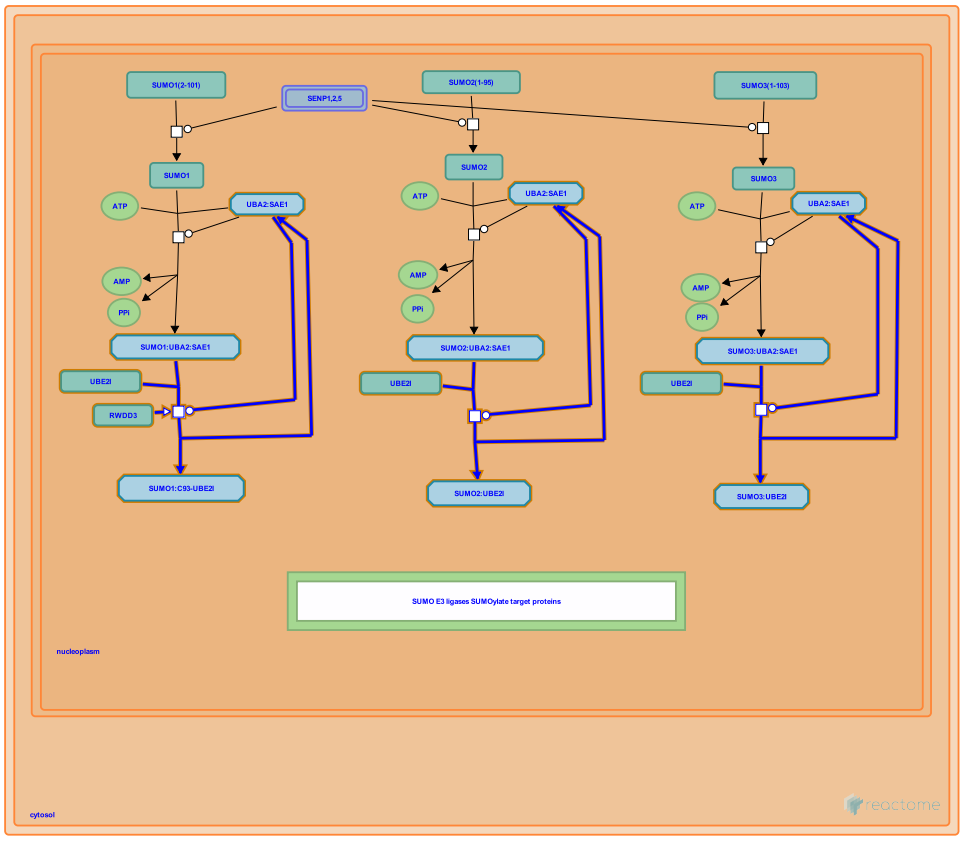
SUMO is transferred from E1 to E2 (UBE2I, UBC9)



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25/06/2019

Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.

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Literature references

Fabregat, A., Sidiropoulos, K., Viteri, G., Forner, O., Marin-Garcia, P., Arnau, V. et al. (2017). Reactome pathway analysis: a high-performance in-memory approach. *BMC bioinformatics, 18*, 142. ↗

Sidiropoulos, K., Viteri, G., Sevilla, C., Jupe, S., Webber, M., Orlic-Milacic, M. et al. (2017). Reactome enhanced pathway visualization. *Bioinformatics, 33*, 3461-3467. ↗

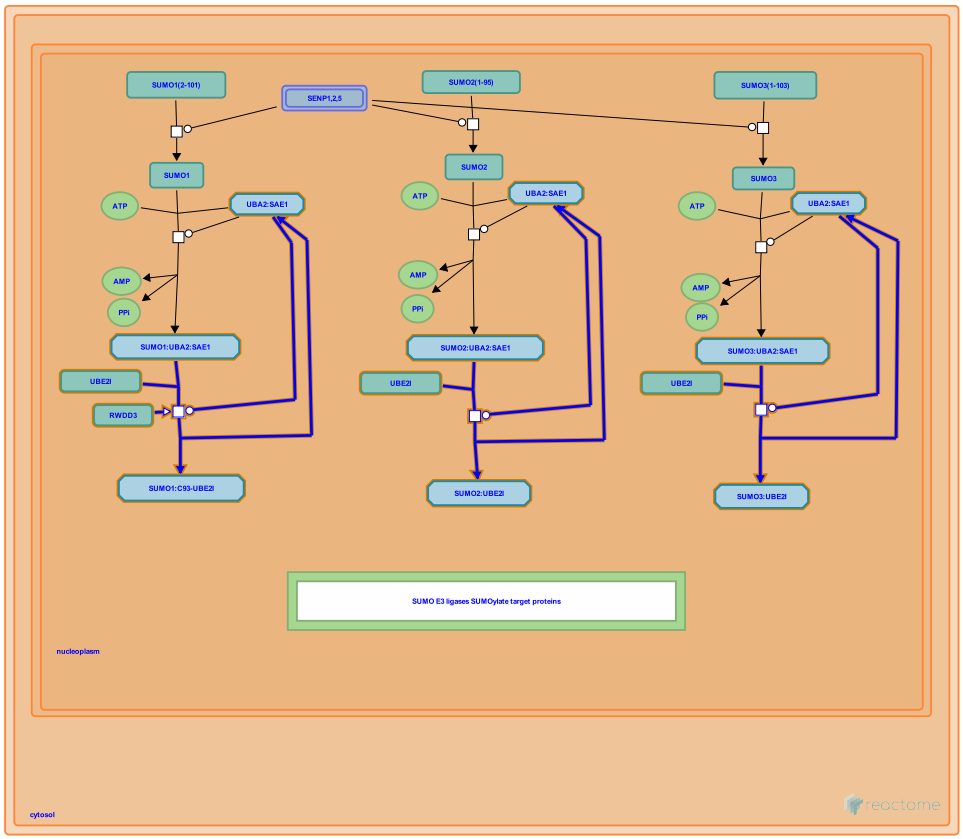
Fabregat, A., Jupe, S., Matthews, L., Sidiropoulos, K., Gillespie, M., Garapati, P. et al. (2018). The Reactome Pathway Knowledgebase. *Nucleic Acids Res, 46*, D649-D655. ↗

Fabregat, A., Korninger, F., Viteri, G., Sidiropoulos, K., Marin-Garcia, P., Ping, P. et al. (2018). Reactome graph database: Efficient access to complex pathway data. *PLoS computational biology, 14*, e1005968. ↗

SUMO is transferred from E1 to E2 (UBE2I, UBC9) ↗

Stable identifier: R-HSA-3065678

Compartments: nucleoplasm



SUMO is transferred from cysteine-173 of UBA2 to cysteine-93 of UBC9 (UBE2I) in a transthiolation reaction (reviewed in Wang and Dasso 2009, Wilkinson and Henley 2010, Hannoun et al. 2010, Gareau and Lima 2010). UBC9 is the only known E2 enzyme for SUMO and on certain substrates such as RanGAP1 may act without the requirement of an E3 ligase.

Literature references

Wilkinson, KA., Henley, JM. (2010). Mechanisms, regulation and consequences of protein SUMOylation. *Biochem. J., 428*, 133-45. ↗

Gareau, JR., Lima, CD. (2010). The SUMO pathway: emerging mechanisms that shape specificity, conjugation and recognition. *Nat. Rev. Mol. Cell Biol., 11*, 861-71. ↗

Wang, Y., Dasso, M. (2009). SUMOylation and deSUMOylation at a glance. *J. Cell. Sci., 122*, 4249-52. ↗

Hannoun, Z., Greenhough, S., Jaffray, E., Hay, RT., Hay, DC. (2010). Post-translational modification by SUMO. *Toxicology, 278*, 288-93. ↗

Editions

2013-02-06	Authored, Edited	May, B.
2013-05-16	Reviewed	Garg, AK.

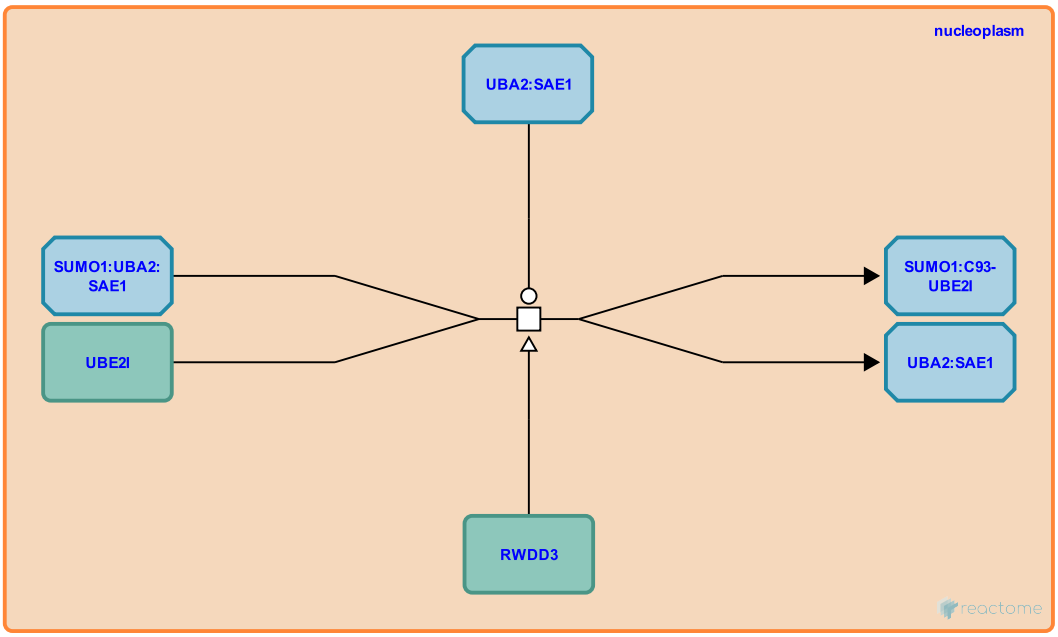
Transfer of SUMO1 from E1 to UBE2I (UBC9) ↗

Location: SUMO is transferred from E1 to E2 (UBE2I, UBC9)

Stable identifier: R-HSA-2993780

Type: transition

Compartments: nucleoplasm



SUMO1 is transferred from cysteine-173 of UBA2 to cysteine-93 of UBC9 (UBE2I) in a transthiolation reaction (Desterro et al. 1999, Okuma et al. 1999, Tatham et al. 2003, Lois and Lima 2005, Wang et al. 2007, Werner et al. 2009). The UbL domain of E1 recruits E2 into proximity for the transfer of SUMO (Lois and Lima 2005, Wang et al. 2009),

Literature references

Werner, A., Moutty, MC., Möller, U., Melchior, F. (2009). Performing in vitro sumoylation reactions using recombinant enzymes. *Methods Mol. Biol., 497*, 187-99. ↗

Desterro, JM., Rodriguez, MS., Kemp, GD., Hay, RT. (1999). Identification of the enzyme required for activation of the small ubiquitin-like protein SUMO-1. *J. Biol. Chem., 274*, 10618-24. ↗

Okuma, T., Honda, R., Ichikawa, G., Tsumagari, N., Yasuda, H. (1999). In vitro SUMO-1 modification requires two enzymatic steps, E1 and E2. *Biochem. Biophys. Res. Commun., 254*, 693-8. ↗

Tatham, MH., Chen, Y., Hay, RT. (2003). Role of two residues proximal to the active site of Ubc9 in substrate recognition by the Ubc9.SUMO-1 thiolester complex. *Biochemistry, 42*, 3168-79. ↗

Wang, J., Hu, W., Cai, S., Lee, B., Song, J., Chen, Y. (2007). The intrinsic affinity between E2 and the Cys domain of E1 in ubiquitin-like modifications. *Mol. Cell, 27*, 228-37. ↗

Editions

2013-01-17	Authored, Edited	May, B.
2013-05-16	Reviewed	Garg, AK.

Transfer of SUMO2 from E1 to UBE2I (UBC9) ↗

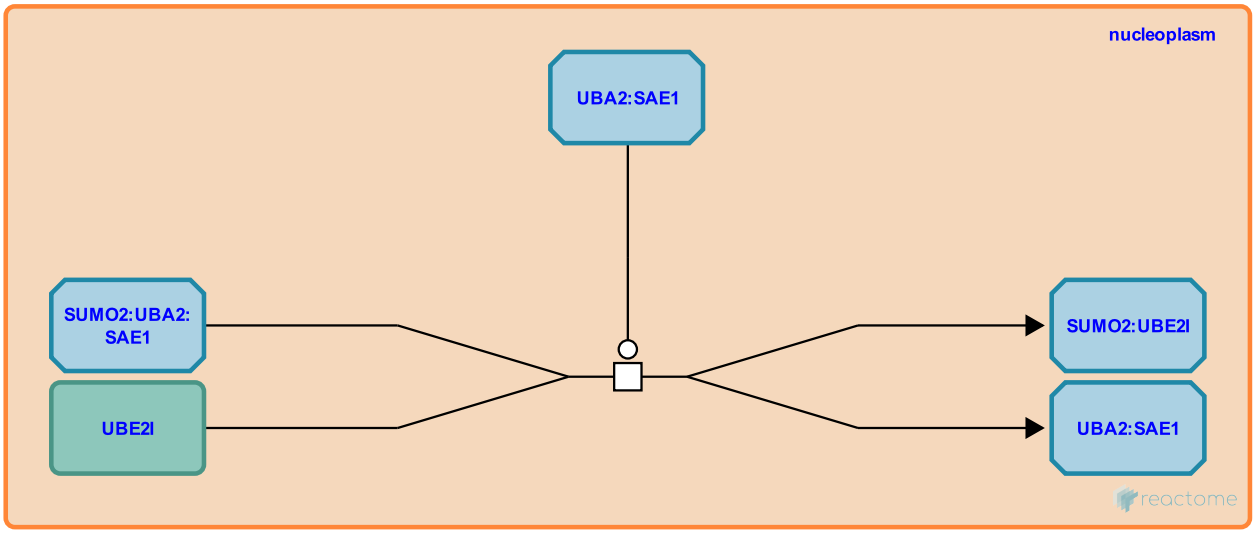
Location: SUMO is transferred from E1 to E2 (UBE2I, UBC9)

Stable identifier: R-HSA-2993790

Type: transition

Compartments: nucleoplasm

Inferred from: Transfer of SUMO1 from E1 to UBE2I (UBC9) (Homo sapiens)



SUMO2 is transferred from cysteine-173 of UBA2 to cysteine-93 of UBC9 (UBE2I) in a transthiolation reaction (Tatham et al. 2001, Werner et al. 2009).

Literature references

Tatham, MH., Jaffray, E., Vaughan, OA., Desterro, JM., Botting, CH., Naismith, JH. et al. (2001). Polymeric chains of SUMO-2 and SUMO-3 are conjugated to protein substrates by SAE1/SAE2 and Ubc9. *J. Biol. Chem., 276*, 35368-74. ↗

Werner, A., Moutty, MC., Möller, U., Melchior, F. (2009). Performing in vitro sumoylation reactions using recombinant enzymes. *Methods Mol. Biol., 497*, 187-99. ↗

Editions

2013-01-17	Authored, Edited	May, B.
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Transfer of SUMO3 from E1 to UBE2I (UBC9) ↗

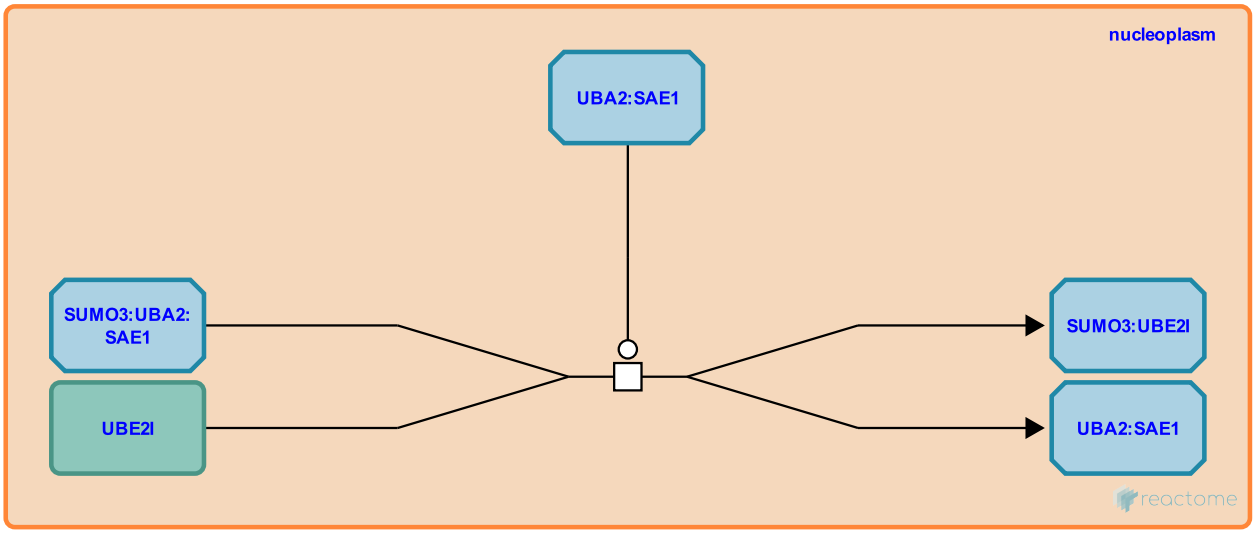
Location: SUMO is transferred from E1 to E2 (UBE2I, UBC9)

Stable identifier: R-HSA-2993769

Type: transition

Compartments: nucleoplasm

Inferred from: Transfer of SUMO1 from E1 to UBE2I (UBC9) (Homo sapiens)



SUMO3 is transferred from cysteine-173 of UBA2 to cysteine-93 of UBC9 (UBE2I) in a transthiolation reaction (Tatham et al. 2001, Werner et al. 2009).

Literature references

Tatham, MH., Jaffray, E., Vaughan, OA., Desterro, JM., Botting, CH., Naismith, JH. et al. (2001). Polymeric chains of SUMO-2 and SUMO-3 are conjugated to protein substrates by SAE1/SAE2 and Ubc9. *J. Biol. Chem., 276*, 35368-74. ↗

Werner, A., Moutty, MC., Möller, U., Melchior, F. (2009). Performing in vitro sumoylation reactions using recombinant enzymes. *Methods Mol. Biol., 497*, 187-99. ↗

Editions

2013-01-17	Authored, Edited	May, B.
2013-05-16	Reviewed	Garg, AK.

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