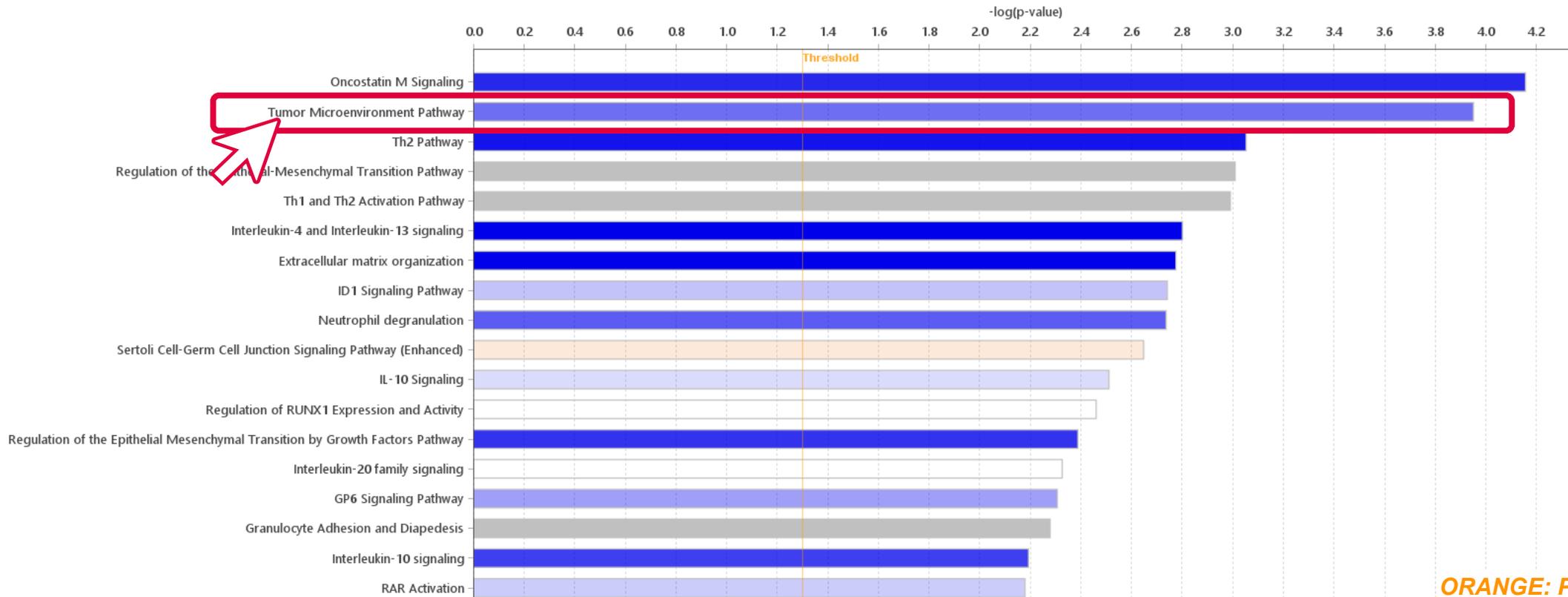
Canonical Pathways My Pathways ML Disease Pathways

Chart Overlapping

Customize Chart Horizontal Bar Chart

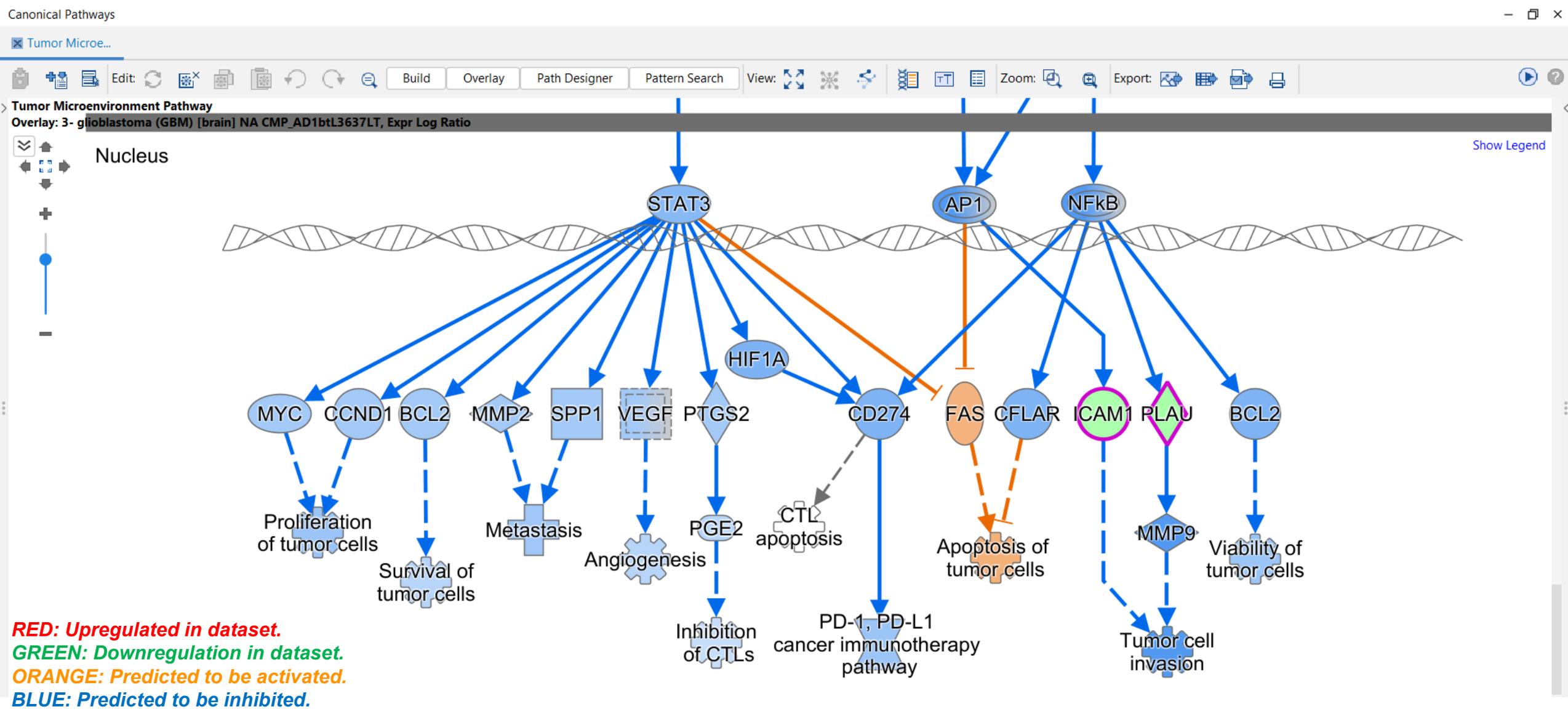


■ positive z-score □ z-score = 0 ■ negative z-score ■ no activity pattern available



ORANGE: Predicted to be activated.
BLUE: Predicted to be inhibited.

Interpret your data with causal analytics and find key pathways



Discover key regulators and targets

Expression Analysis - 3- glioblastoma (GBM) [brain] NA_CMP_AD1btL3637LT

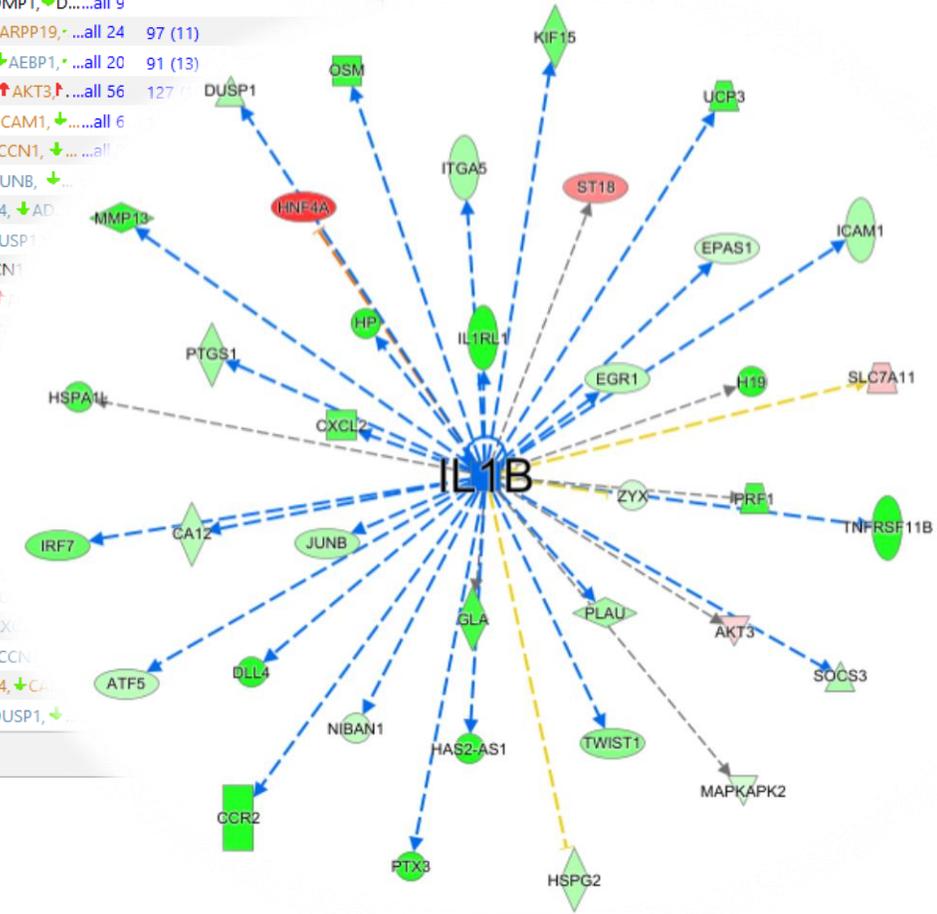
Summary Graphical Summary Pathways Upstream Analysis Diseases & Functions Regulator Effects Networks Lists Analysis Match Molecules

Upstream Regulators Causal Networks

Add To My Pathway Add To My List Display as Network Activity Plot Customize Table Mechanistic Networks

Upstream Regula..	Expr Log Ratio	Molecule Type	Predicted Activat...	Activation z-score	p-value of o...	Target Molecules..	Mechanistic Net...
H3-3A/3B		group			1.99E-05	↑C1QC, ↑DMP1, ↑D.....all 9	
PD98059		chemical - kinase inhibitor	Activated	3.524	2.27E-05	↑ANPEP, ↑ARPP19, ↑.....all 24	97 (11)
NFKBIA	↓-0.414	transcription regulator		-1.002	2.65E-05	↑ADGRE5, ↑AEBP1, ↑.....all 20	91 (13)
TGFB1	↓-0.794	growth factor	Inhibited	-3.793	2.68E-05	↑ADRA1D, ↑AKT3, ↑.....all 56	127
herbimycin		chemical drug	Activated	2.428	2.85E-05	↑DUSP1, ↑ICAM1, ↑.....all 6	
SFTPA1	↑3.139	other	Activated	2.137	2.91E-05	↑ANPEP, ↑CCN1, ↑.....all	
STAT1/3/5 DIMER (complex)		complex	Inhibited	-2.219	2.93E-05	↑EPAS1, ↑JUNB, ↑.....	
beta-estradiol		chemical - endogenous m...		-1.656	2.95E-05	↑ADAMTSL4, ↑AD.....	
TLR3	↓-0.697	transmembrane receptor	Inhibited	-3.283	2.98E-05	↑AKT3, ↑DUSP1, ↑.....	
CREBBP	↓-0.667	transcription regulator		-1.387	3.55E-05	↑AHI1, ↑CCN1, ↑.....	
EGFR	↓-2.751	kinase		-1.542	3.82E-05	↑AARSD1, ↑.....	
KRAS	↑0.521	enzyme		-0.996	4.05E-05	↑AKAP5, ↑.....	
IL1B	↓-1.082	cytokine	Inhibited	-4.549	4.45E-05	↑AKT3, ↑.....	
BRAF	↓-0.009	kinase			4.84E-05	↑ADD3, ↑.....	
glutamine		chemical - endogenous m...		0.998	5.03E-05	↑AMOTL, ↑.....	
PDGF-BB (complex)		complex	Inhibited	-2.441	5.17E-05	↑ADD3, ↑.....	
SMAD3	↓-0.611	transcription regulator	Inhibited	-2.658	5.76E-05	↑ACVR1, ↑.....	
MEK (family)		group	Inhibited	-3.071	6.30E-05	↑ANPEP, ↑.....	
WT1		transcription regulator		-1.144	6.62E-05	↑ADGRE5, ↑.....	
NFKB1	↓-0.507	transcription regulator	Inhibited	-2.051	7.16E-05	↑CCN1, ↑.....	
GAS6	↓-1.523	growth factor		-0.692	7.22E-05	↑CCN1, ↑.....	
F7	↑2.346	peptidase		-1.396	7.42E-05	↑CCN1, ↑.....	
IGF1	↓-0.713	growth factor	Inhibited	-2.690	7.91E-05	↑ANPEP, ↑CCN1, ↑.....	
IGE (complex)		complex	Inhibited	-3.000	8.34E-05	↑ADAMTSL4, ↑CA.....	
dalfampridine		chemical drug	Inhibited	-2.449	8.56E-05	↑CCN1, ↑DUSP1, ↑.....	

Selected 1 / 1130



RED: Upregulated in dataset.
GREEN: Downregulated in dataset.
ORANGE: Predicted to be activated.
BLUE: Predicted to be inhibited.

Study enriched biological functions and diseases

Expression Analysis - 3- glioblastoma (GBM) [brain] NA CMP_AD1btL3637LT

Summary Graphical Summary Pathways Upstream Analysis **Diseases & Functions** Regulator Effects Networks Lists Analysis Match Molecules

Diseases and Bio Functions Tox Functions

Size by: z-score

Color by: z-score

<-3.142 1.994

Highlight: None

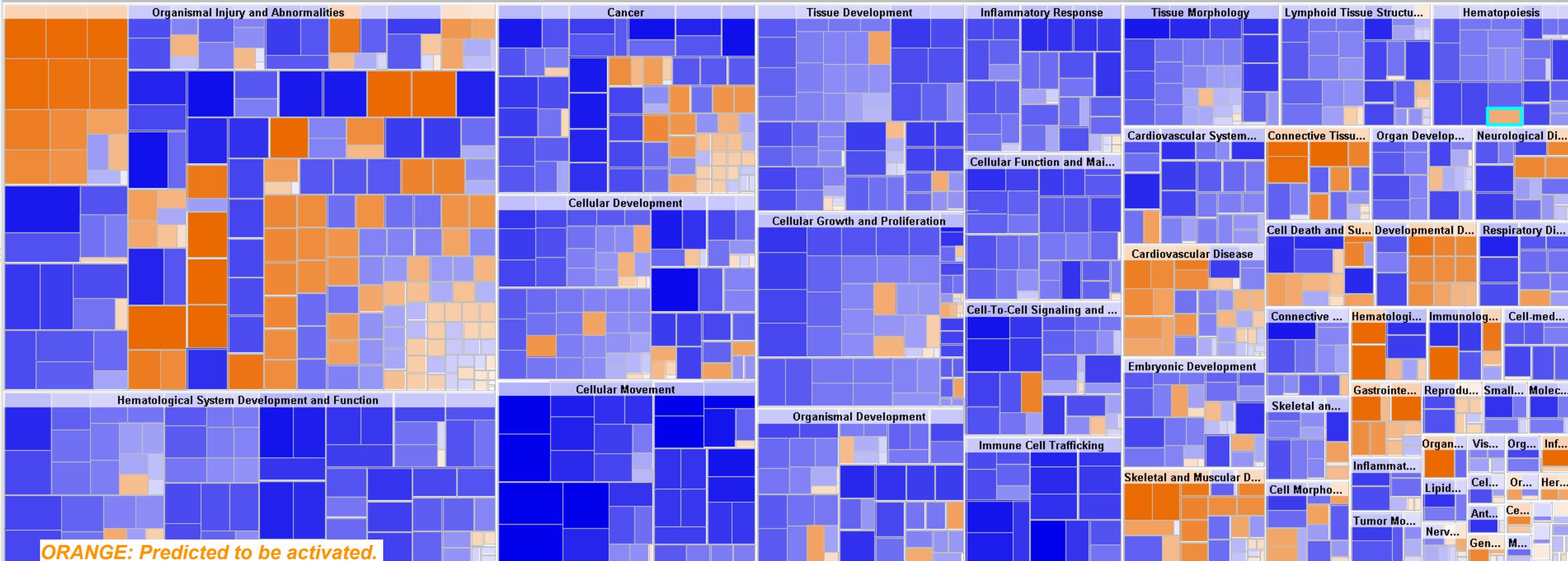


Show Label

Show Barchart



Click squares below to explore Currently Viewing: All



ORANGE: Predicted to be activated.
BLUE: Predicted to be inhibited.

IPA is powered by the QIAGEN knowledge base

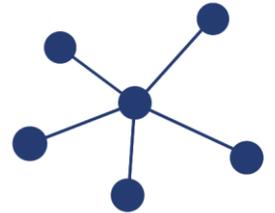


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Ingenuity
Pathway
Analysis



Weekly and quarterly updates with the latest disease, genetics, cancer, and drug findings

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QIAGEN IPA Analysis Match

ArrayExpress, GEO, TCGA, SRA, LINCS, etc.



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QIAGEN OmicSoft Studio



246,000+
comparison

Journal articles and databases such as
Clinical Trials, COSMIC, MGD, OMIM, etc.



Curated Findings

Ingenuity Pathway Analysis



- Explore biological findings in public datasets
- Build confidence in your analysis results
- Make unexpected insights into shared mechanisms between studies
- “Anti-matches” may provide insights

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Uploading data to IPA



IPA

File Edit View Window Help

Genes and Chemicals Diseases and Functions Pathways and Lists Datasets and Analyses

Create New... Search Advanced Search

Provide Feedback | Support Close IPA

QIAGEN Land Explorer

- Create New...
- Core Analysis...
- Comparison Analysis...
- Biomarker Filter...
- Biomarker Comparison Analysis...
- MicroRNA Target Filter...
- BioProfiler
- IsoProfiler
- My Pathway
- Path Designer
- Filter Dataset
- Upload Dataset...
- Advanced Search
- Project...
- Compare
- Import Pathway

Create Core Analysis

Upload

- > My Projects
- > Shared Projects
- > Ingenuity CWS
- > QIAGEN Demo CWS

Next

Public data core analysis search in QIAGEN IPA



Search Results

Datasets and Analyses

Search Results

Showing first 1999 results out of 1999 in 2063ms for query [glioblastoma]

Folder Types

- dataset (1004)
- analysis (995)

Projects

- OncoHuman (1127)
- SingleCellHumanUmi (302)
- ClinicalProteomicTumor (232)
- TCGA (202)
- OncoMouse (72)

Libraries > OmicSoft > OncoLand > Pediatrics > Analyses

[4- glioblastoma \(GBM\) \[brain\] NA 405](#)

Case/Control Differences

Key	Case	Control
diseasestate	glioblastoma (GBM)	normal control

Comparison Context

Open Add to Comparison Customize Table Crea... 2024/... - 2024/... (1/50) << >>

Name	Type	Creation Date	case.diseasestate
726- anaplastic astrocytoma;glioblastoma (GBM) [brain] 725	analysis	2024/01/12 09:12:07	anaplastic astrocytoma;gli
1- diffuse intrinsic pontine glioma (DIPG) [brain] NA 92	analysis	2024/01/09 02:09:40	diffuse intrinsic pontine g
1- glioblastoma (GBM) [brain] DMSO 435	analysis	2024/01/09 02:08:58	glioblastoma (GBM)
1- glioblastoma (GBM) [temporal lobe] 140	analysis	2024/01/09 02:08:36	glioblastoma (GBM)
1- glioblastoma (GBM) [brain] NA 324	analysis	2024/01/09 02:00:06	glioblastoma (GBM)
1- glioblastoma (GBM) [brain] NA 143	analysis	2024/01/09 01:36:33	glioblastoma (GBM)
10- glioblastoma (GBM) [temporal lobe] 149	analysis	2024/01/09 01:24:27	glioblastoma (GBM)
11- glioblastoma (GBM) [temporal lobe] 150	analysis	2024/01/08 22:45:55	glioblastoma (GBM)
12- glioblastoma (GBM) [temporal lobe] 151	analysis	2024/01/08 21:56:51	glioblastoma (GBM)
13- glioblastoma (GBM) [temporal lobe] 152	analysis	2024/01/08 21:11:17	glioblastoma (GBM)
14- glioblastoma (GBM) [temporal lobe] 153	analysis	2024/01/08 20:22:21	glioblastoma (GBM)
2- glioblastoma (GBM) [temporal lobe] 141	analysis	2024/01/08 16:17:19	glioblastoma (GBM)
2- glioblastoma (GBM) [brain] NA 144	analysis	2024/01/08 16:09:19	glioblastoma (GBM)

Search terms:

- Glioblastoma
- bevacizumab
- GSE79671

> BMC Cancer. 2017 Apr 18;17(1):278. doi: 10.1186/s12885-017-3251-3.

Transcriptional changes induced by bevacizumab combination therapy in responding and non-responding recurrent glioblastoma patients

Thomas Urup ¹, Line Mærsk Staunstrup ², Signe Regner Michaelsen ³, Kristoffer Vitting-Seerup ², Marc Bennedbæk ⁴, Anders Toft ³, Lars Rønn Olsen ^{5 6}, Lars Jønson ⁴, Shohreh Issazadeh-Navikas ⁷, Helle Broholm ⁸, Petra Hamerlik ^{3 9}, Hans Skovgaard Poulsen ^{3 10}, Ulrik Lassen ^{3 10 11}

Affiliations + expand

PMID: 28420326 PMCID: PMC5395849 DOI: 10.1186/s12885-017-3251-3

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Agenda

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MAP2K3

Proteome profiling of immortalization-to-senescence transition of human breast epithelial cells identified **MAP2K3** as a senescence-promoting protein which is downregulated in human breast cancer.

Jia M, Souchelnytskyi N, Hellman U, O'Hare M, Jat PS, Souchelnytskyi S.
Proteomics Clin Appl. 2010 Nov;4(10-11):816-28. doi: 10.1002/prca.201000006.
PMID: 21137025

Genome-wide RNA interference screening reveals a COPI-**MAP2K3** pathway required for YAP regulation.

Kim YJ, Jung E, Shin E, Hong SH, Jeong HS, Hur G, Jeong HY, Lee SH, Lee JE, Kim GH, Kim J.
Proc Natl Acad Sci U S A. 2020 Aug 18;117(33):19994-20003. doi: 10.1073/pnas.1915387117. Epub 2020 Aug 3.
PMID: 32747557 [Free PMC article.](#)

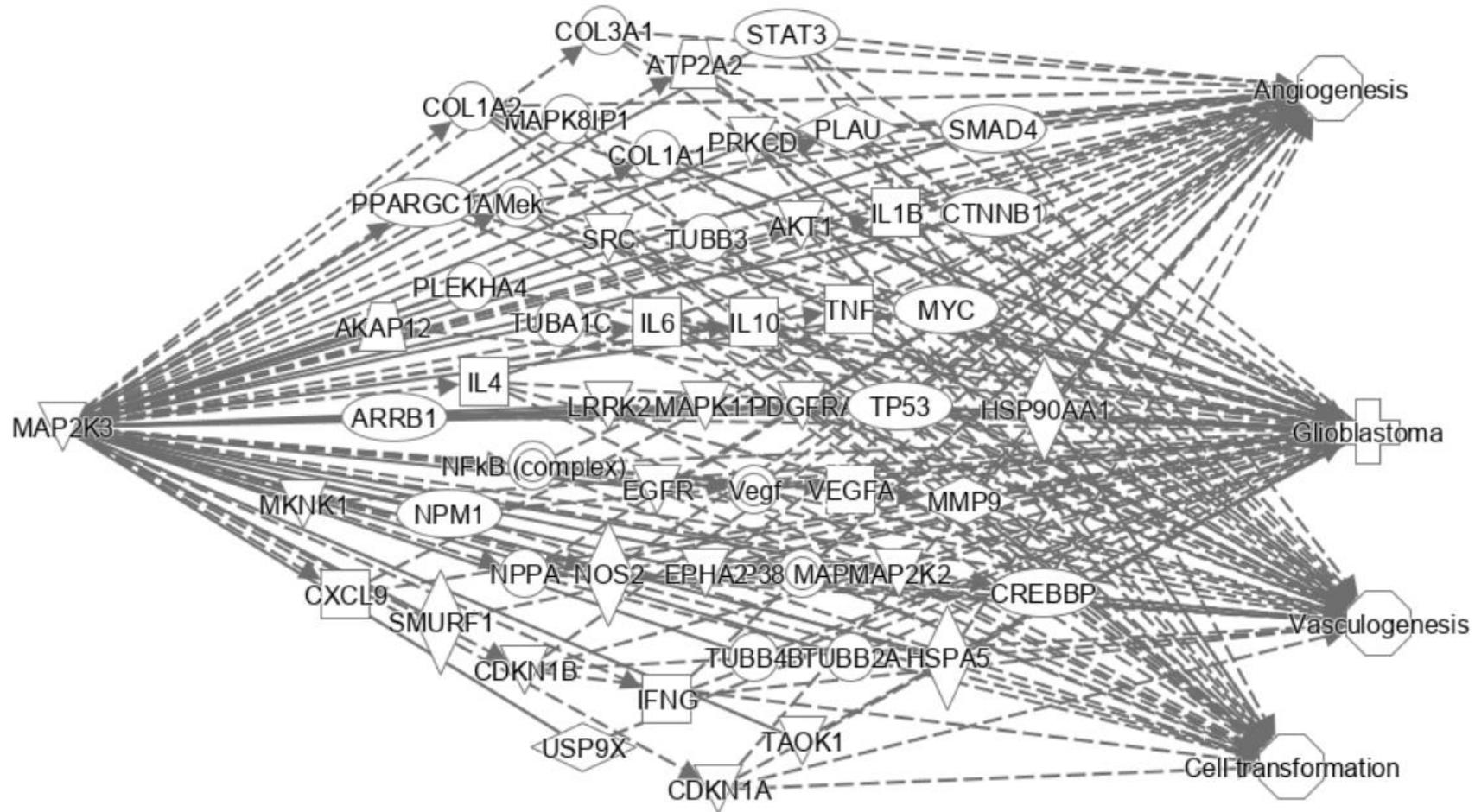
Sulforaphene inhibits esophageal cancer progression via suppressing SCD and CDH3 expression, and activating the GADD45B-**MAP2K3**-p38-p53 feedback loop.

Han S, Wang Y, Ma J, Wang Z, Wang HD, Yuan Q.
Cell Death Dis. 2020 Sep 1;11(8):713. doi: 10.1038/s41419-020-02859-2.
PMID: 32873775 [Free PMC article.](#)

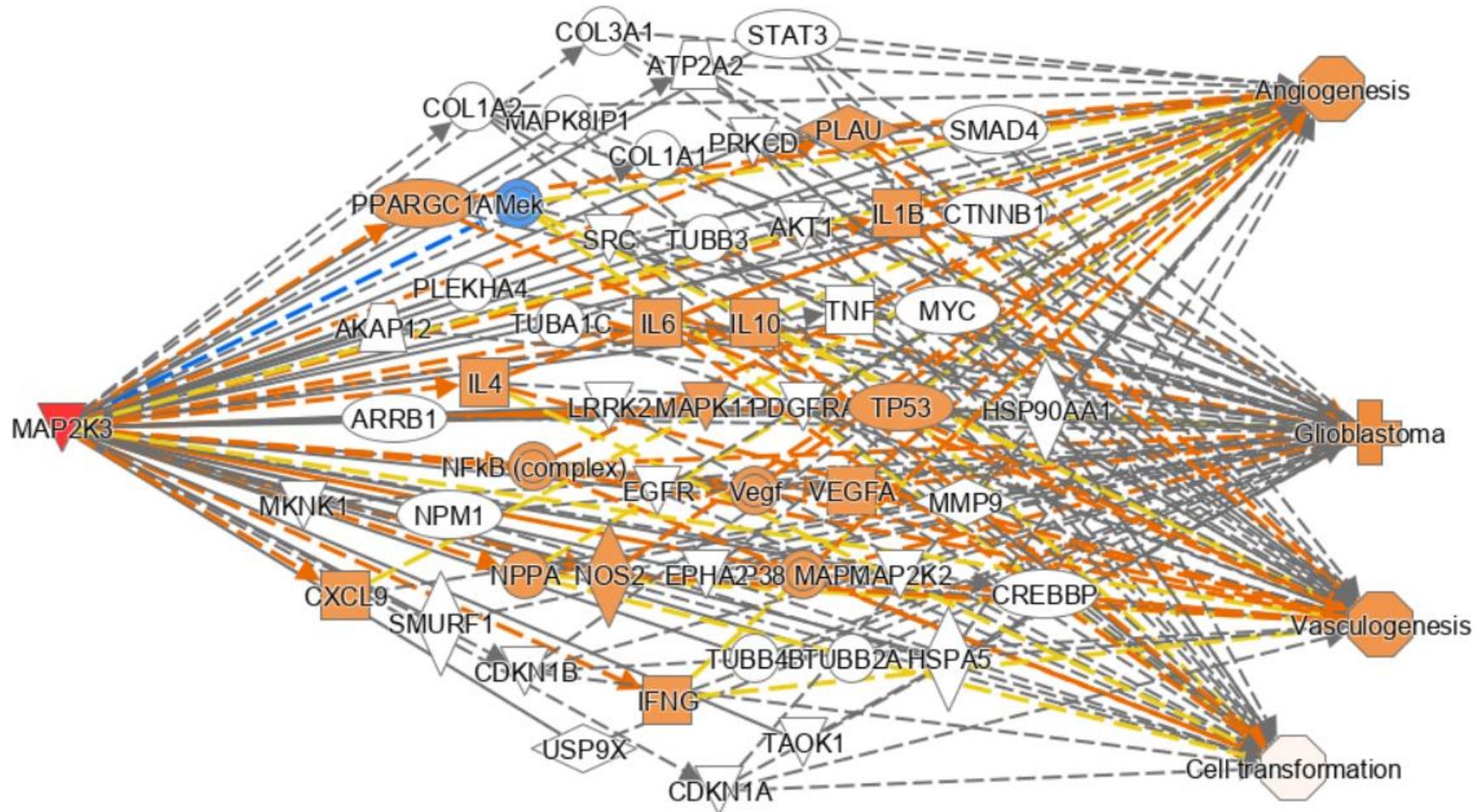
The miR-19b-3p-**MAP2K3**-STAT3 feedback loop regulates cell proliferation and invasion in esophageal squamous cell carcinoma.

Zhang Y, Lu W, Chen Y, Lin Y, Yang X, Wang H, Liu Z.
Mol Oncol. 2021 May;15(5):1566-1583. doi: 10.1002/1878-0261.12934. Epub 2021 Mar 14.
PMID: 33660414 [Free PMC article.](#)

Construct networks based on key biomarkers



Predict molecule activity



Summary

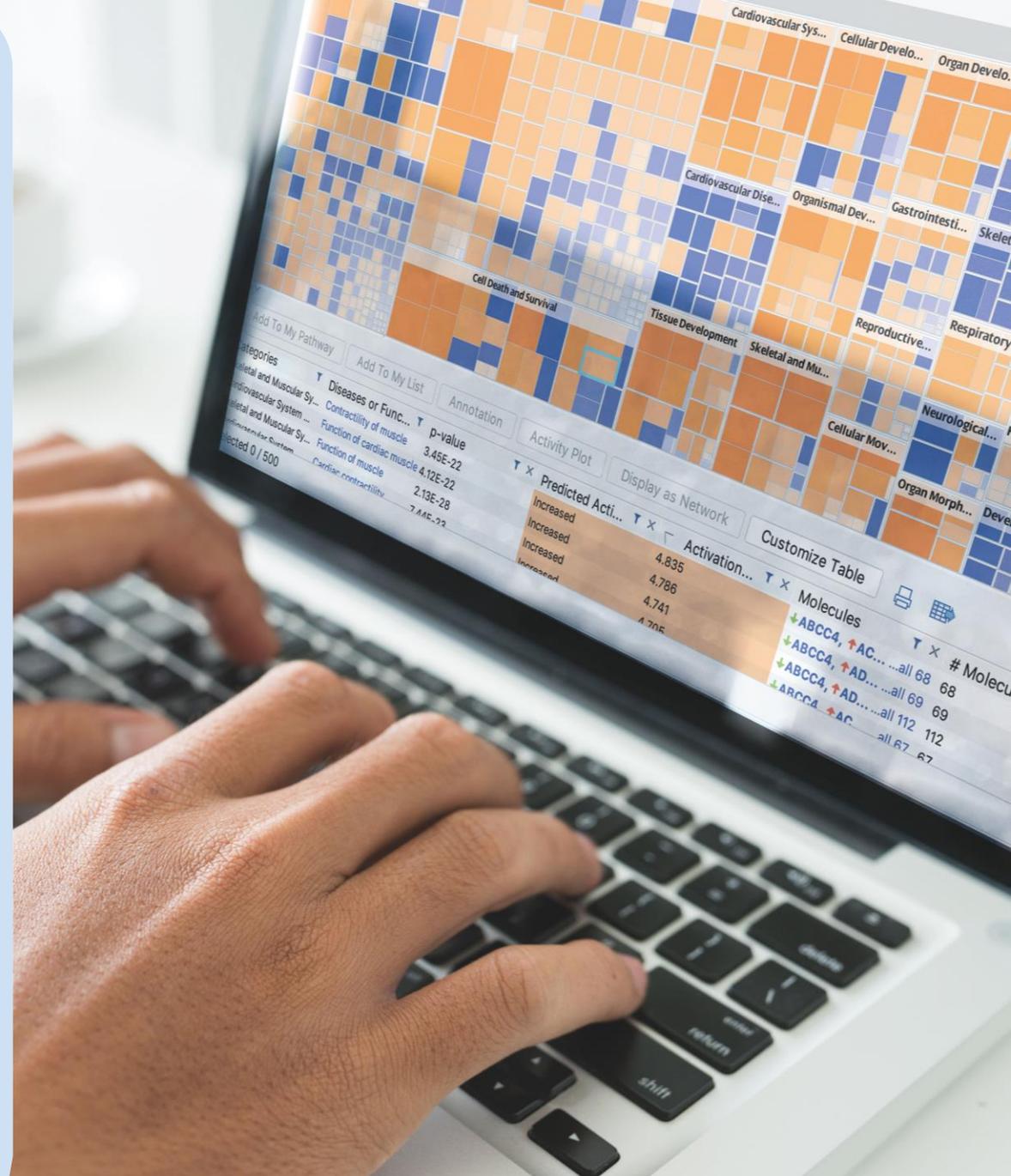


Biological interpretation of data using QIAGEN IPA

- Interrogate key pathways impacted by expression changes at varying levels of detail
- Identify predicted regulators driving the observed expression signature
- Compare biological findings with internal/public data
- Easily generate tables and figures based on the analysis

Utilizing QIAGEN IPA without a dataset

- Leverage QIAGEN Knowledgebase for literature findings
- Build networks in silico and predict activity



Contact Information

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QIAGEN Digital Insights
paul.daniel@qiagen.com



Ingenuity Pathway Analysis trial:

<https://qiagen.showpad.com/share/RC7IWOoVJnSsEd5w9LjiA>

Software questions and support: ts-bioinformatics@qiagen.com
Additional feedback and training: devendra.mistry@qiagen.com