



Pathway Analysis Report

This report contains the pathway analysis results for the submitted sample ". Analysis was performed against Reactome version 95 on 10/12/2025. The web link to these results is:

<https://reactome.org/PathwayBrowser/#/ANALYSIS=MjAyNTEyMTAxOTA1MzFfMjM3Mg%3D%3D>

Please keep in mind that analysis results are temporarily stored on our server. The storage period depends on usage of the service but is at least 7 days. As a result, please note that this URL is only valid for a limited time period and it might have expired.

Table of Contents

1. Introduction
2. Properties
3. Genome-wide overview
4. Most significant pathways
5. Pathways details
6. Identifiers found
7. Identifiers not found

1. Introduction

Reactome is a curated database of pathways and reactions in human biology. Reactions can be considered as pathway 'steps'. Reactome defines a 'reaction' as any event in biology that changes the state of a biological molecule. Binding, activation, translocation, degradation and classical biochemical events involving a catalyst are all reactions. Information in the database is authored by expert biologists, entered and maintained by Reactome's team of curators and editorial staff. Reactome content frequently cross-references other resources e.g. NCBI, Ensembl, UniProt, KEGG (Gene and Compound), ChEBI, PubMed and GO. Orthologous reactions inferred from annotation for *Homo sapiens* are available for 14 non-human species including mouse, rat, chicken, puffer fish, worm, fly and yeast. Pathways are represented by simple diagrams following an SBGN-like format.

Reactome's annotated data describe reactions possible if all annotated proteins and small molecules were present and active simultaneously in a cell. By overlaying an experimental dataset on these annotations, a user can perform a pathway over-representation analysis. By overlaying quantitative expression data or time series, a user can visualize the extent of change in affected pathways and its progression. A binomial test is used to calculate the probability shown for each result, and the p-values are corrected for the multiple testing (Benjamini–Hochberg procedure) that arises from evaluating the submitted list of identifiers against every pathway.

To learn more about our Pathway Analysis, please have a look at our relevant publications:

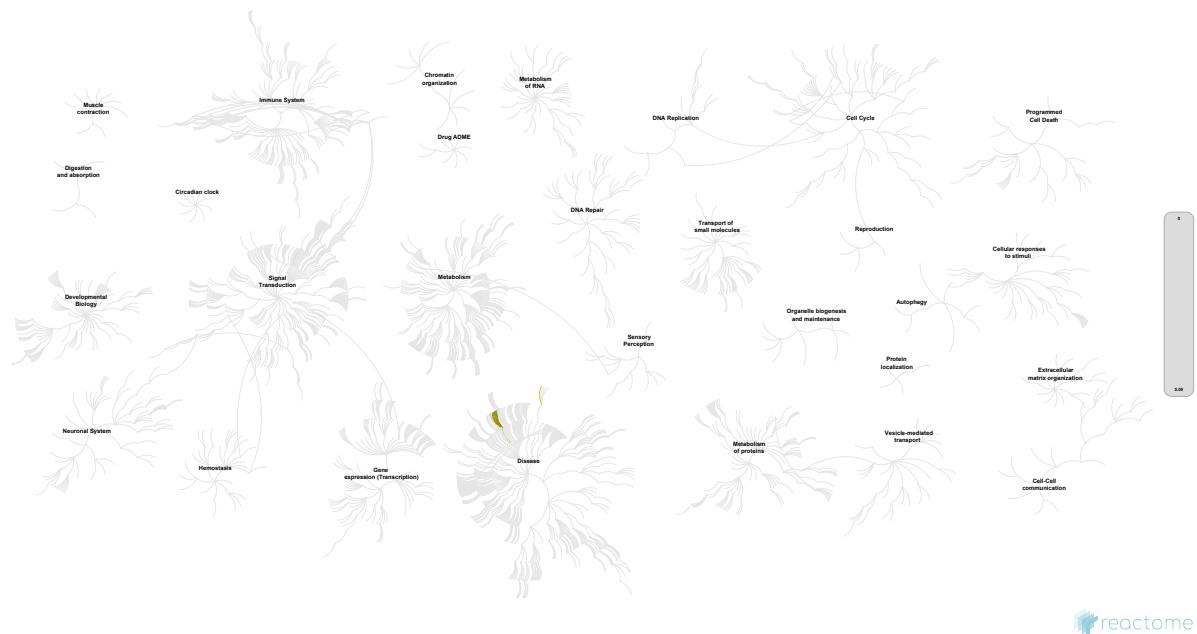
Fabregat A, Sidiropoulos K, Garapati P, Gillespie M, Hausmann K, Haw R, ... D'Eustachio P (2016). The reactome pathway knowledgebase. *Nucleic Acids Research*, 44(D1), D481–D487. <https://doi.org/10.1093/nar/gkv1351>. 

Fabregat A, Sidiropoulos K, Viteri G, Forner O, Marin-Garcia P, Arnau V, ... Hermjakob H (2017). Reactome pathway analysis: a high-performance in-memory approach. *BMC Bioinformatics*, 18. 

2. Properties

- This is an **overrepresentation** analysis: A statistical (hypergeometric distribution) test that determines whether certain Reactome pathways are over-represented (enriched) in the submitted data. It answers the question 'Does my list contain more proteins for pathway X than would be expected by chance?' This test produces a probability score, which is corrected for false discovery rate using the Benjamani-Hochberg method. ↗
- 565 out of 1482 identifiers in the sample were found in Reactome, where 2100 pathways were hit by at least one of them.
- All non-human identifiers have been converted to their human equivalent. ↗
- IntAct interactors were included to increase the analysis background. This greatly increases the size of Reactome pathways, which maximises the chances of matching your submitted identifiers to the expanded pathway, but will include interactors that have not undergone manual curation by Reactome and may include interactors that have no biological significance, or unexplained relevance.
- This report is filtered to show only results for species 'Homo sapiens' and resource 'all resources'.
- The unique ID for this analysis (token) is MjAyNTEyMTAxOTA1MzFfMjM3Mg%3D%3D. This ID is valid for at least 7 days in Reactome's server. Use it to access Reactome services with your data.

3. Genome-wide overview



This figure shows a genome-wide overview of the results of your pathway analysis. Reactome pathways are arranged in a hierarchy. The center of each of the circular "bursts" is the root of one top-level pathway, for example "DNA Repair". Each step away from the center represents the next level lower in the pathway hierarchy. The color code denotes over-representation of that pathway in your input dataset. Light grey signifies pathways which are not significantly over-represented.

4. Most significant pathways

The following table shows the 25 most relevant pathways sorted by p-value.

Pathway name	Entities				Reactions	
	found	ratio	p-value	FDR*	found	ratio
Loss of MECP2 binding ability to 5hmC-DNA	2 / 2	8.06e-05	0.013	1	1 / 1	6.30e-05
Drug resistance in ERBB2 KD mutants	2 / 4	1.61e-04	0.047	1	8 / 8	5.04e-04
Drug-mediated inhibition of ERBB2 signaling	2 / 4	1.61e-04	0.047	1	3 / 3	1.89e-04
Resistance of ERBB2 KD mutants to AEE788	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to osimertinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to sapitinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to afatinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to trastuzumab	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to neratinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Drug resistance in ERBB2 TMD/JMD mutants	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to lapatinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Resistance of ERBB2 KD mutants to tesevatinib	2 / 4	1.61e-04	0.047	1	1 / 1	6.30e-05
Loss of MECP2 binding ability to 5mC-DNA	2 / 5	2.01e-04	0.07	1	2 / 2	1.26e-04
Drug resistance of ALK mutants	1 / 1	4.03e-05	0.082	1	7 / 7	4.41e-04
ceritinib-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
NVP-TAE684-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
lorlatinib-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
Deletions in the AXIN1 gene destabilize the destruction complex	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
alectinib-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
crizotinib-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
ASP-3026-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
Defective SFTPA2 causes IPF	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05
brigatinib-resistant ALK mutants	1 / 1	4.03e-05	0.082	1	1 / 1	6.30e-05

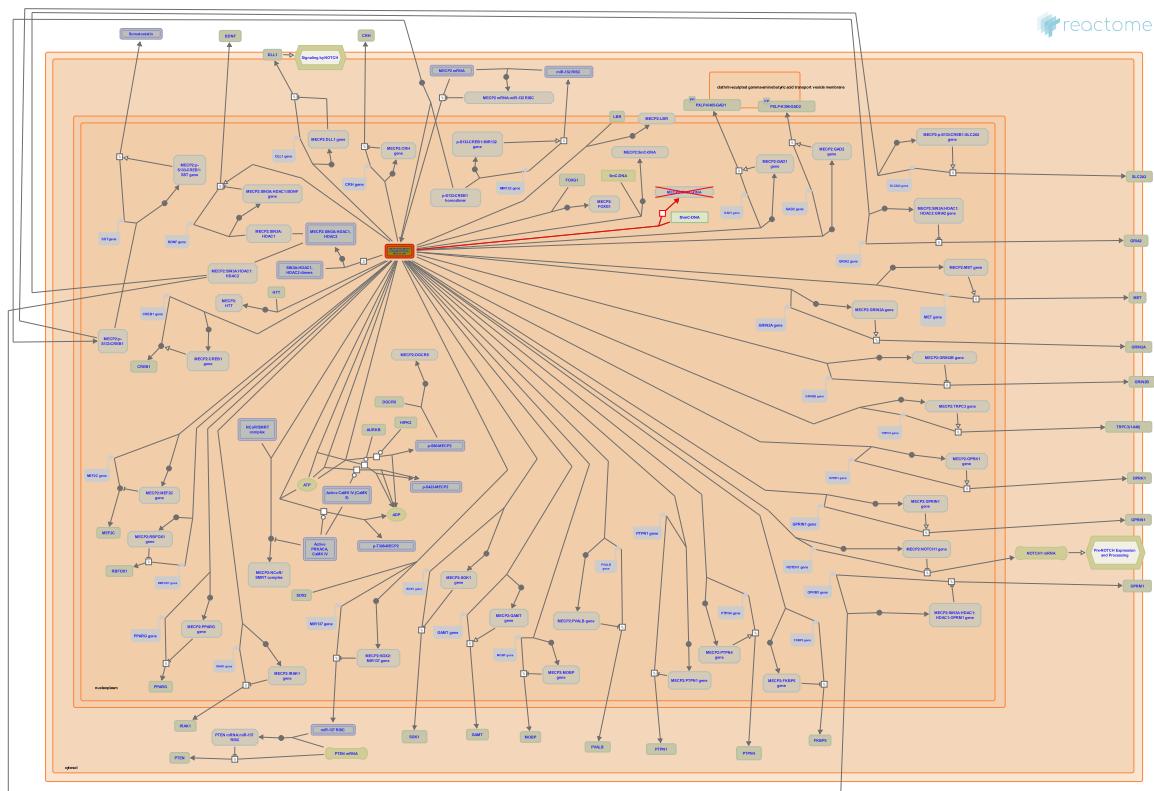
Pathway name	Entities				Reactions	
	found	ratio	p-value	FDR*	found	ratio
Interleukin-21 signaling	3 / 13	5.24e-04	0.103	1	5 / 5	3.15e-04
Loss of phosphorylation of MECP2 at T308	2 / 7	2.82e-04	0.123	1	1 / 1	6.30e-05

* False Discovery Rate

5. Pathways details

For every pathway of the most significant pathways, we present its diagram, as well as a short summary, its bibliography and the list of inputs found in it.

1. Loss of MECP2 binding ability to 5hmC-DNA ([R-HSA-9022534](#))



Cellular compartments: nucleoplasm.

Diseases: Rett syndrome.

Missense mutations in the methyl-CpG binding domain (MBD) of MECP2, spanning amino acids 90 to 162, negatively affect the binding ability of MECP2 to hydroxymethylated DNA (Mellen et al. 2012).

References

Mellén M, Ayata P, Dewell S, Kriaucionis S & Heintz N (2012). MeCP2 binds to 5hmC enriched within active genes and accessible chromatin in the nervous system. *Cell*, 151, 1417-30. 

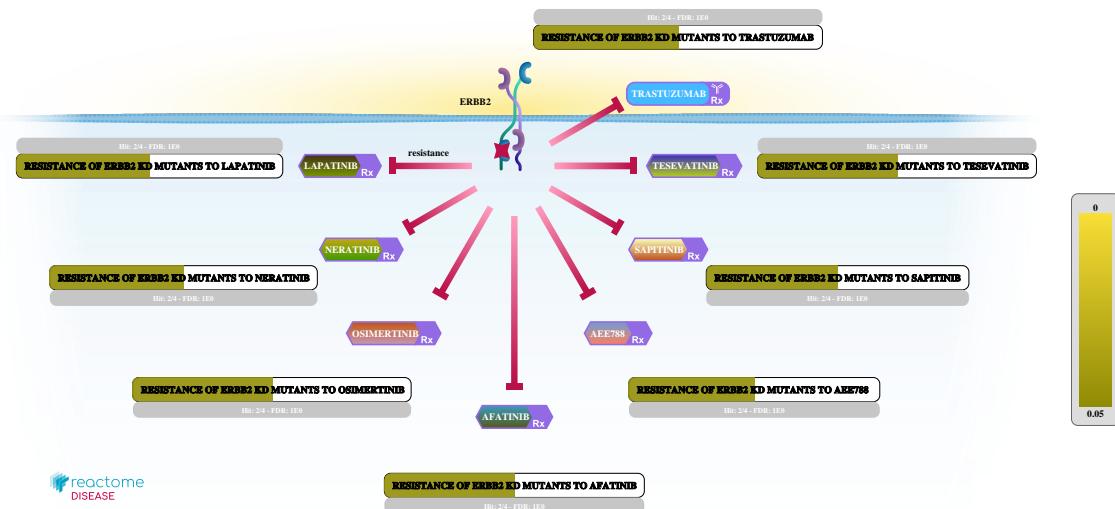
Edit history

Date	Action	Author
2017-09-25	Created	Orlic-Milacic M
2017-10-02	Authored	Orlic-Milacic M
2018-08-07	Reviewed	Christodoulou J, Krishnaraj R
2018-08-08	Edited	Orlic-Milacic M
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id
MECP2	P51608-1, P51608-2

2. Drug resistance in ERBB2 KD mutants ([R-HSA-9665230](#))



Diseases: cancer.

ERBB2 kinase domain (KD) mutants vary in their resistance to various tyrosine kinase inhibitors and therapeutic antibody trastuzumab (herceptin).

The following ERBB2 KD mutants are resistant to the therapeutic antibody trastuzumab (herceptin):

ERBB2 L755P (Nagano et al. 2018);

ERBB2 L755S (Nagano et al. 2018);

ERBB2 I767M (Bose et al. 2013);

ERBB2 D769Y (Nagano et al. 2018);

ERBB2 V777L (Nagano et al. 2018);

ERBB2 G778_P780dup (Bose et al. 2013, Nagano et al. 2018);

ERBB2 T798M (Rexer et al. 2013);

ERBB2 V842I (Nagano et al. 2018);

ERBB2 T862A (Nagano et al. 2018);

ERBB2 L869R (Hanker et al. 2017);

For ERBB2 R896C, both resistance (Bose et al. 2013) and sensitivity (Nagano et al. 2018) to trastuzumab have been reported.

References

- Nagano M, Kohsaka S, Ueno T, Kojima S, Saka K, Iwase H, ... Mano H (2018). High-Throughput Functional Evaluation of Variants of Unknown Significance in *ERBB2*. Clin. Cancer Res., 24, 5112-5122. [🔗](#)

Bose R, Kavuri SM, Searleman AC, Shen W, Shen D, Koboldt DC, ... Ellis MJ (2013). Activating HER2 mutations in HER2 gene amplification negative breast cancer. *Cancer Discov*, 3, 224-37. [🔗](#)

Rexer BN, Ghosh R, Narasanna A, Estrada MV, Chakrabarty A, Song Y, ... Arteaga CL (2013). Human breast cancer cells harboring a gatekeeper T798M mutation in HER2 overexpress EGFR ligands and are sensitive to dual inhibition of EGFR and HER2. *Clin. Cancer Res.*, 19, 5390-401. [🔗](#)

Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired *< i>HER2</i>^{T798I}* Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

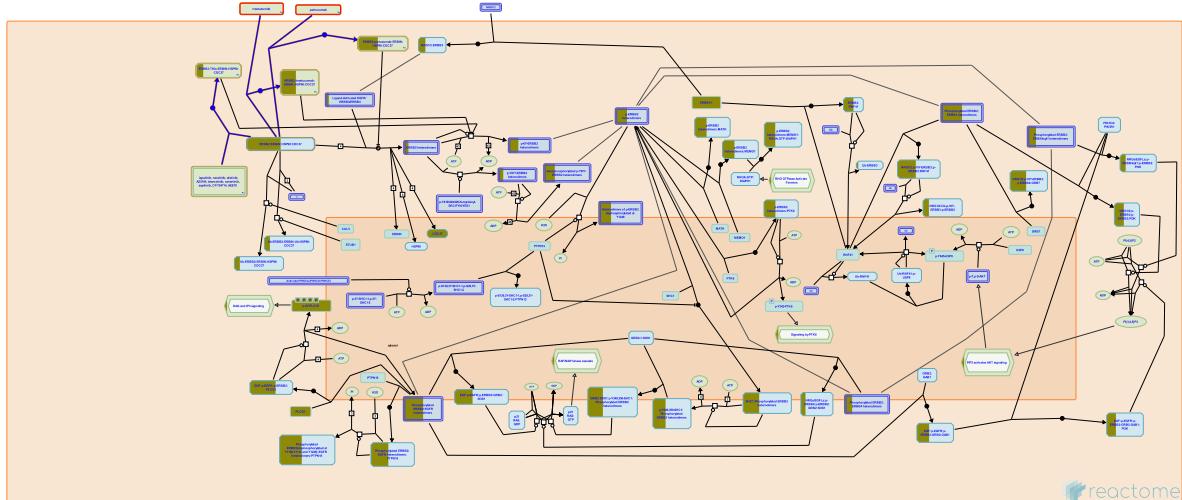
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M
2025-08-19	Modified	Matthews L

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

3. Drug-mediated inhibition of ERBB2 signaling (R-HSA-9652282)



Signaling by ERBB2 can be pharmacologically inhibited with tyrosine kinase inhibitors (TKIs) (Nelson and Fry 2001, Xia et al. 2002, Wood et al. 2004, Rabindran et al. 2004, Gandreau et al. 2007, Jani et al. 2007, Li et al. 2008, Hichkinson et al. 2010, Traxler et al. 2014, Hanker et al. 2017), and therapeutic antibodies, such as trastuzumab (Hudziak et al. 1989, Carter et al. 1992, Pickl and Ries 2009, Maadi et al. 2018) and pertuzumab (Franklin et al. 2004).

References

- Xia W, Mullin RJ, Keith BR, Liu LH, Ma H, Rusnak DW, ... Spector NL (2002). Anti-tumor activity of GW572016: a dual tyrosine kinase inhibitor blocks EGF activation of EGFR/erbB2 and downstream Erk1/2 and AKT pathways. *Oncogene*, 21, 6255-63. [🔗](#)
- Wood ER, Truesdale AT, McDonald OB, Yuan D, Hassell A, Dickerson SH, ... Shewchuk L (2004). A unique structure for epidermal growth factor receptor bound to GW572016 (Lapatinib): relationships among protein conformation, inhibitor off-rate, and receptor activity in tumor cells. *Cancer Res.*, 64, 6652-9. [🔗](#)
- Rabindran SK, Discafani CM, Rosfjord EC, Baxter M, Floyd MB, Golas J, ... Wissner A (2004). Antitumor activity of HKI-272, an orally active, irreversible inhibitor of the HER-2 tyrosine kinase. *Cancer Res.*, 64, 3958-65. [🔗](#)
- Li D, Ambrogio L, Shimamura T, Kubo S, Takahashi M, Chirieac LR, ... Wong KK (2008). BIBW2992, an irreversible EGFR/HER2 inhibitor highly effective in preclinical lung cancer models. *Oncogene*, 27, 4702-11. [🔗](#)
- Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired *ⁱHER2</i>ⁱT798I</sup>* Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

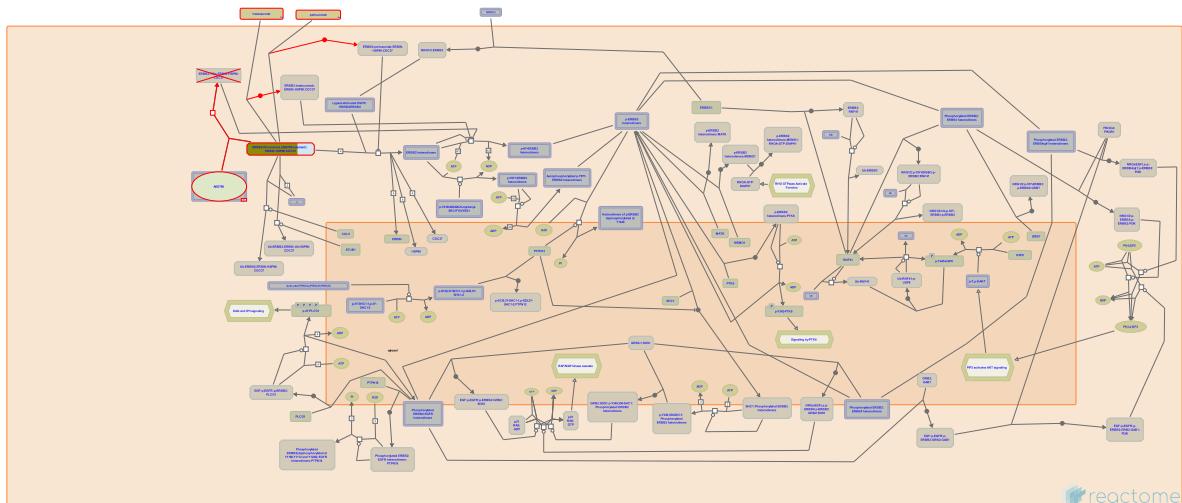
Edit history

Date	Action	Author
2019-06-28	Authored	Orlic-Milacic M
2019-06-28	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M
2019-11-03	Reviewed	Kancha RK

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

4. Resistance of ERBB2 KD mutants to AEE788 (R-HSA-9665250)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor AEE788 (Kancha et al. 2011).

References

Kancha RK, von Bubnoff N, Bartosch N, Peschel C, Engh RA & Duyster J (2011). Differential sensitivity of ERBB2 kinase domain mutations towards lapatinib. PLoS ONE, 6, e26760. [↗](#)

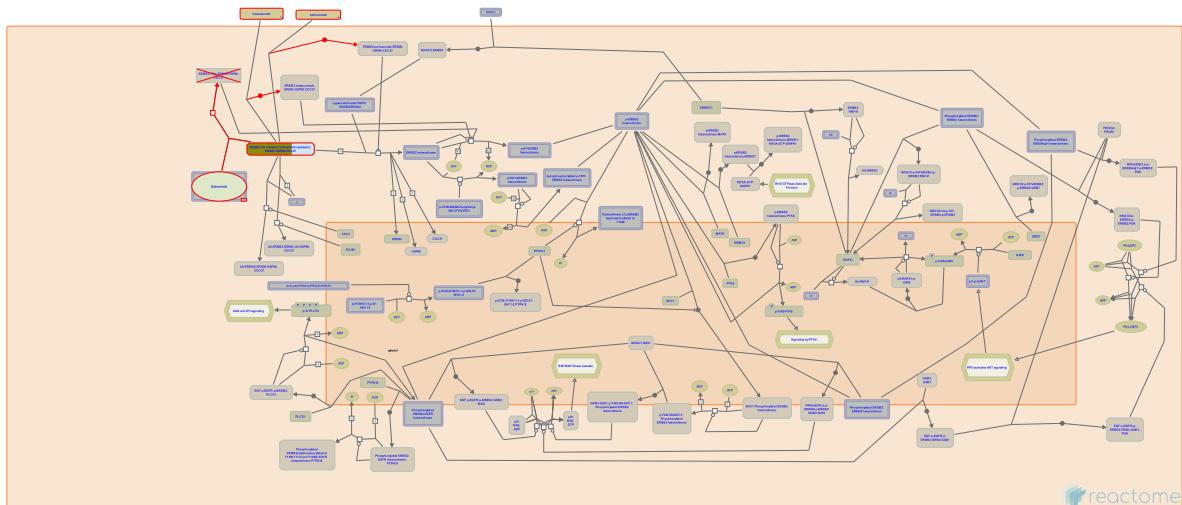
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

5. Resistance of ERBB2 KD mutants to osimertinib (R-HSA-9665247)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor osimertinib (Hanker et al. 2017).

References

Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired *ⁱHER2</i>^{T798I}* Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

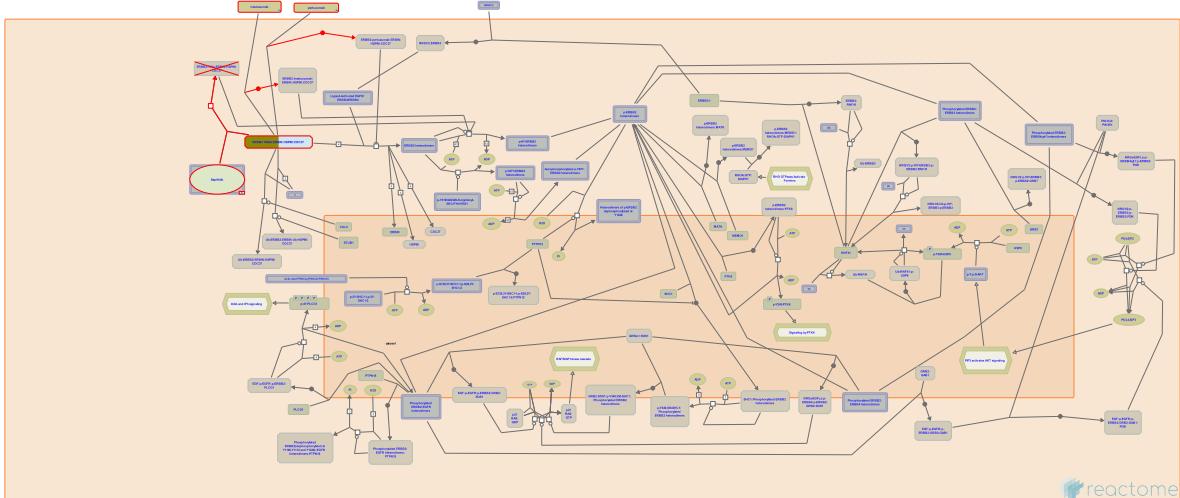
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

6. Resistance of ERBB2 KD mutants to sapitinib (R-HSA-9665244)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor sapitinib (Nagano et al. 2018).

References

Nagano M, Kohsaka S, Ueno T, Kojima S, Saka K, Iwase H, ... Mano H (2018). High-Throughput Functional Evaluation of Variants of Unknown Significance in *ERBB2*. Clin. Cancer Res., 24, 5112-5122. [View](#)

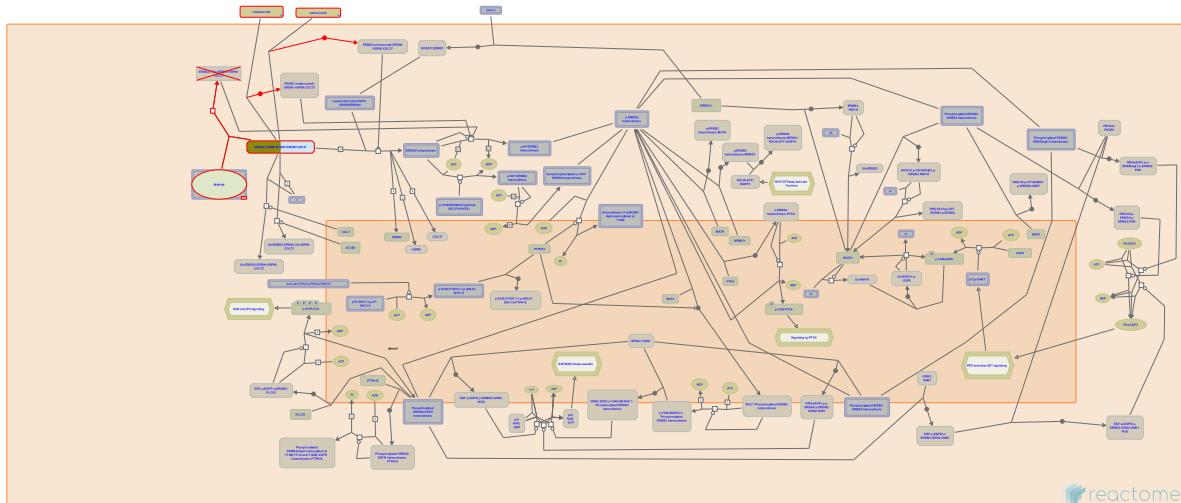
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

7. Resistance of ERBB2 KD mutants to afatinib (R-HSA-9665249)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor afatinib (Rexer et al. 2013, Hanker et al. 2017).

References

Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired *HER2*^{T798I} Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

Rexer BN, Ghosh R, Narasanna A, Estrada MV, Chakrabarty A, Song Y, ... Arteaga CL (2013). Human breast cancer cells harboring a gatekeeper T798M mutation in HER2 overexpress EGFR ligands and are sensitive to dual inhibition of EGFR and HER2. *Clin. Cancer Res.*, 19, 5390-401. [🔗](#)

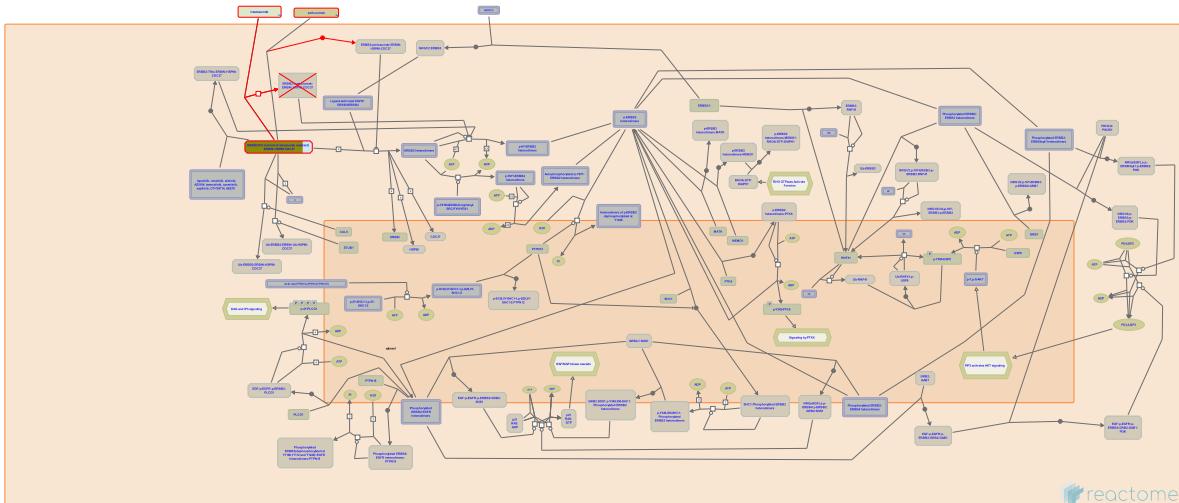
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

8. Resistance of ERBB2 KD mutants to trastuzumab (R-HSA-9665233)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to therapeutic antibody trastuzumab (herceptin) (Bose et al. 2013, Rexer et al. 2013, Hanker et al. 2017, Nagano et al. 2018).

References

- Bose R, Kavuri SM, Searleman AC, Shen W, Shen D, Koboldt DC, ... Ellis MJ (2013). Activating HER2 mutations in HER2 gene amplification negative breast cancer. *Cancer Discov*, 3, 224-37. [🔗](#)
- Nagano M, Kohsaka S, Ueno T, Kojima S, Saka K, Iwase H, ... Mano H (2018). High-Throughput Functional Evaluation of Variants of Unknown Significance in <i>ERBB2</i>. *Clin. Cancer Res.*, 24, 5112-5122. [🔗](#)
- Rexer BN, Ghosh R, Narasanna A, Estrada MV, Chakrabarty A, Song Y, ... Arteaga CL (2013). Human breast cancer cells harboring a gatekeeper T798M mutation in HER2 overexpress EGFR ligands and are sensitive to dual inhibition of EGFR and HER2. *Clin. Cancer Res.*, 19, 5390-401. [🔗](#)
- Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired <i>HER2</i>^{T798I} Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

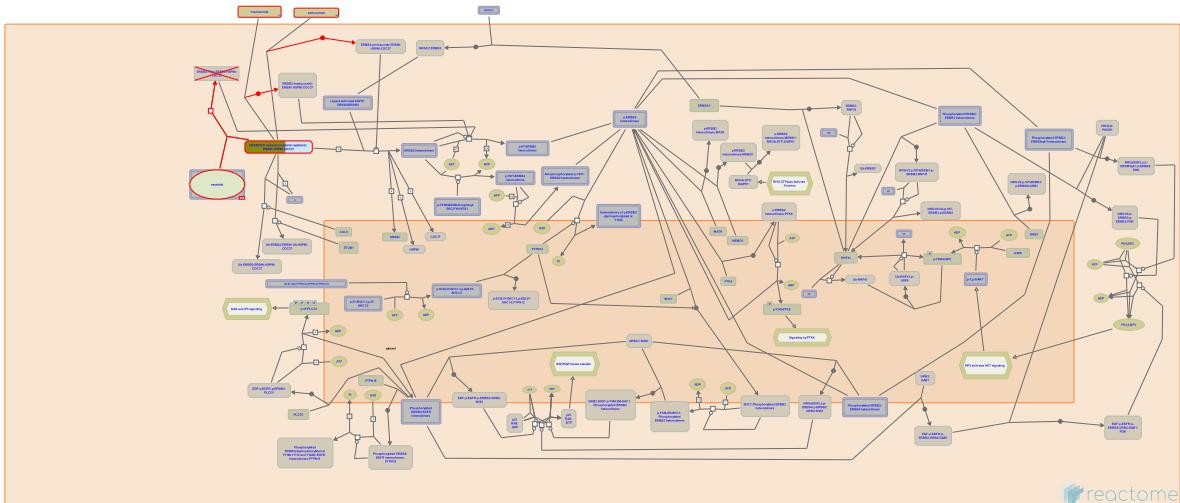
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

9. Resistance of ERBB2 KD mutants to neratinib (R-HSA-9665246)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor neratinib (Hanker et al. 2017).

References

Hanker AB, Brewer MR, Sheehan JH, Koch JP, Sliwoski GR, Nagy R, ... Arteaga CL (2017). An Acquired *HER2^{T798I}* Gatekeeper Mutation Induces Resistance to Neratinib in a Patient with HER2 Mutant-Driven Breast Cancer. *Cancer Discov*, 7, 575-585. [🔗](#)

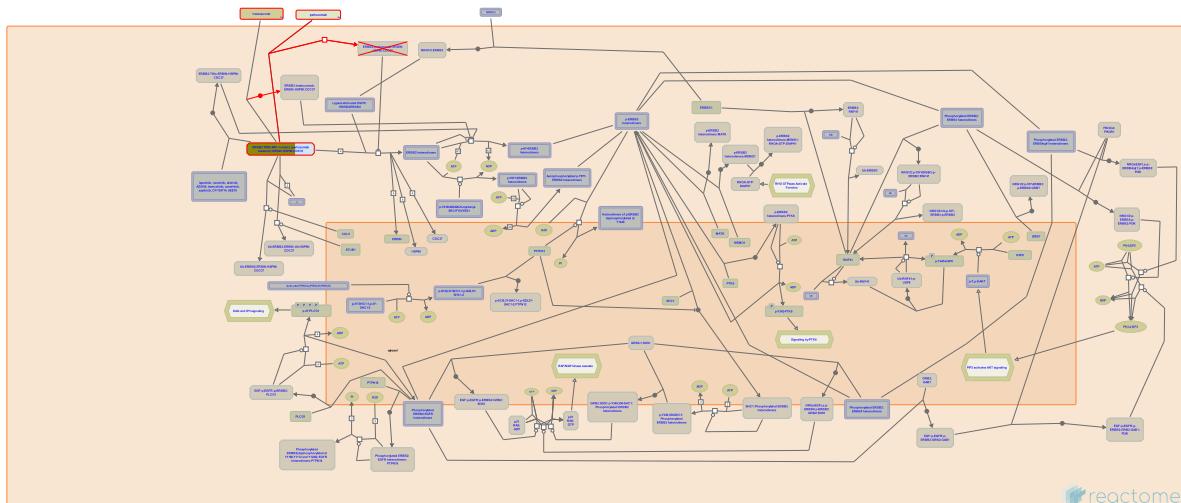
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

10. Drug resistance in ERBB2 TMD/JMD mutants (R-HSA-9665737)



Diseases: cancer.

With respect to pertuzumab, a therapeutic antibody that block ligand-driven heterodimerization of ERBB2, ERBB2 R678Q is sensitive to pertuzumab, while ERBB2 V659E, ERBB2 G660D, ERBB2 G660R and probably ERBB2 Q709L are resistant (Pahuja et al. 2018).

References

Pahuja KB, Nguyen TT, Jaiswal BS, Prabhash K, Thaker TM, Senger K, ... Seshagiri S (2018). Actionable Activating Oncogenic ERBB2/HER2 Transmembrane and Juxtamembrane Domain Mutations. *Cancer Cell*, 34, 792-806.e5. [View](#)

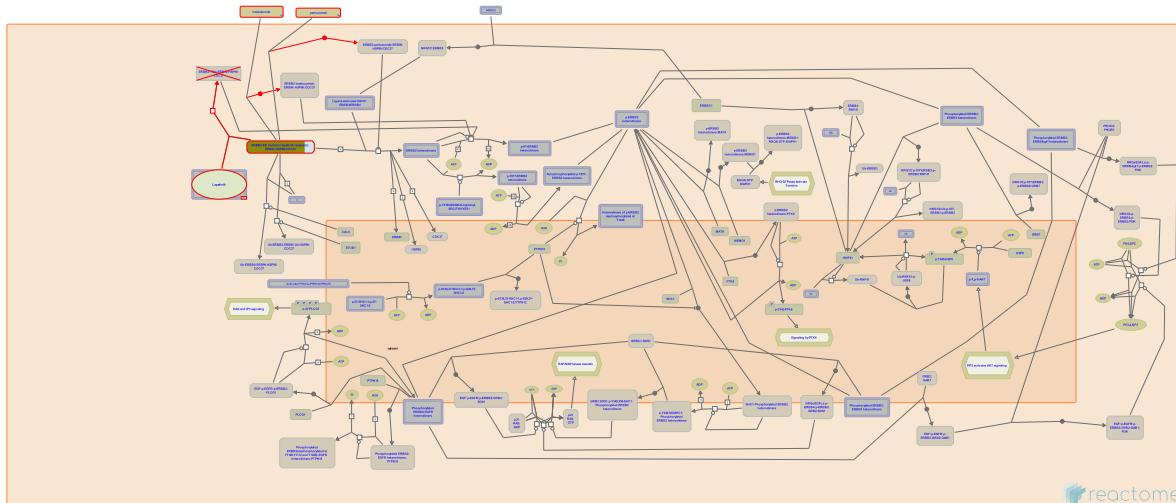
Edit history

Date	Action	Author
2019-10-25	Reviewed	Krishna A, Bose R
2019-10-31	Authored	Orlic-Milacic M
2019-10-31	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M
2019-11-03	Reviewed	Kancha RK

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

11. Resistance of ERBB2 KD mutants to lapatinib (R-HSA-9665251)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor lapatinib (Trowe et al. 2008, Kancha et al. 2011, Bose et al. 2013, Rexer et al. 2013, Yang et al. 2015, Hanker et al. 2017, Cocco et al. 2018, Nagano et al. 2018).

References

- Nagano M, Kohsaka S, Ueno T, Kojima S, Saka K, Iwase H, ... Mano H (2018). High-Throughput Functional Evaluation of Variants of Unknown Significance in <i>ERBB2</i>. Clin. Cancer Res., 24, 5112-5122. [🔗](#)
- Bose R, Kavuri SM, Searleman AC, Shen W, Shen D, Koboldt DC, ... Ellis MJ (2013). Activating HER2 mutations in HER2 gene amplification negative breast cancer. Cancer Discov, 3, 224-37. [🔗](#)
- Yang B, Zhang H & Wang H (2015). Atomistic insights into the lung cancer-associated L755P mutation in HER2 resistance to lapatinib: a molecular dynamics study. J Mol Model, 21, 24. [🔗](#)
- Kancha RK, von Bubnoff N, Bartosch N, Peschel C, Engh RA & Duyster J (2011). Differential sensitivity of ERBB2 kinase domain mutations towards lapatinib. PLoS ONE, 6, e26760. [🔗](#)
- Cocco E, Javier Carmona F, Razavi P, Won HH, Cai Y, Rossi V, ... Scaltriti M (2018). Neratinib is effective in breast tumors bearing both amplification and mutation of ERBB2 (HER2). Sci Signal, 11. [🔗](#)

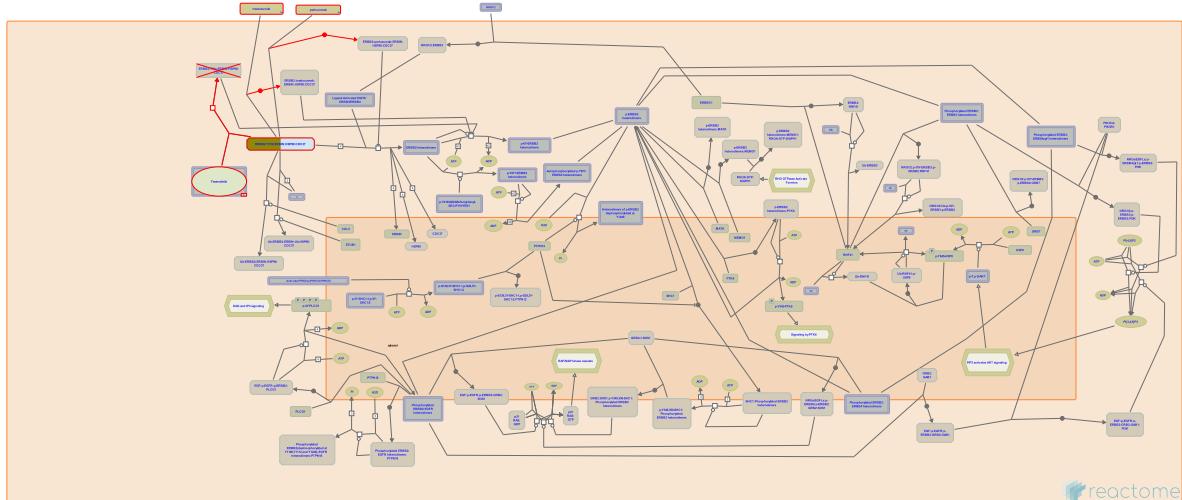
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

12. Resistance of ERBB2 KD mutants to tesevatinib (R-HSA-9665245)



Diseases: cancer.

This pathway describes resistance of ERBB2 KD mutants to tyrosine kinase inhibitor tesevatinib (Trowe et al. 2018).

References

Trowe T, Boukouvala S, Calkins K, Cutler RE, Fong R, Funke R, ... Heuer TS (2008). EXEL-7647 inhibits mutant forms of ErbB2 associated with lapatinib resistance and neoplastic transformation . Clin. Cancer Res., 14, 2465-75. [View](#)

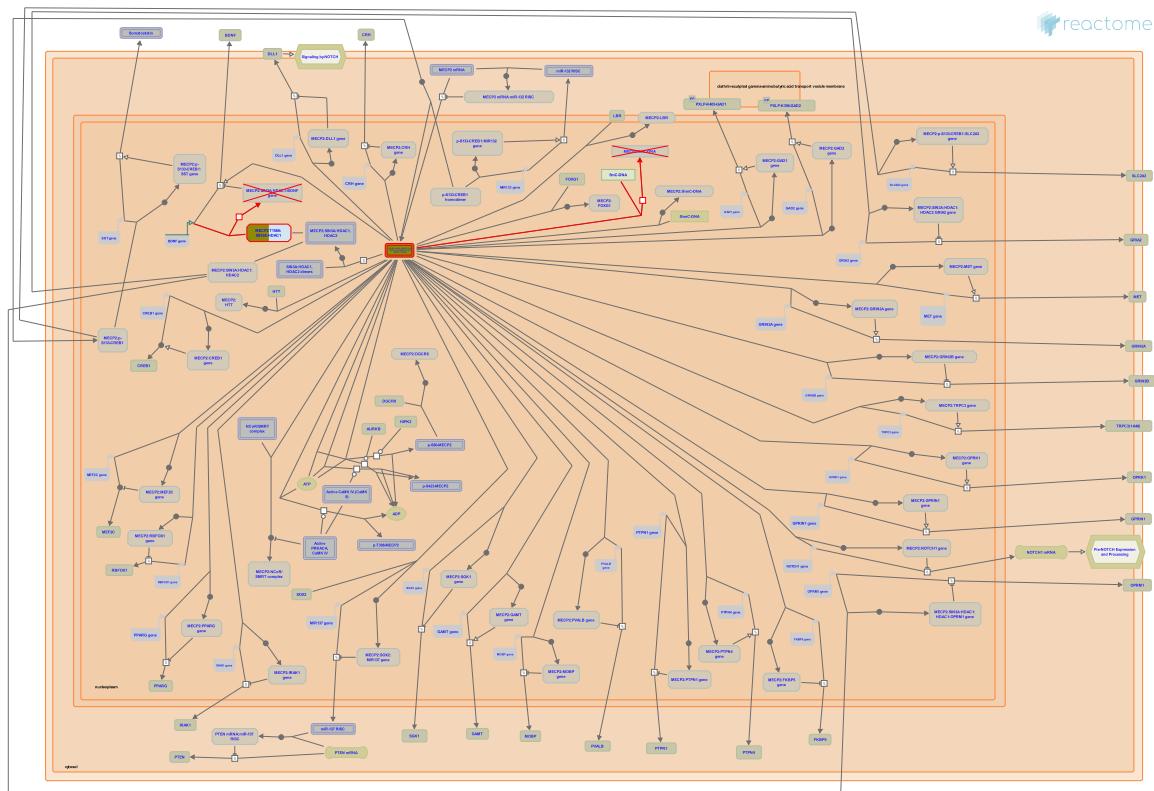
Edit history

Date	Action	Author
2019-09-16	Reviewed	Kancha RK
2019-10-30	Authored	Orlic-Milacic M
2019-10-30	Created	Orlic-Milacic M
2019-11-01	Edited	Orlic-Milacic M

2 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id	Input	UniProt Id
CDC37	Q16543	ERBB2	P04626

13. Loss of MECP2 binding ability to 5mC-DNA ([R-HSA-9022538](#))



Cellular compartments: nucleoplasm.

Diseases: Rett syndrome.

Missense mutations in the methyl-CpG binding domain (MBD) of methyl-CpG-binding protein 2 (MECP2), spanning amino acids 90 to 162, negatively affect the binding ability of MECP2 to methylated DNA (Ghosh et al. 2008, Ho et al. 2008, Goffin et al. 2012, Mellen et al. 2012).

References

- Ho KL, McNae IW, Schmiedeberg L, Klose RJ, Bird AP & Walkinshaw MD (2008). MeCP2 binding to DNA depends upon hydration at methyl-CpG. *Mol. Cell*, 29, 525-31. 

Goffin D, Allen M, Zhang L, Amorim M, Wang IT, Reyes AR, ... Zhou Z (2011). Rett syndrome mutation MeCP2 T158A disrupts DNA binding, protein stability and ERP responses. *Nat. Neurosci.*, 15, 274-83. 

Mellén M, Ayata P, Dewell S, Kriaucionis S & Heintz N (2012). MeCP2 binds to 5hmC enriched within active genes and accessible chromatin in the nervous system. *Cell*, 151, 1417-30. 

Ghosh RP, Horowitz-Scherer RA, Nikitina T, Giersch LM & Woodcock CL (2008). Rett syndrome-causing mutations in human MeCP2 result in diverse structural changes that impact folding and DNA interactions. *J. Biol. Chem.*, 283, 20523-34. 

Edit history

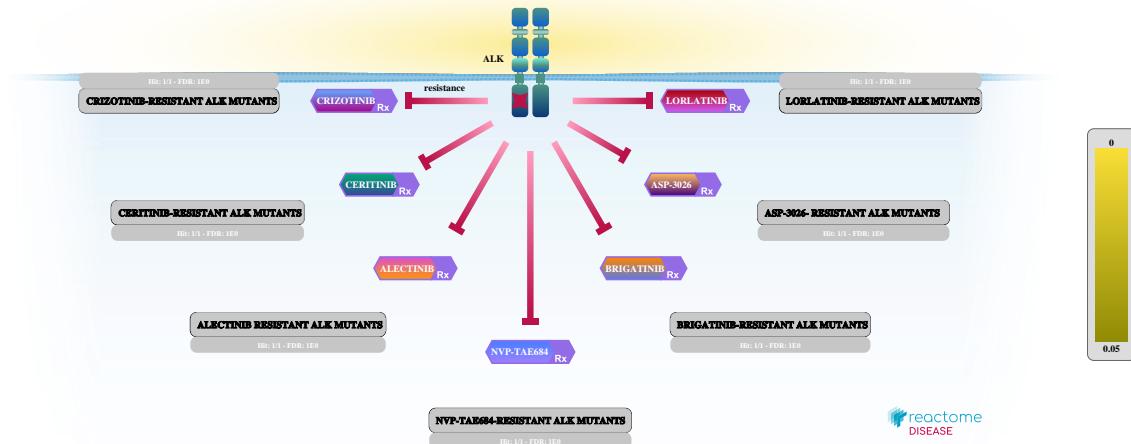
Date	Action	Author
2017-09-25	Created	Orlic-Milacic M
2017-10-02	Authored	Orlic-Milacic M

Date	Action	Author
2018-08-07	Reviewed	Christodoulou J, Krishnaraj R
2018-08-08	Edited	Orlic-Milacic M
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id
MECP2	P51608-1, P51608-2

14. Drug resistance of ALK mutants (R-HSA-9700649)



Diseases: cancer.

Aberrant ALK activity arises through fusions, point mutations, overexpression or amplifications and has been shown to be an oncogenic driver in a number of cancers including anaplastic large cell lymphoma (ALCL), non-small cell lung cancer (NSCLC), inflammatory myofibroblastic tumors (IMTs) neuroblastomas and more (reviewed in Della Corte et al, 2018; Lin et al, 2017). As a result, ALK is a promising therapeutic target for inhibition with tyrosine kinase inhibitors. Crizotinib, ceritinib, brigatinib, alectinib and lorlatinib are all approved for the treatment of ALK-driven cancers, however resistance commonly develops either as a result of accumulating secondary mutations, or through activation of bypass pathways that remove the dependence on ALK signaling (re-reviewed in Della Corte et al, 2017; Roskoski, 2013; Lin et al, 2017).

References

- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. *Mol. Cancer*, 17, 30. [🔗](#)
- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. *Cancer Discov*, 7, 137-155. [🔗](#)
- Roskoski R (2013). Anaplastic lymphoma kinase (ALK): structure, oncogenic activation, and pharmacological inhibition. *Pharmacol. Res.*, 68, 68-94. [🔗](#)

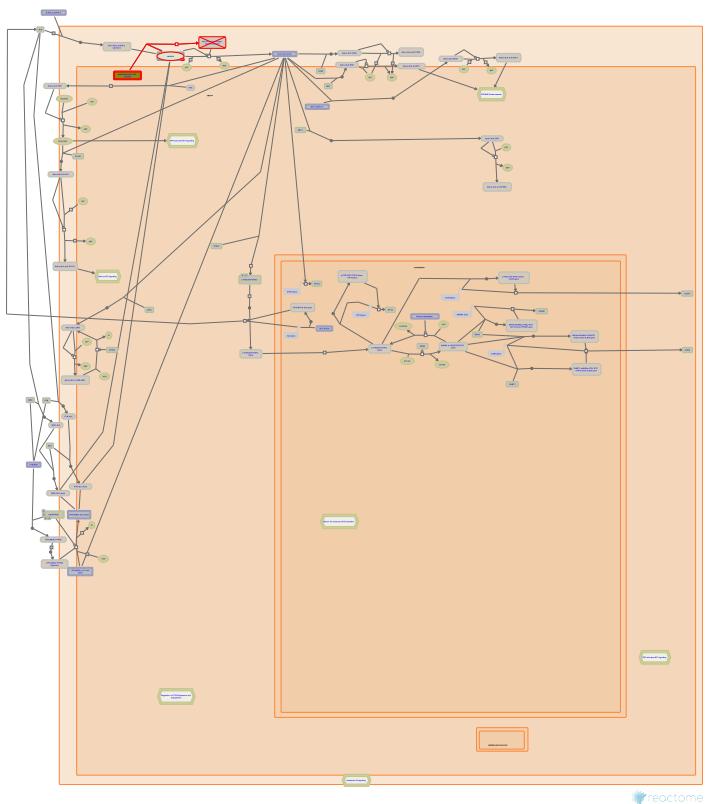
Edit history

Date	Action	Author
2020-09-16	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G
2023-10-12	Modified	Weiser JD

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

15. ceritinib-resistant ALK mutants (R-HSA-9717323)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

Ceritinib is a type I TKI that is effective against ALK driven cancers and is approved for treatment of NSCLC. Ceritinib is a second-generation TKI that shows activity against a number of crizotinib-resistant ALK alleles, however, resistance to ceritinib has also been documented. This pathway describes ALK mutants that are resistant to inhibition with ceritinib (reviewed in Lovly and Pao, 2012; Lin et al, 2017; Della Corte et al, 2018).

References

- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. *Cancer Discov*, 7, 137-155. [🔗](#)
- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. *Mol. Cancer*, 17, 30. [🔗](#)
- Lovly CM & Pao W (2012). Escaping ALK inhibition: mechanisms of and strategies to overcome resistance. *Sci Transl Med*, 4, 120ps2. [🔗](#)

Edit history

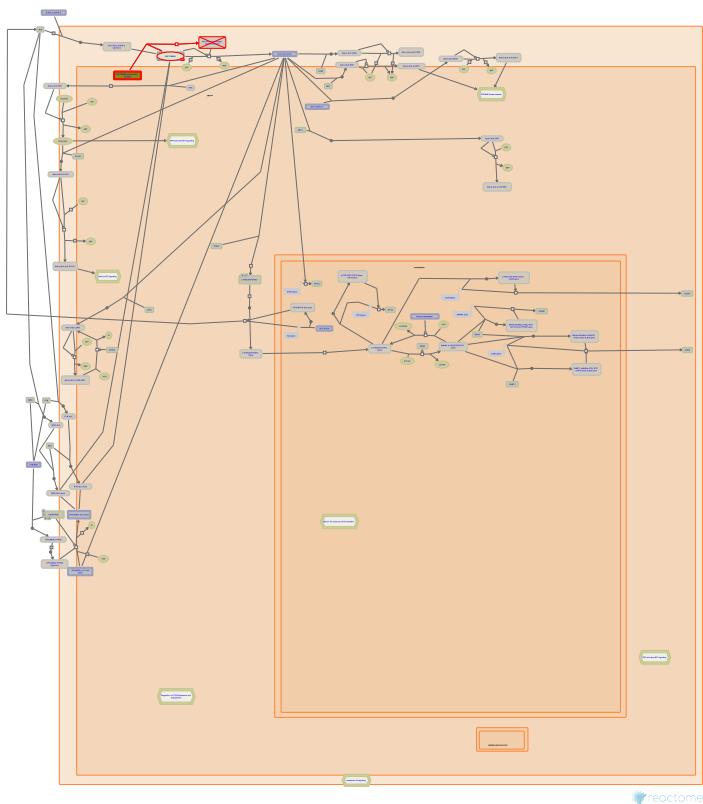
Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G

Date	Action	Author
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

16. NVP-TAE684-resistant ALK mutants (R-HSA-9717301)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

NVP TAE684 is a second generation tyrosine kinase inhibitor with activity against some ALK mutants, including some that show resistance to crizotinib (George et al, 2008; Sasaki et al, 2011; Heuckmann et al, 2011; Ceccon et al, 2013). This pathway describes ALK mutants that show resistance to inhibition by NVP TAE684.

References

- George RE, Sanda T, Hanna M, Fröhling S, Luther W, Zhang J, ... Look AT (2008). Activating mutations in ALK provide a therapeutic target in neuroblastoma. *Nature*, 455, 975-8. [🔗](#)
- Heuckmann JM, Hölzel M, Sos ML, Heynck S, Balke-Want H, Koker M, ... Thomas RK (2011). ALK mutations conferring differential resistance to structurally diverse ALK inhibitors. *Clin. Cancer Res.*, 17, 7394-401. [🔗](#)
- Sasaki T, Koivunen J, Ogino A, Yanagita M, Nikiforow S, Zheng W, ... Jänne PA (2011). A novel ALK secondary mutation and EGFR signaling cause resistance to ALK kinase inhibitors. *Cancer Res.*, 71, 6051-60. [🔗](#)
- Ceccon M, Mologni L, Bisson W, Scapozza L & Gambacorti-Passerini C (2013). Crizotinib-resistant NPM-ALK mutants confer differential sensitivity to unrelated Alk inhibitors. *Mol. Cancer Res.*, 11, 122-32. [🔗](#)

Edit history

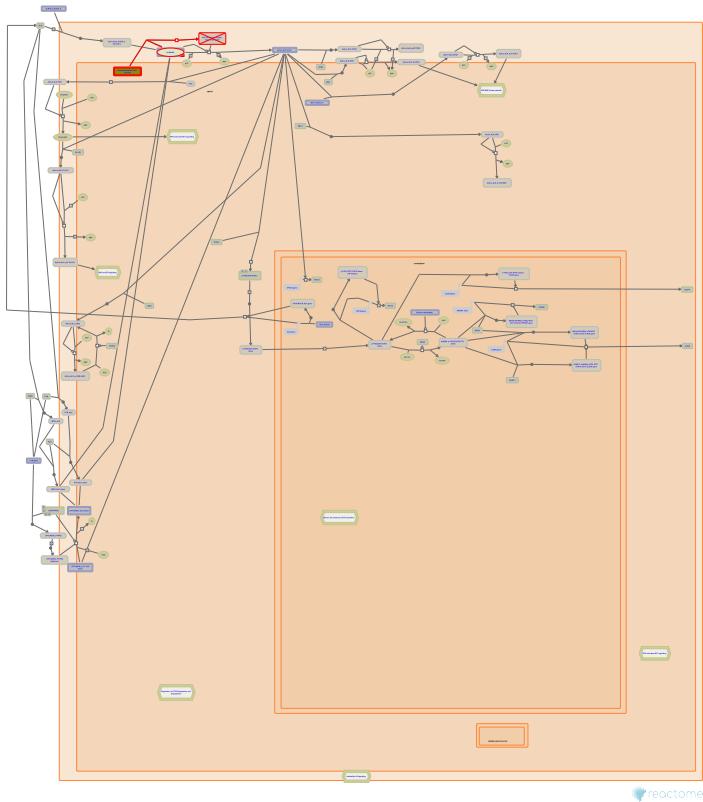
Date	Action	Author
2021-03-08	Created	Rothfels K

Date	Action	Author
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

17. lorlatinib-resistant ALK mutants (R-HSA-9717329)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

Lorlatinib is a third generation tyrosine kinase inhibitor with effectiveness against ALK and ROS rearranged cancers. This pathway describes ALK mutants that are resistant to inhibition by lorlatinib (Yoda et al, 2018; Takahashi et al, 2020; reviewed in Della Corte et al, 2018; Lin et al, 2017; Facchinetto et al, 2016).

References

- Takahashi K, Seto Y, Okada K, Uematsu S, Uchibori K, Tsukahara M, ... Katayama R (2020). Overcoming resistance by ALK compound mutation (I1171S + G1269A) after sequential treatment of multiple ALK inhibitors in non-small cell lung cancer. Thorac Cancer, 11, 581-587. [🔗](#)
- Yoda S, Lin JJ, Lawrence MS, Burke BJ, Friboulet L, Langenbucher A, ... Shaw AT (2018). Sequential ALK Inhibitors Can Select for Lorlatinib-Resistant Compound <i>ALK</i> Mutations in ALK-Positive Lung Cancer. Cancer Discov, 8, 714-729. [🔗](#)
- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. Mol. Cancer, 17, 30. [🔗](#)
- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. Cancer Discov, 7, 137-155. [🔗](#)
- Facchinetto F, Tiseo M, Di Maio M, Graziano P, Bria E, Rossi G & Novello S (2016). Tackling ALK in non-small cell lung cancer: the role of novel inhibitors. Transl Lung Cancer Res, 5, 301-21. [🔗](#)

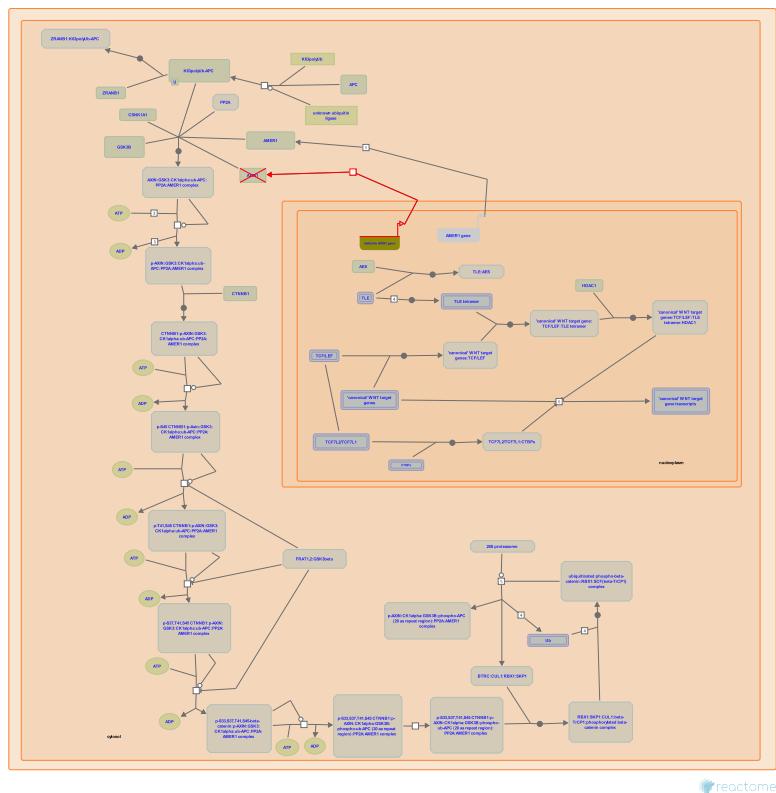
Edit history

Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

18. Deletions in the AXIN1 gene destabilize the destruction complex (R-HSA-5467345)



Diseases: cancer.

Deletions in the AXIN1 gene have been identified in 2 hepatocellular carcinoma cell lines. These deletions, which remove the N-terminal exons of the gene, compromise AXIN1 expression and result in elevated expression of a TCF-dependent reporter (Satoh et al, 2000, reviewed in Salahshor and Woodgett, 2005).

References

Satoh S, Daigo Y, Furukawa Y, Kato T, Miwa N, Nishiwaki T, ... Nakamura Y (2000). AXIN1 mutations in hepatocellular carcinomas, and growth suppression in cancer cells by virus-mediated transfer of AXIN1. *Nat. Genet.*, 24, 245-50. [🔗](#)

Salahshor S & Woodgett JR (2005). The links between axin and carcinogenesis. *J. Clin. Pathol.*, 58, 225-36. [🔗](#)

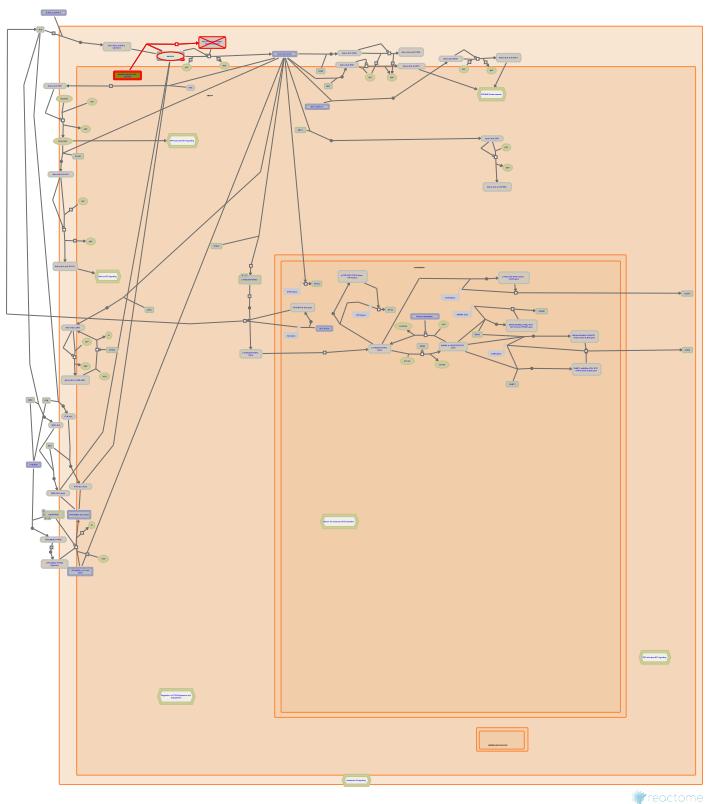
Edit history

Date	Action	Author
2014-01-23	Authored	Rothfels K
2014-04-03	Edited	Matthews L
2014-05-12	Reviewed	Salahshor S
2014-05-16	Created	Rothfels K
2014-05-22	Reviewed	Woodgett J
2023-10-12	Modified	Weiser JD

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	Ensembl Id
AXIN1	ENSG00000103126

19. alectinib-resistant ALK mutants (R-HSA-9717316)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

Alectinib is a second generation tyrosine kinase inhibitor that is approved for use in ALK positive non-small cell lung cancers (NSCLCs). Alectinib is effective against a number of ALK mutants that arise after treatment with crizotinib, however resistance to alectinib has also been reported. This pathway describes ALK mutants that are resistant to inhibition with alectinib (reviewed in Lovly and Pao, 2012; Lin et al, 2017; Della Corte et al, 2018; Hallberg and Palmer, 2016).

References

- Lovly CM & Pao W (2012). Escaping ALK inhibition: mechanisms of and strategies to overcome resistance. *Sci Transl Med*, 4, 120ps2. [🔗](#)
- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. *Cancer Discov*, 7, 137-155. [🔗](#)
- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. *Mol. Cancer*, 17, 30. [🔗](#)
- Hallberg B & Palmer RH (2013). Mechanistic insight into ALK receptor tyrosine kinase in human cancer biology. *Nat. Rev. Cancer*, 13, 685-700. [🔗](#)

Edit history

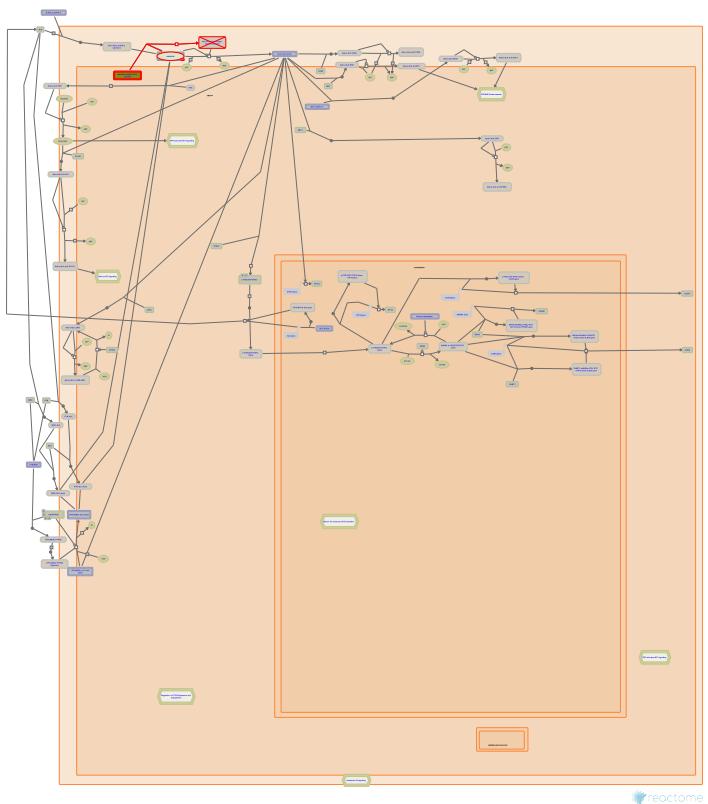
Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K

Date	Action	Author
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

20. crizotinib-resistant ALK mutants (R-HSA-9717326)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

Crizotinib is a type I tyrosine kinase inhibitor that is approved for treatment of ALK-positive non-small cell lung cancer. Crizotinib is also effective against ALCL and IMTs. Development of resistance to crizotinib is not uncommon, however, with patients acquiring secondary mutations or amplifications of the ALK gene that limit the effectiveness of the drug. This pathway describes ALK mutants that are resistant to crizotinib-mediated inhibition (reviewed in Roskoski, 2013; Lin et al, 2017; Della Corte et al, 2018).

References

- Roskoski R (2013). Anaplastic lymphoma kinase (ALK): structure, oncogenic activation, and pharmacological inhibition. *Pharmacol. Res.*, 68, 68-94. [🔗](#)
- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. *Cancer Discov*, 7, 137-155. [🔗](#)
- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. *Mol. Cancer*, 17, 30. [🔗](#)

Edit history

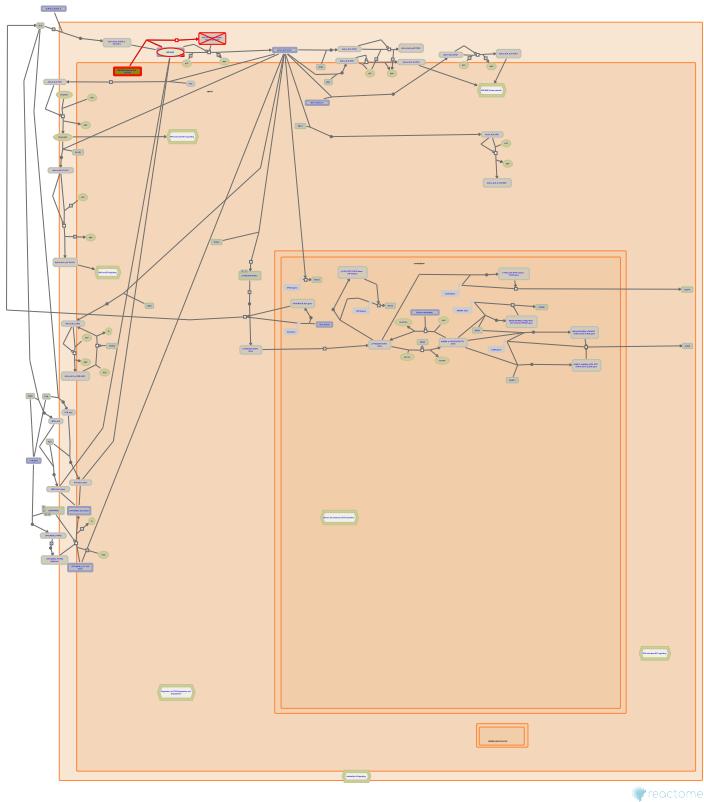
Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K

Date	Action	Author
2021-05-04	Reviewed	Inghirami G
2023-10-12	Modified	Weiser JD

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

21. ASP-3026-resistant ALK mutants (R-HSA-9717264)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

ASP3026 is a second generation tyrosine kinase inhibitor with activity against ALK fusions in non-small cell lung cancers (NSCLC) and anaplastic large cell lymphomas (ALCLs). This pathway describes ALK mutants that are resistant to inhibition by ASP3026 (Amin et al, 2016; Katayama et al, 2014; George et al, 2008; Mori et al, 2014; reviewed Roskoski, 2013; Lovly and Pao, 2012)

References

- Amin AD, Li L, Rajan SS, Gokhale V, Groysman MJ, Pongtornpipat P, ... Schatz JH (2016). TKI sensitivity patterns of novel kinase-domain mutations suggest therapeutic opportunities for patients with resistant ALK+ tumors. *Oncotarget*, 7, 23715-29. [🔗](#)
- Katayama R, Friboulet L, Koike S, Lockerman EL, Khan TM, Gainor JF, ... Shaw AT (2014). Two novel ALK mutations mediate acquired resistance to the next-generation ALK inhibitor alectinib. *Clin Cancer Res*, 20, 5686-96. [🔗](#)
- George RE, Sanda T, Hanna M, Fröhling S, Luther W, Zhang J, ... Look AT (2008). Activating mutations in ALK provide a therapeutic target in neuroblastoma. *Nature*, 455, 975-8. [🔗](#)
- Mori M, Ueno Y, Konagai S, Fushiki H, Shimada I, Kondoh Y, ... Kuromitsu S (2014). The selective anaplastic lymphoma receptor tyrosine kinase inhibitor ASP3026 induces tumor regression and prolongs survival in non-small cell lung cancer model mice. *Mol Cancer Ther*, 13, 329-40. [🔗](#)
- Roskoski R (2013). Anaplastic lymphoma kinase (ALK): structure, oncogenic activation, and pharmacological inhibition. *Pharmacol. Res.*, 68, 68-94. [🔗](#)

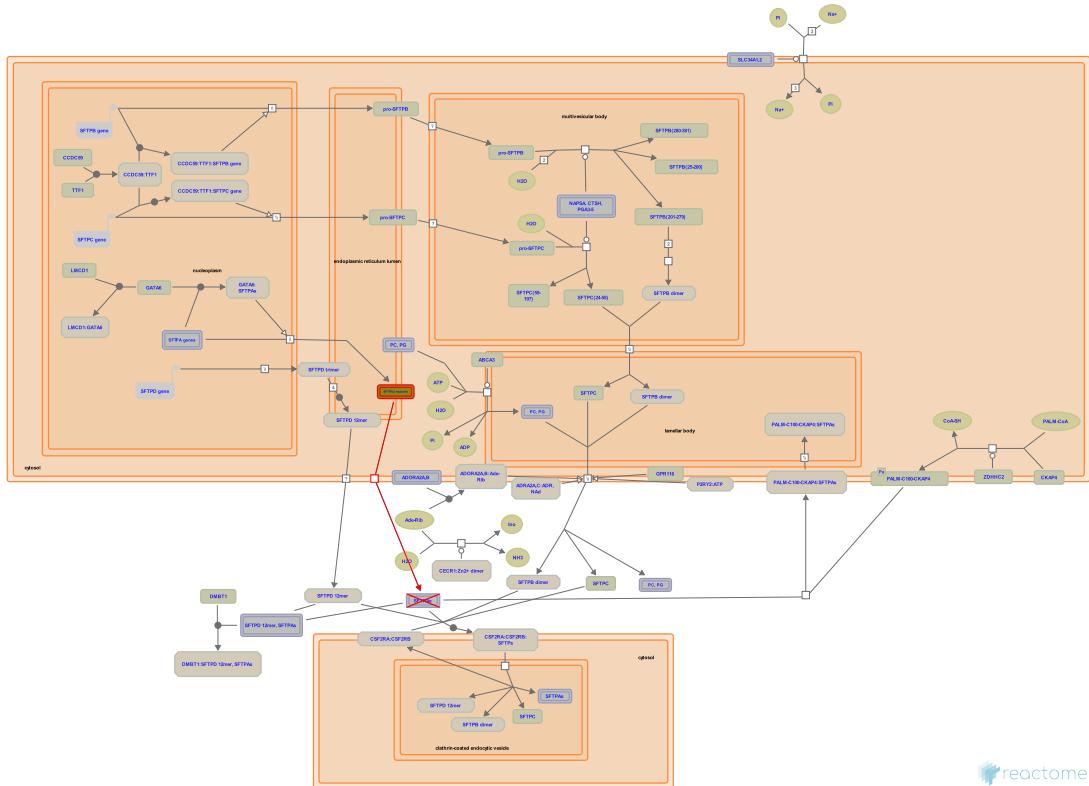
Edit history

Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K
2021-05-04	Reviewed	Inghirami G
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

22. Defective SFTPA2 causes IPF (R-HSA-5687868)



reactome

Diseases: idiopathic pulmonary fibrosis, newborn respiratory distress syndrome.

One function of the pulmonary collectins, surfactant proteins A1, A2, A3 and D (SFTPAs, D), is that they influence surfactant homeostasis, contributing to the physical structures of lipids in the alveoli and to the regulation of surfactant function and metabolism. They are directly secreted from alveolar type II cells into the airway to function as part of the surfactant. The mechanism of secretion is unknown. Mutations in SFTPA2 disrupt protein structure and the defective protein is retained in the ER membrane causing idiopathic pulmonary fibrosis (IPF; MIM:178500). IPF is one of a family of idiopathic pneumonias sharing clinical features of shortness of breath, formation of scar tissue and varying degrees of inflammation and/or fibrosis on lung biopsy. IPF is typically progressive, leading to death from respiratory failure within 2-5 years of diagnosis in the majority of instances (Meltzer & Noble 2008, Noble & Barkauskas 2012).

References

Meltzer EB & Noble PW (2008). Idiopathic pulmonary fibrosis. Orphanet J Rare Dis, 3, 8. [🔗](#)

Noble PW, Barkauskas CE & Jiang D (2012). Pulmonary fibrosis: patterns and perpetrators. J. Clin. Invest., 122, 2756-62. [🔗](#)

Edit history

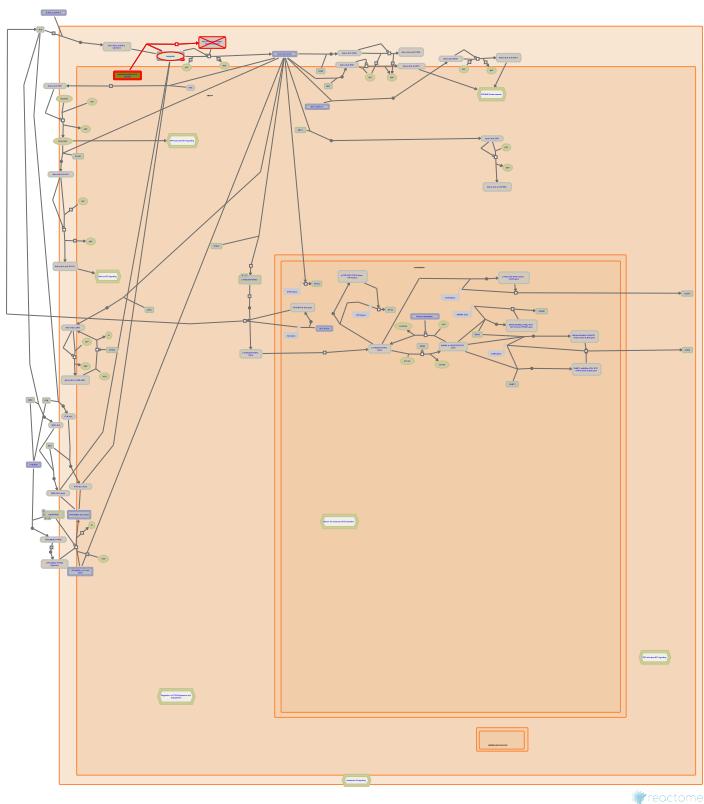
Date	Action	Author
2015-04-10	Edited	Jassal B
2015-04-10	Authored	Jassal B
2015-04-10	Created	Jassal B
2015-08-17	Reviewed	D'Eustachio P

Date	Action	Author
2023-10-12	Modified	Weiser JD

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
SFTPA1	Q8IWL1

23. brigatinib-resistant ALK mutants (R-HSA-9717319)



Cellular compartments: cytosol, plasma membrane.

Diseases: cancer.

Brigatinib is a second generation tyrosine kinase inhibitor with activity against ALK. This pathway describes ALK mutants that are resistant to inhibition by brigatinib (reviewed in Della Corte et al, 2018; Roskoski, 2013; Lin and Pao, 2017; Hallberg and Palmer, 2013).

References

- Roskoski R (2013). Anaplastic lymphoma kinase (ALK): structure, oncogenic activation, and pharmacological inhibition. *Pharmacol. Res.*, 68, 68-94. [🔗](#)
- Della Corte CM, Viscardi G, Di Liello R, Fasano M, Martinelli E, Troiani T, ... Morgillo F (2018). Role and targeting of anaplastic lymphoma kinase in cancer. *Mol. Cancer*, 17, 30. [🔗](#)
- Lin JJ, Riely GJ & Shaw AT (2017). Targeting ALK: Precision Medicine Takes on Drug Resistance. *Cancer Discov*, 7, 137-155. [🔗](#)
- Hallberg B & Palmer RH (2013). Mechanistic insight into ALK receptor tyrosine kinase in human cancer biology. *Nat. Rev. Cancer*, 13, 685-700. [🔗](#)

Edit history

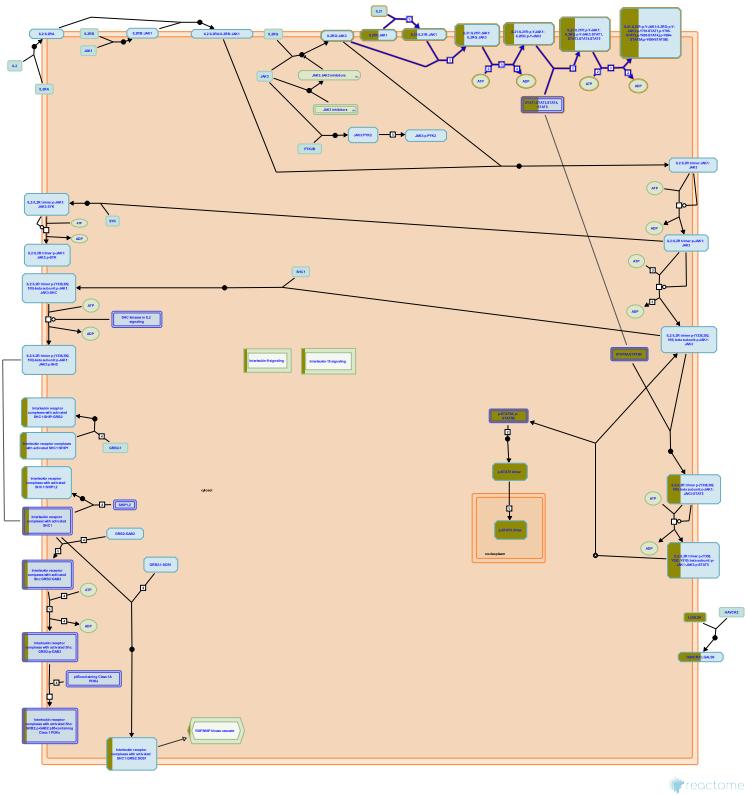
Date	Action	Author
2021-03-08	Created	Rothfels K
2021-03-22	Authored	Rothfels K
2021-03-30	Edited	Rothfels K

Date	Action	Author
2021-05-04	Reviewed	Inghirami G
2023-03-08	Modified	Matthews L

1 submitted entities found in this pathway, mapping to 1 Reactome entities

Input	UniProt Id
ALK	Q9UM73

24. Interleukin-21 signaling (R-HSA-9020958)



Interleukin-21 (IL21) is a pleiotropic cytokine with four alpha-helical bundles. It is produced primarily by natural killer T cells, T follicular helper cells and TH17 cells, with lower levels of production by numerous other populations of lymphohaematopoietic cells (Spolski & Leonard 2014). IL21 binds Interleukin-21 receptor (IL21R, NILR) and Cytokine receptor common subunit gamma (IL2RG, GammaC).

IL21R has significant homology with the class I cytokine receptors Interleukin-2 receptor subunit beta (IL2RB) and Interleukin-4 receptor subunit alpha (IL4R) and was predicted to similarly form a complex with IL2RG. IL21R dimers can weakly bind and signal in response to IL21 but IL21 generates a much stronger response when IL21R is combined with IL2RG, which is required for a fully signaling capable IL21 receptor complex (Ozaki et al. 2000, Asao et al. 2001, Habib et al. 2002). IL21R can bind Janus kinase 1 (JAK1) (Ozaki et al. 2000) but IL2RG is required for IL21 induced signaling (Asao et al. 2001). The heteromeric IL21 receptor complex can activate JAK1, JAK3, Signal transducer and activator of transcription 1 (STAT1), STAT3, STAT4 and STAT5, depending on the cell type. In cultured T-cells IL21 induced phosphorylation of JAK1, JAK3, STAT1, STAT3 and weakly STAT5 (Asao et al. 2001). In primary CD4+ T cells IL21 induced the phosphorylation of STAT1 and STAT3 but not STAT5, whereas IL2 induced the phosphorylation of STAT5 and STAT1 but not STAT3 (Bennet et al. 2003). IL21 stimulation of primary splenic B cells and the pro-B-cell line Ba-F3 induced the activation of JAK1, JAK3 and STAT5 (Habib et al. 2002). In primary human NK cells or the NK cell line NK-92, IL21 induced the activation of STAT1, STAT3, and STAT4 but not STAT5 (Stengell et al. 2002, 2003). IL21 activated STAT1 and STAT3 in human monocyte-derived macrophages (Valli  res & Girard 2017).

References

Spolski R & Leonard WJ (2014). Interleukin-21: a double-edged sword with therapeutic potential.
Nat Rev Drug Discov, 13, 379-95. [🔗](#)

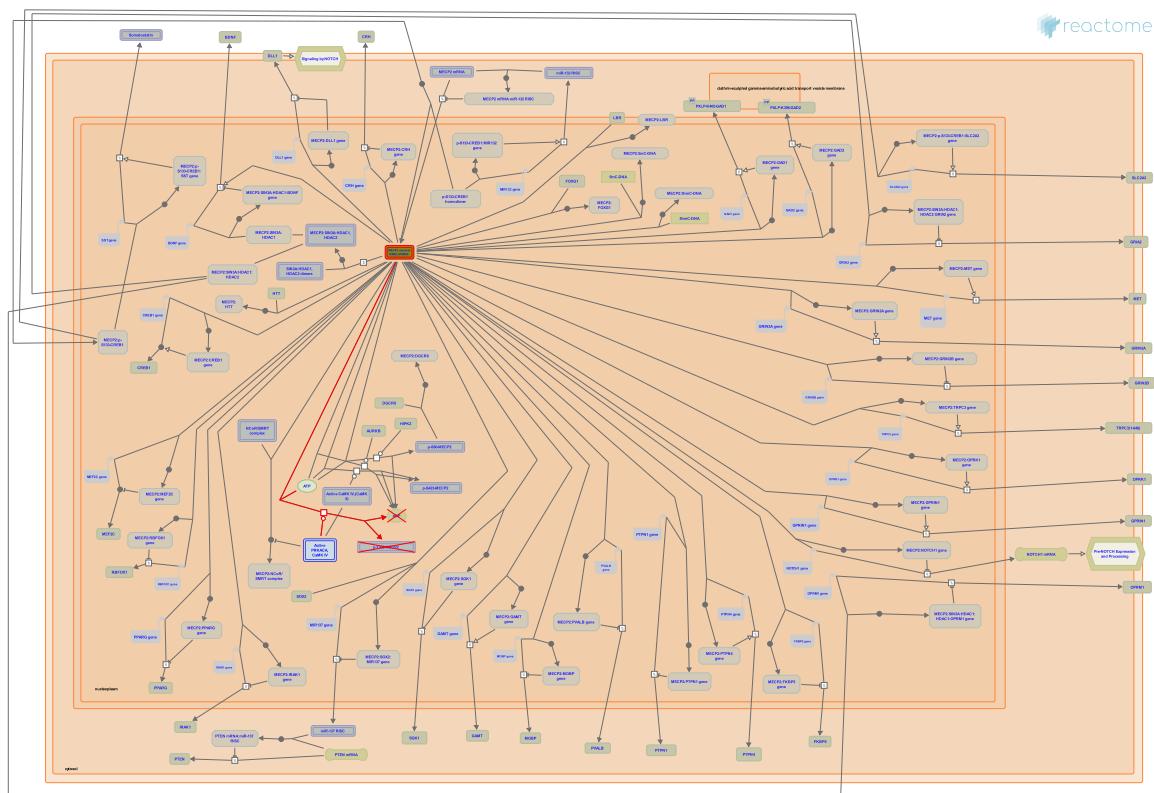
Edit history

Date	Action	Author
2017-05-11	Authored	Jupe S
2017-09-12	Created	Jupe S
2017-11-03	Edited	Jupe S
2017-11-03	Reviewed	Meldal BH

2 submitted entities found in this pathway, mapping to 3 Reactome entities

Input	UniProt Id	Input	UniProt Id
IL21R	Q9HBE5	STAT5A	P42229, P51692

25. Loss of phosphorylation of MECP2 at T308 (R-HSA-9022535)



Cellular compartments: nucleoplasm.

Diseases: Rett syndrome.

Missense mutations of methyl-CpG-binding protein 2 (MECP2) in the vicinity of its threonine T308 phosphorylation site can negatively affect the ability of MECP2 to be phosphorylated at T308 in response to neuronal membrane depolarization (neuronal activity) (Ebert et al. 2013).

References

Ebert DH, Gabel HW, Robinson ND, Kastan NR, Hu LS, Cohen S, ... Greenberg ME (2013). Activity-dependent phosphorylation of MeCP2 threonine 308 regulates interaction with NCoR. *Nature*, 499, 341-5. [\[CrossRef\]](#)

Edit history

Date	Action	Author
2017-09-25	Created	Orlic-Milacic M
2017-10-02	Authored	Orlic-Milacic M
2018-08-07	Reviewed	Christodoulou J, Krishnaraj R
2018-08-08	Edited	Orlic-Milacic M

1 submitted entities found in this pathway, mapping to 2 Reactome entities

Input	UniProt Id
MECP2	P51608-1, P51608-2

6. Identifiers found

Below is a list of the input identifiers that have been found or mapped to an equivalent element in Reactome, classified by resource.

565 of the submitted entities were found, mapping to 728 Reactome entities

Input	UniProt Id	Input	UniProt Id	Input	UniProt Id
ABCA10	Q8WWZ4	ABCA8	O94911	ABCC4	O15439
ACAD11	Q709F0	ACE2	Q9BYF1	ACOT1	Q86TX2
ACOX2	Q99424	ACSBG1	Q96GR2	ACTB	P60709
ADAM11	O75078	ADAM30	Q9UKF2	ADAMTS20	P59510
ADD3	Q9UEY8	ADORA2B	P29275	ADSS2	P30520
AGK	Q53H12	AGRP	O00253	AHCTF1	Q8WYP5
AK3	P27144	AK9	Q5TCS8	AKAP5	P24588
ALCAM	Q13740	ALK	Q9UM73	ALKBH5	Q6P6C2
ALOX15	P16050	ALS2	Q96Q42	AMOTL2	Q9Y2J4
ANG	P03950	AP4S1	Q9Y587	APIP	Q96GX9
ARF3	P61204	ARHGAP18	Q8N392	ARHGAP30	Q7Z6I6
ARHGAP6	O43182	ARHGEF10L	Q9HCE6	ARHGEF11	O15085
ARHGEF16	Q5VV41	ARID1B	Q8NFD5	ARID4A	P29374
ARV1	Q9H2C2	ASB15	Q8WXK1, Q9Y575	ATAD3B	Q5T9A4
ATF1	P18846	ATF6B	Q99941	ATP10B	O94823
ATP10D	Q9P241	ATP12A	P54707	ATP2B2	P23634, Q01814
ATP6V1B1	P15313	ATP7B	P35670	ATP9A	O75110
ATXN7L3	Q14CW9	AVPR1B	P47901	AXIN1	O15169
AXL	P30530	B3GNT5	Q9BYG0	B4GALT3	O60512
B9D2	Q9BPU9	BBIP1	A8MTZ0	BIRC3	Q13489
BLVRA	P53004	BMP4	P12644	BPNT2	Q9NX62
BRIP1	Q9BX63	BTNL2	Q9UIR0	CAMK2A	Q9UQM7
CAMK2D	Q13554, Q13557	CASK	P68400	CASTOR2	A6NHX0
CBR1	P16152	CCN2	P29279	CCND1	P24385
CCR2	P51681	CCR9	P51686	CCT6B	Q92526
CD101	Q93033	CD177	Q8N6Q3	CD200R1L	Q8TD46
CD207	Q9UJ71	CD274	Q9NZQ7	CD4	P01730
CD53	P19397	CD5L	O43866	CD79A	P11912
CD8B	P10966	CDA	P32320	CDC37	Q16543
CDH1	P12830	CDH10	Q9Y6N8	CDH3	P55291
CDK11A	Q9UQ88	CDK5RAP1	Q13424	CDKN1C	P49918
CDKN2A	Q8N726	CDSN	Q15517	CENPF	P49454
CER1	O95813	CFI	P05156	CGB3	P0DN86
CHCHD10	Q8WYQ3	CHEK1	O14757	CHGB	P05060
CHI3L1	P36222	CHKA	P35790	CHMP4B	Q96CF2, Q9H444
CHMP7	Q8WUX9	CHRNB3	Q05901	CHST14	Q8NCH0
CHTF18	Q8WVB6	CKM	P06732	CLDN18	P56856
CLDN9	O95484	CLEC7A	Q9BXN2	CLIC5	Q9NZA1
CLOCK	O15516	CNIH1	O95406	CNN1	P51911
COA4	Q9NYJ1	COG2	Q14746	COG5	Q9UP83

Input	UniProt Id	Input	UniProt Id	Input	UniProt Id
COLEC10	Q9Y6Z7	COLGALT2	Q8IYK4	COQ2	Q96H96
CPSF7	Q8N684	CRAT	P43155	CRKL	P46109
CSF1R	P07333	CSF2RA	P15509	CSNK1E	P49674
CSRPI	P21291	CTNNB1	P35222	CTSB	P07858
CTSC	P53634	CTSW	P56202	CYB5RL	Q6IPT4
CYLD	Q9NQC7	DAGLB	Q8NCG7	DAPP1	Q9UN19
DBI	P07108	DCPS	Q96C86	DCTN1	Q14203
DDHD1	Q8NEL9	DENND2A	Q9ULE3	DGCR8	Q8WYQ5
DGKH	Q86XP1	DOCK4	Q8N1I0	DOCK6	Q96HP0
DOK6	Q6PKX4	DOLPP1	Q86YN1	DPH5	Q9H2P9
DSC2	Q02487	DSE	Q9UL01	DTX1	Q86Y01
DTX3L	Q8TDB6	DUOXA1	Q1HG43	DUSP9	Q99956
DYNC1LI1	Q9Y6G9	ECE2	P0DPD6	EDC4	Q6P2E9
EGR1	P18146	EGR2	P11161	EHD3	Q6NVY1
EIF4B	P23588	ELF3	P78545	ELOC	Q15369
EMILIN1	Q9Y6C2	ENPP4	Q9Y6X5	ENTPD1	P49961
EOMES	O95936	EPHA5	P54756	EPHB4	P54760
EPX	P11678	ERBB2	P04626	ERBB3	P21860-1
ESYT2	A0FGR8, A0FGR9	EVPL	Q92817	FAAP20	Q6NZ36
FABP4	P15090	FAR2	Q96K12	FBP1	P09467
FBP2	O00757	FCER2	P06734	FCSK	Q8N0W3
FMO2	Q99518	FOXF1	Q12946	FOXO3B	O43524
FPGS	Q05932-1, Q05932-2	FZD5	Q13467	GABPA	Q06546
GABPB2	Q06547-1, Q06547-2, Q06547-3, Q06547-4	GABRA5	P31644	GABRR2	P28476
GAMT	Q14353	GATAD2B	Q8WXI9	GBA3	Q9H227
GBP6	Q6ZN66	GBP7	Q96PP8	GEMIN4	P57678
GFOD1	Q9NXC2	GGT5	P36269	GHDC	Q8N2G8
GJB2	P29033	GJD4	Q96KN9	GLRX	P35754
GMPPA	Q96IJ6	GNG3	P63215	GOLGA7	Q7Z5G4
GOPC	Q9HD26	GPBAR1	Q8TDU6	GPR17	Q13304
GPX3	O75715, P22352	GPX8	Q8TED1	GRPR	P30550
GSK3A	P49841	GSTT2	P0CG29, P0CG30	GTF3C5	Q9Y5Q8
H2AB3	P0C5Y9	H2AC16	P20671	H2AC21	Q8IUE6
H2BC11	P06899	H2BC5	P58876	H3C1	P68431
H4C12	P62805	HBA2	P69905	HBG2	P69892
HCAR2	Q8TDS4	HEBP2	Q9Y5Z4	HEPH	Q9BQS7
HERC4	Q15034, Q5GLZ8	HK2	P52789	HLA-DMB	P28068
HLA-DPB1	P04440	HLA-DQB1	P01920, P05538	HM13	Q8TCT9
HMX3	Q8IZL8	HPR	P77335	HSD17B2	P37059
IDS	P22304	IFI30	P13284	IGFBP1	P08833
IGFBP2	P18065	IGFBP4	P22692	IKBIP	Q70UQ0
IL21R	Q9HBE5	IL22RA2	Q8N6P7, Q969J5	IL27	Q8NEV9
IL3RA	P26951	ING5	Q8WYH8	IRF3	Q92985
IRF6	O14896	IRF7	Q92985	ISL1	P61371
IST1	P53990	ITGBL1	Q95965	ITIH2	P19823
ITM2B	Q9Y287	ITPA	Q9BY32	JAG2	Q9Y219
JMY	Q8N9B5	JOSD2	Q8TAC2	KCNAB2	Q13303
KCNJ14	Q9UNX9	KCNK15	Q9H427	KCNN1	Q92952
KCNN3	Q9UGI6	KDM3B	Q7LBC6	KDM4A	O75164

Input	UniProt Id	Input	UniProt Id	Input	UniProt Id
KDM6A	O15550	KIF1C	O43896	KIRREL1	Q96J84
KLHL2	O95198	KLKB1	P03952	KLRG1	Q96E93
KMT5B	Q4FZB7, Q86Y97	KRBA1	A5PL33	KRT15	P19012
KRT8	P13647	KRTAP5-6	Q6L8G9	KRTAP5-8	Q75690, Q6L8H1, Q701N4
KYNU	Q16719	LAG3	P18627	LAMB2	P11047, P55268
LAMP3	P34810	LAMTOR5	O43504	LDHD	Q86WU2
LGALS1	P09382	LGALS9	O00182	LGR6	Q9HBX8
LIPM	Q5VYY2	LIPT2	A6NK58	LOXL2	Q9Y4K0
LPCAT1	Q8NF37	LPIN1	Q14693	LRRC41	Q15345
LRRTM2	O43300	LRRTM4	O43300, Q86VH4	LSM11	P83369
LTBP2	Q14767	LYRM7	Q5U5X0	M6PR	P20645
MAD2L2	Q9UI95	MADD	Q8WXG6-3	MANEA	Q5SRI9
MAP4K4	O95819	MAX	P61244	MBOAT4	Q96T53
MCOLN2	Q8IZK6	MDM2	Q00987	MECP2	P51608-1, P51608-2
MED28	Q9H204	MERTK	Q12866	MGAT4C	Q9UBM8
MINK1	Q8N4C8	MKRN1	Q9UHC7	MLANA	Q16655
MMUT	P22033	MRI1	Q9BV20	MRPL24	Q96A35
MRPL33	O75394	MRPL54	Q6P161	MRPS9	P82933
MRRF	Q96E11	MSI1	O43347	MTOR	P42345
MUC2	Q02817	MYH6	P13533	MYL5	Q02045
MYL9	P24844	MYO18B	P35626	MYO5B	Q9ULV0
NAPG	Q99747	NAT2	P11245, P18440	NAT8	Q9UHE5
NAT8L	Q8N9F0	NCAM1	P13591	NCK2	O43639
NCOA1	Q15788	ND4L	P03901	NDUFB1	Q75438
NECTIN2	Q92692	NEU3	Q9UQ49	NEUROG3	Q9Y4Z2
NF2	P35240	NLRC4	Q9NPP4	NLRP12	P59046
NPB	Q8NG41	NT5C2	P49902	NT5M	Q8TCD5, Q9NPB1
NUDT10	Q9BW91-1	NUMA1	Q14980	NUP93	Q8N1F7
OPLAH	O14841	OR13C2	Q8NGS9	OR2A42	Q8NGT9
OR52I1	Q8NGK6	OR8D1	Q8WZ84	OSBPL6	Q9BZF3
OSCAR	Q8IYS5	OXCT2	Q9BYC2	PAC SIN1	Q9BY11
PAK1	Q13153	PANK1	Q8TE04	PCDH19	Q8TAB3
PCSK6	P29122	PCTP	Q9UKL6	PDE11A	Q9HCR9
PDE6B	P35913	PDZD11	Q5EBL8	PGLYRP1	Q75594
PHF20	Q9BVI0	PIGF	Q07326	PIGU	Q9H490
PIP5K1B	O14986	PITPNM3	Q9BZ71	PITRM1	Q5JRX3
PITX2	Q99697	PKNOX1	P55347	PLAC8	Q9NZF1
PLAU	P00749	PLCG1	P19174	PLPPR4	Q7Z2D5
PLXNC1	O60486	PNPLA4	P41247	POLR2J	P52435
PPM1B	O75688	PPP1R8	Q12972	PRKRIP1	Q9H875
PROCR	Q9UNN8	PSMD2	Q13200	PTPN20	Q4JDL3
PYGL	P06737	PYGO2	Q9BRQ0	QSOX1	O00391
RAB19	A4D1S5	RAB2B	Q8WUD1	RAB33A	Q14088
RAB3GAP1	Q15042	RAB9B	Q9NP90	RAC2	P15153
RALGDS	Q12967	RAMP2	O60895	RAPGEF1	Q13905
REEP1	Q9H902	REV3L	O60673	RINL	Q6ZS11
RLIM	Q9NVW2	RND3	P61587	RNF111	Q6ZNA4
RNF146	Q9NTX7	RNLS	Q5VYX0	ROCK1	Q13464
RPEL1	Q2QD12	RPL23A	P62750	RPL28	P46776, P46779

Input	UniProt Id	Input	UniProt Id	Input	UniProt Id
RPP40	O75818	RPS15	P62841	RPS23	P62266
RPS28	P62857	RPS4X	P62701, Q8TD47	RPS6KA5	Q75582
RRAGA	Q5VZM2, Q7L523	SC5D	O75845	SCN5A	Q14524
SDC3	O75056	SDHD	O14521	SDK2	Q58EX2
SEC61G	P60059	SEMA3A	Q14563	SERP1	Q9Y6X1
SERPINB11	P30740	SERPINB2	P05120	SERPINB6	P35237
SESN2	P58004	SETD1B	Q9UPS6	SF3B1	O75533
SFTPA1	Q8IW1	SGCG	Q13326	SH3RF1	Q7Z6J0
SIGMAR1	Q99720	SIKE1	Q9BRV8	SKIC3	Q6PGP7
SLC14A2	Q15849	SLC15A1	P46059	SLC15A3	Q8IY34
SLC1A1	P43005	SLC22A13	Q9Y226	SLC25A21	Q9BQT8
SLC27A6	Q9Y2P4	SLC28A1	O00337	SLC35B3	Q9H1N7
SLC36A1	Q7Z2H8	SLC39A6	Q13433	SLC41A2	Q96JW4
SLC43A2	Q8N370	SLC44A2	Q8IWA5, Q8NCS7	SLC4A9	Q96Q91
SLC51B	Q86UW2	SLC9A4	Q6AI14	SLX4	Q8IY92
SMPD3	Q9NY59	SNRPB2	P08579, P09012	SOX4	Q06945
SPRN	Q5BIV9	SPTSSB	Q8NFR3	SPX	Q15427
SRD5A1	P18405	SRD5A3	Q9H8P0	SRPRA	P08240
SRRM2	Q9UQ35	SRSF8	Q9BRL6	SS18	Q15532
STARD6	P59095	STAT5A	P42229, P51692	STOML2	Q9UJZ1
STON1	Q9Y6Q2	STT3B	Q8TCJ2	SYCE3	A1L190
SYN2	Q9NY99	SYNJ2	O15056	SYS1	Q8N2H4
SYT11	Q9BT88	SYT7	O43581	TAS2R3	Q9NYW6
TBX2	Q13207	TBX5	Q99593	TBX6	O95947
TCF3	Q9HCS4	TDRD1	Q9BXT4	TDRKH	Q9Y2W6
TEAD1	P28347	TEK	Q02763	TEX12	Q9BXU0
TFAP2B	Q92481	TFF1	P04155	THBD	P07204
THPO	P40225	TICAM2	Q86XR7	TIMP1	P01033
TIMP3	P35625	TLL1	O43897	TLR7	Q9NYK1
TMPO	P42167	TNFRSF11A	Q9Y6Q6	TNFRSF11B	O00300
TNFRSF12A	Q9NP84	TNFSF12	O43508	TNN	Q9UQP3
TRDMT1	O14717	TRDN	Q13061	TRIM31	Q9BZY9
TRIM9	Q9C026	TRMT44	Q8IYL2	TRPV5	Q9NQA5
TSHB	P01222	TULP3	O75386	TUT1	Q9H6E5
TXN	P10599	TYRP1	P17643	UBQLN2	Q9UHD9
UBTF	P17480	UQCRCFS1	P47985	UQCRLH	A0A096LP55, P07919
USP16	Q9Y5T5	USP17L11	C9JVI0	USP2	O75604
VAV2	P52735	VPS72	Q15906	VRK2	Q86Y07
VWF	P04275	WAS	P42768	WDR20	Q8TBZ3
WDR6	Q9NNW5	WIPF3	A6NGB9	WNK1	Q9H4A3
WSB1	Q9Y6I7	WTAP	Q15007	ZBTB17	Q13105
ZDHHC21	Q8IVQ6	ZFYVE9	O95405-1	ZIC3	O60481
ZMIZ1	Q92520	ZNF154	A6NNF4, Q13106	ZNF180	Q9UJW8
ZNF223	Q9UK11	ZNF226	Q9NZL3	ZNF23	P17027
ZNF263	O14978	ZNF334	Q9HCZ1	ZNF33B	Q06730
ZNF391	Q8NCK3	ZNF423	Q2M1K9	ZNF436	Q9C0F3
ZNF486	Q96H40	ZNF490	Q9ULM2	ZNF556	Q9HAH1
ZNF600	Q6ZNG1	ZNF606	Q8WXB4	ZNF627	Q7L945
ZNF675	Q8TD23	ZNF699	Q32M78	ZNF705A	Q6ZN79

Input	UniProt Id	Input	UniProt Id	Input	UniProt Id
ZNF777	Q9ULD5				

Input	Ensembl Id	Input	Ensembl Id	Input	Ensembl Id
ACTB	ENST00000331789	AGRP	ENSG00000159723	ALK	ENSG00000171094
ALOX15	ENSG00000161905	AXIN1	ENSG00000103126	BMP4	ENSG00000125378
CCN2	ENSG00000118523	CCND1	ENSG00000110092	CCR2	ENSG00000121807
CD274	ENST00000381573.3	CDH1	ENST00000261769	CDKN2A	ENSG00000147889, ENST00000579755
CENPF	ENSG00000117724	CER1	ENST00000380911	CGB3	ENSG00000104827
CHEK1	ENSG00000149554, ENST00000438015	CLOCK	ENSG00000134852	CSF1R	ENSG00000182578
CSRP1	ENSG00000159176	DCTN1	ENSG00000204843	EGR1	ENSG00000120738
EGR2	ENSG00000122877	ELOC	ENST00000520242	EOMES	ENSG00000163508
ERBB2	ENST00000269571	FABP4	ENSG00000170323	FCER2	ENSG00000104921
FOXF1	ENSG00000103241	GABPA	ENSG00000154727	GAMT	ENSG00000130005
GBP6	ENSG00000183347	GBP7	ENSG00000213512	GSK3A	ENSG00000105723
HBG2	ENSG00000196565	HLA-DPB1	ENSG00000223865	HLA-DQB1	ENSG00000179344
IFI30	ENSG00000216490	IGFBP1	ENST00000275525	IKBIP	ENSG00000166130
IRF3	ENSG00000126456	IRF6	ENSG00000117595	IRF7	ENSG00000185507
ISL1	ENSG0000016082	ITGBL1	ENSG00000198542	KRT8	ENST00000293308
LPIN1	ENSG00000134324	MAP4K4	ENSG00000071054	MDM2	ENSG00000135679
MECP2	ENST00000303391, ENST00000453960	MINK1	ENSG00000141503	MLANA	ENSG00000120215
MYL9	ENSG00000101335	NCAM1	ENSG00000149294	NEUROG3	ENSG00000122859
NLRC4	ENSG00000091106	OR13C2	ENSG00000276119	OR2A42	ENSG00000212807, ENSG00000221970
OR52I1	ENSG00000232268	OR8D1	ENSG00000196341	PCDH19	ENSG00000165194
PITX2	ENSG00000164093	PLAC8	ENSG00000145287	PTPN20	ENSG00000204179
SC5D	ENSG00000109929	SERP1	ENSG00000120742	SERPINB2	ENSG00000197632
SESN2	ENSG00000130766	SFTPA1	ENSG00000122852	SRPRA	ENSG00000182934
STAT5A	ENSG00000126561	STT3B	ENSG00000163527	TBX2	ENSG00000121068
TBX5	ENSG00000089225	TBX6	ENSG00000149922	TFF1	ENSG00000160182
TIMP1	ENSG00000102265	TRIM31	ENSG00000204616	TXN	ENSG00000136810
TYRP1	ENSG00000107165	ZBTB17	ENSG00000116809	ZIC3	ENSG00000156925

Input	miRBase Id	Input	miRBase Id	Input	miRBase Id
MIR200B	MI0000342	MIR26B	MI0000084	MIR675	MI0005416

Interactors (641)

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
ABCC4	O15439	P17931	ACAD11	Q709F0	Q14493
ACE2	Q9BYF1	Q13685	ACOT1	Q86TX2	P05549
ACOX2	Q99424	P63172	ACTB	EBI-5276484	P26358
ADAM30	Q9UKF2	P27824	ADORA2B	P29275	P29274
ADSS2	P30520	Q8NB12	AGK	Q53H12	Q9Y5J6
AGRP	O00253	Q04721	AHCTF1	Q8WYP5	P06748
AK3	P27144	P13501	AKAP5	P24588	P63252
AKAP7	Q9P0M2	P17612	ALCAM	Q13740	P17931
ALK	Q9UM73	P29353	ALKBH5	Q6P6C2	P52294

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
ALOX15	P16050	P30086	ALS2	A0A0S2Z5Q7	O75925
AMMECR1	Q9Y4X0	Q9Y2T1	AMOTL2	Q9Y2J4	P46937
ANG	P03950	P19883	ANKRD50	Q9ULJ7	Q9UJV9
APIP	Q96GX9	Q96GX9	ARF3	P61204	P05067
ARHGEF10L	Q9HCE6	Q8NHY2	ARHGEF11	O15085	O43157
ARHGEF16	Q5VV41	Q14160	ARID1B	Q8NFD5	P51531
ARID4A	P29374	Q13547	ARL6IP1	Q15041	Q00059
ARMH4	Q86TY3	Q9NPF0	ARV1	Q9H2C2	P01730
ASB15	Q8WXK1	P55040	ATAD3B	Q5T9A4	P21802
ATE1	O95260	P01185	ATF1	P18846	P18846
ATF6B	Q99941	Q8TC07	ATP2B2	P23634, Q01814	P01258
ATP6V1B1	P15313	P21281	ATP7B	P35670	O00244
ATP9A	O75110	P51684	ATXN1L	P0C7T5	O75593
ATXN7L3	Q14CW9	Q92831	AXIN1	O15169, O35625	P46937
AXL	P30530	P19174	B4GALT3	O60512	Q9H5K3
B9D2	Q9BPU9	P47897	BBIP1	A8MTZ0	Q96RK4, Q8N3I7
BEX5	Q5H9J7	O14561	BIRC3	Q13489	Q13546, Q9Y572
BLOC1S2	Q6QNY1	A1L4H1	BLVRA	P53004	Q9H244
BMP4	P12644	Q9UMX1	BRD3	Q15059	P01106
BRINP1	O60477	P09651	BRIP1	Q9BX63	P54278
BTBD18	B2RXH4	Q9UBU9	BTNL2	Q9UIR0-4	Q96CV9
C12orf50	Q8NA57	Q08379	C19orf38	A8MVS5	O60443
C2CD2L	O14523	P23945	C4orf33	Q8N1A6	P55212
CAMK2A	Q9UQM7	Q13224	CAMK2D	Q13557	O96015
CARD10	Q9BWT7	O14908	CASK	O14936	Q13009
CBR1	P16152	P00533	CCDC186	Q7Z3E2	P0DTC6
CCDC71L	Q8N9Z2	Q13185	CCDC82	Q8N4S0	Q08945
CCDC85B	Q15834	Q16512	CCDC87	Q9NVE4	P40763
CCDC90B	Q9GZT6	P04183	CCL26	Q9Y258	P13501, P48061
CCN2	P29279	P02751	CCND1	P24385	Q13761
CCT6B	Q92526	O96019	CD207	Q9UJ71	O00767
CD274	Q9NZQ7	Q9UPQ8	CD4	P01730	P01730
CD53	P19397	P78382	CD79A	P11912	P48065
CDA	P32320	Q96QG7	CDC37	Q16543	Q13882
CDH1	P12830	Q68CZ2	CDH10	Q9Y6N8	P35222
CDH3	P22223	P35222	CDIP1	Q9H305	O43561-2
CDK10	Q15131	P15036	CDK11A	Q9UQ88-1	O96017
CDK2AP1	O14519	P52294	CDK5RAP1	Q96SZ6	Q8N4J0
CDKN1C	P49918	P11802	CDKN2A	P42771	P11802
CDR2L	Q86X02	Q969Z0	CDSN	Q15517	P15498
CELA1	Q9UNI1	P10071	CELF1	Q92879	P07910
CELF5	Q8N6W0	Q9NSE4	CENPF	P49454	Q96QG7
CER1	O95813	P35813	CFI	P05156-PRO_0000027569, P05156-PRO_0000027570, P05156	P08603
CGB3	P0DN86	P01215	CGNL1	Q0VF96	P31946
CHCHD10	Q8WYQ3	Q8N4J0	CHEK1	O14757	P38398
CHGB	P05060	Q5S007	CHI3L1	P36222	P17931
CHMP4B	Q9H444	Q96FZ7, Q8WUX9, Q9Y3E7	CHMP7	Q8WUX9	Q9H444
CHRNB3	Q05901	Q8NC56	CHST14	Q8NCH0	P27824

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
CHTF18	Q8WVB6	P40937, P35249	CIB3	Q96Q77	Q02548
CIBAR1	A1XBS5-3, A1XBS5	Q9Y3M2	CILK1	Q9UPZ9	Q13451
CKM	P06732	P42858	CLDN18	P56856	Q08426
CLDN9	O95484	P24593	CLEC7A	Q9BXN2	Q01638
CLOCK	O08785	Q03164	CLSTN1	Q94985	Q01523
CLUH	O75153	Q96PE7	CNIH1	O95406	Q6IN84
CNN1	P51911	Q8N0S2	COG2	Q14746	Q9NZQ7
COG5	Q9UP83	Q9Y639	COLEC10	Q9Y6Z7	Q07065
COLGALT2	Q8IYK4	Q9BT09	CPSF4L	A6NMK7	Q9C0J8
CPSF7	Q8N684-3, Q8N684	O43809	CRKL	P46109	Q13905
CSF1R	P09581, P07333	P09603	CSNK1E	P49674	Q75695
CSRP1	P21291	Q16790	CT45A1	Q5HYN5	P61024
CT45A10	P0DMU9	O00560	CTNNB1	P35222	Q99697
CTSB	P07858	P40692	CYB561D1	Q8N8Q1	Q05329
CYLD	Q9NQC7	Q9Y6K9	DAGLB	Q8NCG7	P21926
DAPP1	Q9UN19	Q8WY64	DCLK1	O15075	O43602
DCPS	Q96C86	Q96C86	DCTN1	Q14203	P30622
DDX19A	Q9NUU7	P13569	DENND2A	Q9ULE3-2	Q96B97
DGCR8	Q8WYQ5	P46087	DLEU1	O43261	Q92993
DOCK4	Q8N1I0	P62993	DOK6	Q6PKX4	Q16288
DPCD	Q9BVM2	Q92696	DPH5	Q9H2P9	P0DTD2
DSC2	Q02487	Q14126	DSE	Q9UL01	Q9NRD5
DTX1	Q86Y01	Q96J02	DUSP12	Q9UNI6	P55010
DUSP9	Q99956	Q16539	DYNC1LI1	Q9Y6G9	P43034
E4F1	Q66K89	P67809	EDC4	Q6P2E9	Q8IZH2
EGR1	P18146	Q8N726	EGR2	A0A0S2Z3U4	Q08379
EHD3	Q9NZN3	Q9H1K0	EIF4B	P23588	P53350
ELF3	P78545	Q04206	ELOC	Q15369	O14543
EMILIN1	Q9Y6C2-2, Q9Y6C2	Q00994	ENPP4	Q9Y6X5	Q9H8X2
ENTPD1	P49961	Q96S59	EPHB4	P54760	P01588
ERBB2	P04626	Q14451	ERBB3	P21860	Q14451
ESYT2	A0FGR8	Q9BRI3	EVPL	Q92817	Q9Y324
FAAP20	Q6NZ36	Q9UBZ9	FABP4	P15090	P08670
FAM111B	Q6SJ93	Q01105	FAM120C	Q9NX05	P07910
FAM222B	Q8WU58	Q9UBE8	FAM50B	Q9Y247	P40692
FAM53C	Q9NYF3	P53350	FANCD2OS	Q96PS1	Q5W0B1
FAR2	Q96K12	P40855	FAXC	Q5TGI0	Q9H668, Q2NKJ3
FBP1	P09467	Q99814	FBP2	O00757	P04792
FBXO3	Q9UK99	P04608	FCER2	P06734	P21802
FIBP	O43427	Q00535	FOXF1	Q12946	Q9UPW6
FRMD6	Q96NE9	Q6NYC1	GABPA	Q06546	P08047
GABPB2	Q06547-2	P31930	GAMT	Q14353	O95363
GATAD1	Q8WUU5	Q13547	GATAD2B	Q8WXI9	Q15274
GBP7	Q8N8V2	P32456	GEMIN4	P57678	Q13304
GFOD1	Q9NXC2	O15534	GGT5	P36269	Q03426
GIGYF2	Q6Y7W6	P12273	GJB2	P29033	P29033, P08034
GMPPA	Q96IJ6	Q92917	GNG3	P63215	Q13371
GOLGA7	Q7Z5G4	P0DTC2	GOPOC	Q9HD26	Q6UWP7

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
GPBAR1	Q8TDU6	P38646	GPN1	Q9HCN4	O15160, O95602, P19388, P61218, P62875
GPR17	Q13304	Q7Z5K2	GPRC5D	Q9NZD1	Q99650
GPX8	Q8TED1	Q8N130	GRPR	P30550	Q7L8W6
GSK3A	P49840, EBI-11789122	O15169	GSTT2	P0CG30	P13569
GTF3C5	Q9Y5Q8	P53350	H2AC16	P0C0S8	O95760
H2AC21	Q8IUE6	P17096	H2BC11	P06899	P02675
H2BC5	P58876	Q01831	H3C1	P68431	P09429
H4C12	P62805	P0DTC4	HBA2	P69905	Q96T60
HEPH	Q9BQS7-3	O76003	HES4	Q9HCC6	Q00403
HHLA3	Q9RX5X, Q9RX5-2	Q13287	HIC2	Q96JB3	Q96KQ7
HK2	P52789	P19367	HLA-DPB1	P04440	P04233
HM13	Q8TCT9	P04578	HMGN5	P82970	Q8WVK2
HMX3	Q8IZL8	P19838	HOXB9	P17482	P21673
HPR	P77335	P77335	HS1BP3	Q53T59	P06396
HSF4	Q9ULV5-2	P56693	HSFY1	Q96LI6-3	P07900
HSFY2	Q96LI6-3	P07900	IDS	P22304	Q8NBK3, Q8NBJ7
IFI30	P13284	P22735	IGFBP1	P08833	P01033
IGFBP2	P18065	P59665	IGFBP4	P22692	P05019
IKBIP	Q70UQ0	O14920	IL3RA	P26951-1	P08700
INA	Q16352	P31947	ING5	Q8WYH8	Q00994
INSYN2A	Q6ZSG2	O15111	IQSEC2	Q5JU85	P0DP23
IRF3	Q14653	P10914	IRF7	Q92985	Q9UHD2
ISL1	P61371	Q9Y4X5	IST1	P53990, P53990-3	P13798
ITIH2	P19823	O15520	ITM2B	Q9Y287	Q86XT9
ITPA	Q9BY32	P56705	JMY	Q9QXM1	Q09472
JOSD2	Q8TAC2	P49638	KCNAB2	Q13303	P42858
KCNJ14	Q99712	P63252	KCTD12	Q96CX2	P0CG13
KCTD16	Q68DU8	P42357	KDM3B	Q7LBC6	P09917
KDM4A	O75164	Q15831	KDM6A	O15550	O43474
KIAA0930	Q6ICG6	Q14191	KIF1C	Q43896	P31946
KIFBP	Q96EK5	Q13451	KIRREL1	Q96J84	Q07157
KLF11	O14901	Q8WVX9	KLHDC2	Q9Y2U9	Q9H015
KLHL2	O95198	Q9UF56	KLHL38	Q2WGJ6	Q9Y5J6
KLKB1	P03952	Q8N0U8	KLRG1	Q96E93	Q6IN84
KMT5B	Q4FZB7	Q9H2G4	KRBA1	A5PL33	P14373
KRT15	P19012	Q8IVS8	KRT8	P05787	P18031
KRTAP5-6	Q6L8G9	Q96FE5	KRTAP5-8	Q701N4	P07438
LAMB2	P55268	Q03405	LAMP3	Q9UQV4	Q9NWZ5
LAMTOR5	O43504	P68104	LGALS1	P09382	Q58EX2, Q7Z5N4
LGALS9	O00182	P51790	LGALS9C	Q6DKI2	P17931
LGALSL	Q3ZCW2	P50458	LIMS4	P0CW20	P41182
LINC00312	Q9Y6C7	P03372	LONRF2	Q1L5Z9	P99999
LOXL2	Q9Y4K0	Q03405	LPCAT1	Q8NF37	O14975
LPIN1	Q14693	P12931	LRRC41	Q15345	Q93034, Q9UBF6
LRRC73	Q5JTD7	Q6UWV6	LRRN4	Q75427	Q8NBQ5
LRRTM2	O43300	Q9BT09	LRRTM4	Q86VH4	O14786
LSM11	P83369	P62306, P62304	LSM12	Q3MHD2	P10636-8
LTBP2	Q14767	Q9UBX5	LURAP1L	Q8IV03	O00560

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
LYRM7	Q5U5X0	Q9H1K1	M6PR	P20645	Q9NZ52
MAD2L2	Q9UI95	Q9UBZ9	MADD	Q8WXG6	Q9NUX5
MAGEA10	P43363	Q99741	MAGEA12	P43365	P01160
MAGEL2	Q9UJ55	Q93009	MANBAL	Q9NQG1	Q9Y337
MAP3K7CL	P57077	Q13227	MAP4K4	O95819	Q9H0R5
MAPRE2	Q15555	Q99757	MARCHF5	Q9NX47	O00767
MARCHF7	Q9H992	P37173	MAST3	O60307	P60484
MAX	P61244	P29692	MCOLN2	Q8IZK6	Q9GZU1
MDM2	Q00987	Q8N726	MECP2	Q00566	P46100
MED28	Q9H204	P12931	METTL13	Q8N6R0	Q12933
MFSD5	Q6N075	P25103	MGAT4C	Q9UBM8	O75197
MICAL3	Q7RTP6, Q7RTP6-1	Q02241	MINK1	Q8N4C8	Q00613
MKRN1	Q9UHC7	P38936	MLANA	Q16655	P51810
MMUT	P22033	P42858	MORC3	Q14149	Q9NWF9
MRI1	Q9BV20	Q9BV20	MRPL24	Q96A35	P62753
MRPS9	P82933	Q9P031	MRRF	Q96E11	P11182
MSI1	O43347	O43347	MSS51	Q4VC12	Q9H0E2
MTOR	P42345	Q9NZQ7	MXD1	Q05195	Q96ST3
MXI1	P50539-3	Q7Z3S9, P0DPK4	MYEF2	Q9P2K5-2	Q13077
MYH6	P13533	Q16665	MYL9	P24844	P35579
MYO5B	Q9ULV0, Q9ULV0-2	Q12982	NAPG	Q99747	O15155
NAT2	P11245	Q9NQZ5	NAT8	Q9UHE5	Q9H2K0
NAT8L	Q8N9F0	P40855	NCAM1	P13591	P25098
NCCRP1	Q6ZVX7	Q15915	NCK2	Q43639	Q13177
NCOA1	Q15788	Q13569	NDUFB1	Q75438	Q9P0J0
NECTIN2	Q92692-2	P22735	NEU3	Q9UQ49	P09917
NEUROG3	Q9Y4Z2	O95631	NF2	P35240	Q16584
NFE2L1	Q14494	O15525	NLRC4	Q9NPP4	P29466, Q9NPP4
NLRP12	P59046	P08631	NOL4	O94818-2	P07237
NPB	Q8NG41	Q9BTV6	NPM3	Q75607	P40429
NPTX1	Q15818	P0DTC8	NT5C2	P49902	Q8IVS8
NTMT1	Q9BV86	P13501	NTN5	Q8WTR8	Q8N2S1
NUDT6	P53370	P46199	NUMA1	Q14980	Q9UIL1
NUP93	Q8N1F7	O60733	NXPE1	Q8N323	P12830
NYNRIN	Q9P2P1	Q15185	ODF3L1	Q8IXM7	O95630
OLFM2	O95897	O14641	OSBPL6	Q9BZF3	P53350
OSR2	Q8N2R0	P25788	OXCT2	Q9BYC2	Q9BW92
OXR1	Q8N573-5	Q14145	PACSIN1	Q9BY11	Q9NUX5
PAEP	P09466	P07225	PAK1	Q13153	P53667
PBX3	Q96AL5	Q05329	PCARE	A6NGG8	Q5JRX3
PCGF3	Q3KNV8	P68400, P67870	PCSK6	P29122	P0DTC8
PCYOX1	Q9UHG3	O94955	PDCD10	Q9BUL8	Q9BRV8
PDLIM1	O00151	P48431	PDZD11	Q5EBL8	Q04656
PDZD2	O15018	P59637	PGAP4	Q9BRR3	Q6ZMH5
PHF20	Q9BVI0	P62805	PHLDB2	Q86SQ0	P21333
PHYHD1	Q5SRE7	Q9NUX5	PIFO	Q8TCI5	Q9BT73
PIGF	Q07326	Q8N661	PIH1D2	Q8WWB5	O60469
PITRM1	Q5JRX3	Q80H93	PITX2	Q99697-3	Q12948

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
PKNOX1	P55347	P40424	PLAC8	Q9UHV8	Q12837
PLAU	P00749	Q03405	PLCG1	P19174	P16234
PLEKHB2	Q96CS7	Q86T03	PLXNC1	O60486	O75326
PNPLA4	P41247	Q9NQ88	PODXL	O00592	P51684
POLR2J	P52435	Q9Y5B0	PPM1B	O75688-3	Q9UI95
PPM1H	Q9ULR3	P31946	PPM1J	Q5JR12	Q96GM5
PPP1R1A	Q13522	O75807	PPP1R2	P41236	P49841
PPP1R37	O75864	O75593	PPP1R8	Q12972, Q12972-2	P36873
PPP2R2C	Q9Y2T4	P67775	PRKRIP1	Q9H875	P62304
PROCR	Q9UNN8	P0DTC3	PRUNE2	Q8WUY3	P07900
PSMD2	Q13200	O00487	PTPRN	Q16849	Q13093
PTPRQ	Q15256	Q16539	PWP1	Q13610	P48431
PYGL	P06737	Q13451	RAB2B	Q8WUD1	Q96FJ0
RAB33A	Q14088	Q8IUQ4	RAB3GAP1	Q15042	P09917
RAB9B	Q9NP90	Q92696	RAC2	P15153	P52306
RALGDS	Q12967	P15056	RANBP3L	Q86VV4	Q08379
RAPGEF1	Q13905	P46109	RASSF6	Q6ZTQ3	P78352
RASSF8	Q8NHQ8	Q13485	REEP1	Q9H902	P21291
REEP6	Q96HR9	P0DTC5	REV3L	O60673	Q9UI95
RGPD5	Q99666	P61769	RLIM	Q9NVW2	Q9H0E2
RMDN1	Q96DB5	P05181	RND3	P61587	O43157
RNF111	Q99ML9	O15169	RNF146	Q9NTX7	Q86WJ1
RNF149	Q8NC42	Q30201	RNF24	Q9Y225-2	Q3KNW5
RNLS	Q5VYX0	P23634	ROCK1	Q13464	P61586
RPL23A	P62750	Q01105	RPL28	P46779	P43146
RPP40	O75818	P04004	RPS15	P62841	P62937
RPS23	P62266	Q15843	RPS28	P62857	P16104
RPS4X	P62701	Q9UPY3	RPS6KA5	O75582	Q16539
RRAGA	Q7L523	P61916	RRS1	Q15050	P40429
RSPH14	Q9UHP6	Q96CW1	RTN1	Q16799-3	O00560
RUBCN	Q92622	Q9P2Y5	SAMD3	Q8N6K7-2	P04156
SASS6	Q6UVJ0	Q9HC77	SC5D	O75845	Q8TDU9
SCGB2A1	O75556	O14975	SCN5A	Q14524	P26045
SDC3	A0A0S2Z4U3	P63252	SDK2	Q58EX2	P17931
SEC61G	P60059	P11686	SELENON	Q9NZV5	P22891
SEMG2	Q02383	Q9HAU4	SERF1A	O75920	A1L3X0
SERP1	Q9Y6X1	Q12846	SERPINB2	P05120	Q9NRY4
SERTAD2	Q14140	O60733	SESN2	P58004	Q13501
SETD1B	Q9UPS6	Q9UER7	SF3B1	O75533	O43809
SFTPA1	Q8IWL2	Q9UGM3	SGCG	Q13326	O00501
SH3RF1	Q7Z6J0	O43255	SH3RF3	Q8TEJ3	Q13177
SHC4	Q6S5L8	P00533	SHISAL1	Q3SXP7	P29033
SIGMAR1	Q99720	P14416	SIKE1	Q9BRV8	P40222
SKIC3	Q6PGP7	P06748	SLC14A2	Q15849	O43561-2
SLC15A1	P46059	Q8NE86	SLC15A3	F5H1C8	Q14974
SLC16A6	O15403	O76024	SLC1A1	P43005	Q6IAN0
SLC22A18AS	Q8N1D0-2	Q6DKK2	SLC25A21	Q9BQT8	P0DTC5
SLC27A6	Q9Y2P4	Q9Y2C2	SLC35G1	Q2M3R5	Q15125
SLC36A1	Q7Z2H8	P05067	SLC39A6	Q13433	Q6ZMH5
SLC41A2	Q96JW4	P21217	SLC43A2	Q8N370	P0DPK4

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
SLC44A2	Q8IWA5	O75695	SLC51B	Q86UW2	O43561-2
SLMAP	Q14BN4	Q9BRV8	SLX4	Q8IY92	P43246
SMIM3	Q9BZL3	Q16585	SMPD3	Q9NY59	P04114
SNAP47	Q5SQN1	Q9Y624	SNRPB2	P08579	Q14566
SNX20	Q7Z614-3	P37173	SOX12	O60248	O00712, Q12857
SOX4	Q06945	P04637	SPATA17	Q96L03	P36957
SPATA22	Q8NHS9	Q00403	SPRING1	Q9H741	P40855
SPX	Q9BT56	Q6IN84	SRCAP	Q6ZRS2	Q13257
SRPRA	P08240	Q6UWB1	SRRM2	Q9UQ35	P04608
SRSF8	Q9BRL6	P61981	SS18	Q15532	Q92925
SSUH2	Q9Y2M2-2	Q969R5	SSX4	O60224	Q16665
STAT5A	P42229	P10515	STK36	Q9NRP7	P08151
STOML2	Q9UJZ1	O76024	STOX1	Q6ZVD7	Q01974
STT3B	Q8TCJ2	Q14165	SYCE3	A1L190	Q96NL6
SYNDIG1	Q9H7V2	Q9H1C4	SYNJ2	O15056	Q96B97
SYS1	Q8N2H4	Q8NBQ5	SYT11	Q9BT88	Q9NQ11
SYT7	O43581	Q8IUQ4	TAMALIN	Q7Z6J2	Q9BYF1
TBX2	Q13207	Q6DKK2	TBX5	Q99593	P46937
TBX6	O95947	P31930	TCEAL8	Q8IYN2	P04792
TCF3	P15923	Q9Y4Z2	TEAD1	P28347	P46937
TEFM	Q96QE5	O00411	TEK	Q02763	P29353
TEKT4	Q8WW24	P12236	TEX12	Q9BXU0	Q13153
TFAP2B	Q92481	Q92993	TFCP2	Q12800	P03428
TFF1	EBI-5590876	P05412	TGM3	Q08188	Q9Y570
THBD	P07204	P55056	THPO	P40225	P40238
TICAM2	Q86XR7	O00206	TIMP1	P01033	P21802
TIMP3	P35625	P78536	TJP3	O95049	Q8NI35
TLNRD1	Q9H1K6	Q9NRD5	TLX2	O43763	O00712, Q12857
TM4SF19	Q96DZ7	P09601	TMC7	Q7Z402	P50747
TMEM108	Q6UXF1	Q9NYV6	TMEM140	Q9NV12	Q15800
TMEM184B	Q9Y519	Q96RK4	TMEM255A	Q5JRV8	Q96J02
TMEM41A	Q96HV5	P18031	TMPO	P42166	Q93009
TMTc3	Q6ZXV5	Q6PIU2	TMTc4	Q5T4D3	Q9Y4Z2
TNFRSF11A	Q9Y6Q6	O00300	TNFRSF11B	O00300	Q9Y6Q6
TNFRSF12A	Q9NP84	Q9BRI3	TNFSF12	O43508	Q9NP84
TRAFD1	O14545	Q96RK4	TRAM1L1	Q8N609	Q96BA8
TRDN	Q13061	Q5SRI9	TRIM16L	Q309B1	P11142
TRIM55	Q9BYV6	Q92995	TRIM9	Q9C026	P48730
TRIP13	Q15645	Q8NDV7	TRMT44	Q8IYL2	P00740
TRPV5	Q9NQA5	Q96T88	TSHB	P01222	P11021
TSPAN2	O60636	O00501	TSPAN6	O43657	Q9NY25
TTC28	Q96AY4	O43639	TULP3	O75386	P98160
TUT1	Q9H6E5	Q9P2I0, Q92797, Q10570	TXN	P10599	P19883
TYRP1	P17643	O14908	UBQLN2	Q9UHD9	Q9UNW1
UBTF	P17480	P52306	UFSP2	Q9NUQ7	Q96FT7
UQCRCFS1	P47985	Q9H1K1	USB1	Q9BQ65	Q13573
USP16	Q9Y5T5	O95714	USP2	O75604	Q86U10
USP27X	A6NNY8	Q96B97	VAV2	P52735-1, P52735	Q03135
VCX2	Q3SXR9	P26367	VPS72	Q15906	O96019

Input	UniProt Id	Interacts with	Input	UniProt Id	Interacts with
VRK2	Q86Y07-2, Q86Y07-1	Q13469	VWF	P04275	P00451
WAS	P42768	Q05209	WBP1L	Q9NX94	Q8N2W9
WDR20	Q8TBZ3	Q8TAF3	WDR6	Q9NNW5	P03496
WDR62	O43379	P45983	WIPF3	A6NGB9	O00401
WNK1	Q9H4A3	Q15149	WSB1	Q9Y6I7	Q93034, Q9UBF6
WTAP	Q15007-2	P54252	YTHDF1	Q9BYJ9	P08311
ZBTB17	Q13105	P04198	ZBTB44	Q8NCP5	Q8NB12
ZCCHC3	Q9NUD5	P63244	ZDHHC19	Q810M5	P40763
ZDHHC21	Q8IVQ6	Q6P5S7	ZFAT	Q9P243	Q9UER7
ZFYVE9	O95405	P08100	ZNF180	Q9UJW8-4	P07196
ZNF22	P17026	P61247	ZNF223	Q9UK11	Q13263
ZNF23	P17027	Q13077	ZNF263	O14978	O60437
ZNF334	Q9HCZ1	P05067	ZNF423	Q2M1K9	Q96K83
ZNF436	Q9C0F3	P35240	ZNF490	Q9ULM2	Q16623
ZNF556	Q9HAH1	Q53H54	ZNF57	Q68EA5	Q9NPB3
ZNF592	Q92610	Q13547	ZNF606	Q8WXB4	P05067
ZNF627	Q7L945	Q9UBX5	ZNF646	O15015	A8MZ59
ZNF675	Q8TD23	Q9Y4K3	ZNF777	Q9ULD5	P04004
ZNF783	Q6ZMS7-2	Q13526	ZNF836	Q6ZNA1	P05067
ZNG1C	Q5JTY5	P05155			
Input	ChEBI Id	Interacts with	Input	ChEBI Id	Interacts with
GLRX	P35754	16856	MMUT	P22033	18408
PAK1	Q13153	15996	TLL1	O43897	29108

7. Identifiers not found

These 917 identifiers were not found neither mapped to any entity in Reactome.

A2MP1	ABHD16B	ACAP2	ACVR2B-AS1	ADAMTS7P1	ADAMTSL4-AS2	ADGRD2	AFAP1L2
AFTPH-DT	AGAP1	ALKBH7	ANGPTL5	ANKAR	ANKRD20A19P	ANKRD20A4-ANKRD20A20P	ANKRD62P1-PARP4P3
ANXA2R-AS1	APCDD1L-DT	ARHGAP11B-DT	ARHGEF35-AS1	ARHGEF38-IT1	ARMS2	ARRDC3-AS1	ASPDH
ATXN7L3B	B3GALT1-AS1	B4GALT1-AS1	BISPR	BRD3OS	C11orf58	C12orf60	C14orf178
C16orf96	C17orf99	C18orf61	C1QTNF8	C1orf162	C1orf174	C2CD4A	C2CD4D-AS1
C2orf74-AS1	C8orf34-AS1	CALML3-AS1	CAPN10-DT	CASC16	CASC21	CATSPER2P1	CCDC88C-DT
CD163L1	CDC20-DT	CDKN2A-DT	CDKN2B-AS1	CDR2-DT	CELF2	CELSR1	CETN4P
CFAP141	CFAP20DC	CFAP44	CFAP69	CLUL1	CMKLR2	CNBD2	COL25A1-DT
COLCA1	CPEB1-AS1	CRISP1	CRNDE	CRTAC1	CSDC2	CSRP1-AS1	CSTF3-DT
CT70	CTD-2194D22.4	CYLC1	CYP20A1	DAW1	DBIL5P	DCDC1	DEFB131B
DENND3-AS1	DLEU1-AS1	DLG3-AS1	DLX1	DM1-AS	DNAH10	DNAH7	DNAJB7
DNAJC21	DNMBP-AS1	DNNEP-AS1	DPP3-DT	DSG1-AS1	DZANK1	EGFLAM	EHBP1-AS1
ENTPD1-AS1	EPHA1-AS1	EPN2-AS1	EPN2-IT1	ERVV-1	ETDB	EVPLL	FAM131C
FAM225A	FAM227A	FAM53B-AS1	FAM78B-AS1	FAM85B	FAM95B1	FHAD1	FKSG29
FLJ20021	FLJ40194	FMC1-LUC7L2	FOXD2-AS1	FRMD3-AS1	FRRS1	FSCN3	GAGE12B
GAGE12D	GAS6-DT	GASK1B	GDF6	GDF7	GET1-SH3BGR	GLIS1	GPATCH3
GPR173	GPR84-AS1	GPR85	GPRC5D-AS1	GRHL2-DT	GTF3C2-AS1	GVINP1	Gene
H2AB2	H2BW1	HCG20	HDAC4-AS1	HDGFL3	HEXD	HFM1	HIVEP2-DT
HMSD	HOXA13	HPS3	HSPB2-C11orf52	IFITM5	IGHEP1	IGHV1-24	IGSF1
IL21R-AS1	INTS6L	IPW	JARID2-AS1	JDP2-AS1	KANK3	KBTBD11	KCTD13-DT
KIAA1549L	KIAA2012	KLF7	LAMA5-AS1	LANCL3	LBX2-AS1	LERFS	LETM2
LGALS8-AS1	LGSN	LHFPL6	LINC00240	LINC00251	LINC00334	LINC00501	LINC00593
LINC00607	LINC00612	LINC00630	LINC00857	LINC00887	LINC00965	LINC01094	LINC01095
LINC01119	LINC01121	LINC01140	LINC01166	LINC01216	LINC01275	LINC01301	LINC01305
LINC01311	LINC01347	LINC01372	LINC01482	LINC01488	LINC01535	LINC01569	LINC01586
LINC01587	LINC01599	LINC01623	LINC01664	LINC01668	LINC01695	LINC01705	LINC01756
LINC01906	LINC01967	LINC01968	LINC01980	LINC02036	LINC02050	LINC02084	LINC02100
LINC02102	LINC02137	LINC02231	LINC02273	LINC02288	LINC02316	LINC02322	LINC02390
LINC02405	LINC02520	LINC02551	LINC02613	LINC02618	LINC02695	LINC02720	LINC02747
LINC02788	LINC02795	LINC02815	LINC02864	LINC02883	LINC02919	LINC02988	LINC03014
LINC03025	LINC03048	LINC03060	LIX1L	LMBR1L	LMNB1-DT	LNCRNA-ATB	LOC100129175
LOC100129203	LOC100130283	LOC100287175	LOC100288637	LOC100505555	LOC100506124	LOC100506514	LOC100507006
LOC100653133	LOC101060341	LOC101448202	LOC101926994	LOC101927098	LOC101927166	LOC101927263	LOC101927511
LOC101927556	LOC101927583	LOC101927608	LOC101927756	LOC101927919	LOC101927971	LOC101927999	LOC101928047
LOC101928143	LOC101928230	LOC101928234	LOC101928336	LOC101928387	LOC101928438	LOC101928841	LOC101928933
LOC101929107	LOC101929185	LOC101929200	LOC101929386	LOC101929506	LOC101929657	LOC101929800	LOC101929828
LOC101929937	LOC101930100	LOC102723313	LOC102723546	LOC102723716	LOC102723752	LOC102723855	LOC102723870
LOC102724046	LOC102724117	LOC102724273	LOC102724420	LOC102724479	LOC102724591	LOC102724603	LOC103344931
LOC105369151	LOC105369373	LOC105369617	LOC105369625	LOC105369632	LOC105369725	LOC105369745	LOC105369819
LOC105370024	LOC105370090	LOC105370115	LOC105370126	LOC105370227	LOC105370271	LOC105370314	LOC105370340
LOC105370412	LOC105370475	LOC105370504	LOC105370639	LOC105370753	LOC105370791	LOC105370827	LOC105370935
LOC105371059	LOC105371067	LOC105371077	LOC105371098	LOC105371376	LOC105371425	LOC105371434	LOC105371449

LOC105371452	LOC105371516	LOC105371517	LOC105371634	LOC105371711	LOC105371741	LOC105371750	LOC105371932
LOC105371956	LOC105371990	LOC105372049	LOC105372172	LOC105372179	LOC105372210	LOC105372244	LOC105372266
LOC105372401	LOC105372507	LOC105372606	LOC105372631	LOC105372662	LOC105372671	LOC105372815	LOC105372817
LOC105372824	LOC105372832	LOC105372836	LOC105373018	LOC105373042	LOC105373124	LOC105373150	LOC105373155
LOC105373194	LOC105373244	LOC105373323	LOC105373346	LOC105373534	LOC105373562	LOC105373716	LOC105373759
LOC105373769	LOC105373881	LOC105373975	LOC105374090	LOC105374164	LOC105374179	LOC105374287	LOC105374310
LOC105374346	LOC105374418	LOC105374470	LOC105374662	LOC105374721	LOC105374724	LOC105374746	LOC105374773
LOC105374800	LOC105374839	LOC105374924	LOC105375065	LOC105375079	LOC105375091	LOC105375106	LOC105375153
LOC105375164	LOC105375260	LOC105375314	LOC105375422	LOC105375446	LOC105375451	LOC105375513	LOC105375536
LOC105375560	LOC105375615	LOC105375626	LOC105375628	LOC105375719	LOC105375777	LOC105375783	LOC105375784
LOC105375835	LOC105375901	LOC105375902	LOC105376034	LOC105376093	LOC105376139	LOC105376176	LOC105376236
LOC105376364	LOC105376481	LOC105376486	LOC105376576	LOC105376714	LOC105376724	LOC105376754	LOC105376759
LOC105376781	LOC105376819	LOC105376861	LOC105376938	LOC105376982	LOC105377022	LOC105377048	LOC105377055
LOC105377103	LOC105377104	LOC105377112	LOC105377161	LOC105377177	LOC105377343	LOC105377374	LOC105377473
LOC105377581	LOC105377626	LOC105377766	LOC105377887	LOC105377928	LOC105377971	LOC105378011	LOC105378030
LOC105378052	LOC105378100	LOC105378141	LOC105378187	LOC105378267	LOC105378449	LOC105378479	LOC105378480
LOC105378483	LOC105378484	LOC105378513	LOC105378526	LOC105378576	LOC105378577	LOC105378736	LOC105378797
LOC105378841	LOC105378859	LOC105378866	LOC105378954	LOC105379061	LOC105379185	LOC105379263	LOC105379325
LOC105379417	LOC105379524	LOC105379539	LOC105379623	LOC105447645	LOC107983976	LOC107984109	LOC107984220
LOC107984292	LOC107984298	LOC107984308	LOC107984376	LOC107984455	LOC107984546	LOC107984573	LOC107984591
LOC107984745	LOC107984763	LOC107984794	LOC107984867	LOC107984888	LOC107984935	LOC107985041	LOC107985144
LOC107985163	LOC107985231	LOC107985286	LOC107985320	LOC107985360	LOC107985361	LOC107985481	LOC107985568
LOC107985573	LOC107985577	LOC107985584	LOC107985593	LOC107985665	LOC107985675	LOC107985728	LOC107985839
LOC107985939	LOC107986029	LOC107986077	LOC107986079	LOC107986083	LOC107986141	LOC107986160	LOC107986324
LOC107986368	LOC107986383	LOC107986428	LOC107986489	LOC107986516	LOC107986538	LOC107986550	LOC107986562
LOC107986714	LOC107986760	LOC107986868	LOC107986870	LOC107986897	LOC107986909	LOC107986929	LOC107986948
LOC107987012	LOC107987068	LOC107987071	LOC107987074	LOC107987101	LOC107987126	LOC107987135	LOC107987174
LOC107987222	LOC107987326	LOC107987348	LOC107987363	LOC112267859	LOC112267899	LOC112267957	LOC112268035
LOC112268063	LOC112268112	LOC112268122	LOC112268134	LOC112268147	LOC112268155	LOC112268182	LOC112268244
LOC112268250	LOC112268423	LOC112268444	LOC112268445	LOC284581	LOC339539	LOC339685	LOC388436
LOC389895	LOC400748	LOC414300	LOC440311	LOC644656	LOC646214	LOC646548	LOC646903
LOC731157	LOC780529	LOC84214	LOC93463	LRATD1	LRRC17	LRRC26	LRRC39
LRRC70	LRRN3	LUNAR1	LY6G5C	LYPD9P	LYPLA2P2	MADD-AS1	MAGEA4-AS1
MAGEB5	MAMSTR	MAP4K1-AS1	MAST4	MAST4-AS1	MBD3L5	MEIS3P1	MGAT4FP
MGC16025	MIATNB	MIDEAS-AS1	MIF-AS1	MINAR2	MIR10393	MIR1178	MIR1206
MIR1269A	MIR1289-1	MIR1291	MIR3124	MIR3179-1	MIR3192	MIR3613	MIR3651
MIR374C	MIR378H	MIR4273	MIR4292	MIR4656	MIR4683	MIR4697	MIR542
MIR553	MIR568	MIR574	MIR593	MIR595	MIR596	MIR597	MIR600
MIR600HG	MIR601	MIR602	MIR6125	MIR623	MIR641	MIR643	MIR6728
MIR6744	MIR6745	MIR6746	MIR6747	MIR6748	MIR6749	MIR6750	MIR6751
MIR6752	MIR6753	MIR6755	MIR6756	MIR6757	MIR6758	MIR6764	MIR6768
MIR6784	MIR6791	MIR6802	MIR6822	MIR6824	MIR6889	MIR6890	MIR7113
MIR7705	MIR7851	MIR8069-1	MIR9898	MMEL1	MPV17L	MRPL42P5	MRPL45P2
MSC	MSMP	MSRA-DT	MTRNR2L10	MUC12-AS1	MYRFL	NBPF4	NCBP2AS2
NCOR1P1	NEMP2-DT	NKPD1	NLRP11	NLRP6	NOC2LP2	NQO2-AS1	NRG3-AS1
NUDT17	NUDT9P1	NUGGC	OLFML3	OVOL1-AS1	PA2G4P4	PAN3-AS1	PARP11-AS1
PART1	PATE2	PATE4	PAXIP1-DT	PCA3	PCAT1	PCDH1	PCDHA6
PCDHACT	PCDHB1	PCDHB4	PCF11-AS1	PCGF3-AS1	PDLM3	PHACTR1	PHEX
PHOSPHO2-KLHL23	PHYHIPL	PICSAR	PIM2	PKD1-AS1	PKHD1L1	PLEKHM2	PORCN-DT
POTE8	PPP1R42	PPY2P	PRDM4-AS1	PRICKLE2-AS1	PRRT4	PRSS43P	PSMG3-AS1

PTCHD4	PTMAP11	RACGAP1P1	RAMP2-AS1	RANBP3-DT	RBAK-RBAKDN	RBBP9	RBM14-RBM4
RBM38-AS1	REM2	RGPD4	RIIAD1	RNASEH1-DT	RNF212	RNF222	RNF5P1
RNVU1-4	RP1L1	RPL34-DT	RRN3P3	RTL5	SAP30-DT	SBK1	SEC22B4P
SECISBP2L	SEPTIN9-DT	SFMBT2	SH2D7	SH3BGR	SH3GL1P2	SKINT1L	SLC22A14
SLC25A25-AS1	SLC25A51P1	SLC26A10P	SLC2A1-DT	SLC45A4	SLC7A6OS	SLFN14	SMARCAD1-DT
SMCR2	SMIM10L2B-AS1	SNHG29	SNHG8	SNORA105A	SNORA117	SNORA11D	SNORA11F
SNORA18	SNORA23	SNORA27	SNORA2A	SNORA37	SNORA41	SNORA47	SNORA48
SNORA55	SNORA59B	SNORA63	SNORA69	SNORA70H	SNORA71C	SNORA77	SNORA7A
SNORA84	SNORD103C	SNORD116-29	SNORD116-6	SNORD116-8	SNORD12	SNORD14A	SNORD14C
SNORD162	SNORD18B	SNORD19	SNORD42B	SNORD54	SNORD55	SNORD80	SNORD81
SNORD97	SNTG2-AS1	SNX15	SPDYE17	SPDYE8	SPRNP1	SSX6P	ST13P4
ST18	ST7-OT3	STRCP1	STUM	STX18-AS1	STXBP5-AS1	STYXL1	SUCLG2-DT
SUMO4	SUSD1	SUSD2	SWT1	SYNRG	SYP-AS1	SYT9-AS1	TAC4
TBX2-AS1	TBX3-AS1	TCAM1P	TDRKH-AS1	TEKT2	TGM4	TLCD5	TMCC1-DT
TMCO1	TMED7-TICAM2	TMEM191C	TMEM253	TMEM71	TMPRSS9	TP53I11	TP53TG3
TPBGL	TPM3P9	TPRG1-AS1	TRA-AGC3-1	TRA-TGC4-1	TRC-GCA23-1	TRC-GCA3-1	TRI-AAT2-1
TRI-AAT4-1	TRIM49D2	TRM-CAT2-1	TRP-TGG3-3	TRPM2-AS	TRR-ACG1-3	TRS-AGA5-1	TRV-CAC8-1
TRW-CCA1-1	TRX-CAT1-6	TSHZ1	TSPY26P	TTC3P1	TTC7B-AS1	TVP23C-CDRT4	UBBP4
UBE2E2-DT	UBXN7-AS1	ULK4	UQCC4	USP32P1	USP7-AS1	VAMP9P	VEPH1
VIM-AS1	VIPR1-AS1	VLDLR-AS1	VN1R1	VTRNA1-2	VTRNA1-3	WARS2-AS1	WDPCP
WDR47	WEE2-AS1	WHAMMP1	XKR4	XKR6	XLOC_009911	YEATS2-AS1	YWHAEP7
ZC3H11B	ZDHHC23	ZFHX4-AS1	ZIC5	ZMYM1	ZNF137P	ZNF185	ZNF225-AS1
ZNF578	ZNF687-AS1	ZNF879	ZNRF2P2	ZSCAN12P1			