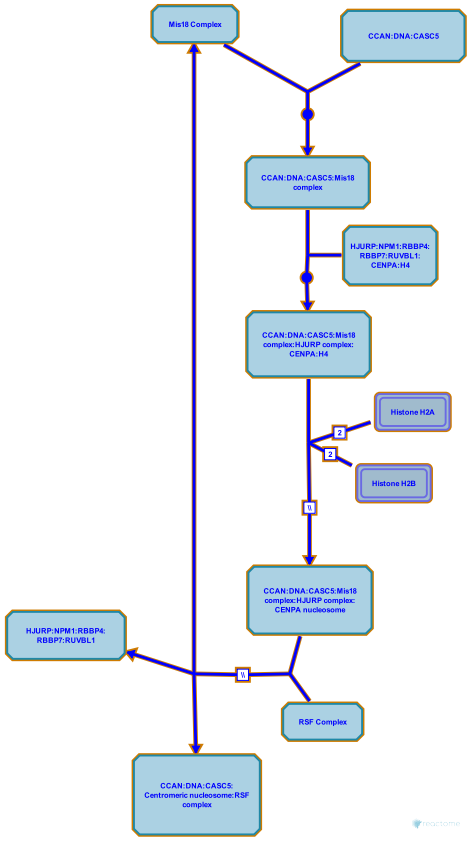
Deposition of new CENPA-containing nucleosomes at the centromere



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14/11/2019

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.

The development of Reactome is supported by grants from the US National Institutes of Health (P41 HG003751), University of Toronto (CFREF Medicine by Design), European Union (EU STRP, EMI-CD), and the European Molecular Biology Laboratory (EBI Industry program).

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. ↗

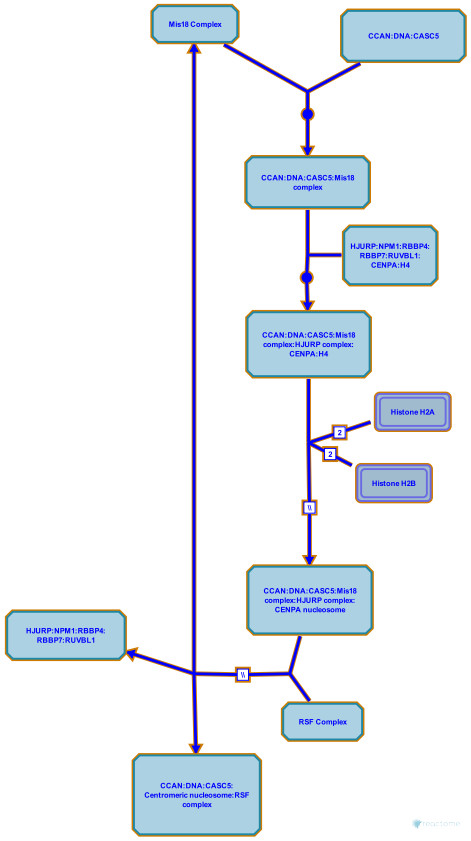
Fabregat, A., Jupe, S., Matthews, L., Sidiropoulos, K., Gillespie, M., Garapati, P. et al. (2018). The Reactome Pathway Knowledgebase. *Nucleic Acids Res, 46*, D649-D655. ↗

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. ↗

Deposition of new CENPA-containing nucleosomes at the centromere ↗

Stable identifier: R-HSA-606279

Compartments: nucleoplasm



Eukaryotic centromeres are marked by a unique form of histone H3, designated CENPA in humans. In human cells newly synthesized CENPA is deposited in nucleosomes at the centromere during late telophase/early G1 phase of the cell cycle. Once deposited, nucleosomes containing CENPA remain stably associated with the centromere and are partitioned equally to daughter centromeres during S phase. A current model proposes that pre-existing CENPA at the centromere drives recruitment of new CENPA, however this has not been proved.

The deposition process requires at least 3 complexes: the Mis18 complex, HJURP complex, and the RSF complex. HJURP binds newly synthesized CENPA-H4 tetramers before deposition and brings them to the centromere for deposition in new CENPA-containing nucleosomes. The exact mechanism of deposition remains unknown.

Literature references

Silva, MC., Jansen, LE. (2009). At the right place at the right time: novel CENP-A binding proteins shed light on centromere assembly. *Chromosoma, 118*, 567-74. ↗

Torras-Llort, M., Moreno-Moreno, O., Azorín, F. (2009). Focus on the centre: the role of chromatin on the regulation of centromere identity and function. *EMBO J, 28*, 2337-48. ↗

Foltz, DR., Jansen, LE., Bailey, AO., Yates, JR 3rd., Bassett, EA., Wood, S. et al. (2009). Centromere-specific assembly of CENP-a nucleosomes is mediated by HJURP. *Cell, 137*, 472-84. ↗

Mellone, BG., Zhang, W., Karpen, GH. (2009). Frodos found: Behold the CENP-a "Ring" bearers. *Cell, 137*, 409-12. ↗

Jansen, LE., Black, BE., Foltz, DR., Cleveland, DW. (2007). Propagation of centromeric chromatin requires exit from mitosis. *J Cell Biol, 176*, 795-805. ↗

Editions

2010-04-15	Authored, Edited	May, B.
2010-05-30	Reviewed	Dunleavy, EM., Almouzni-Pettinotti, G.
2010-06-14	Reviewed	Foltz, DR.

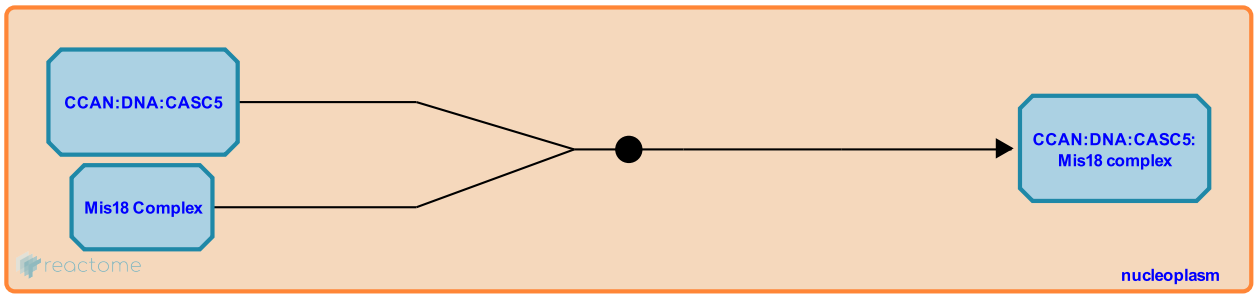
Mis18 complex binds the centromere ↗

Location: Deposition of new CENPA-containing nucleosomes at the centromere

Stable identifier: R-HSA-606349

Type: binding

Compartments: nucleoplasm



The Mis18 complex (containing Mis18-alpha, Mis18-beta, Mis18BP1, RBap46, and RbAp48) transiently binds the centromere in late anaphase-telophase to early G1. The mechanism by which the Mis18 complex binds the centromere is unknown. The Mis18 complex is required for deposition of new CENPA-containing nucleosomes at the centromere. The CENPH-I complex is constitutively associated with centromeres and is required for deposition of new CENPA-containing nucleosomes.

Followed by: HJURP:CENPA complex localizes to the centromere

Literature references

Fujita, Y., Hayashi, T., Kiyomitsu, T., Toyoda, Y., Kokubu, A., Obuse, C. et al. (2007). Priming of centromere for CENP-A recruitment by human hMis18alpha, hMis18beta, and M18BP1. *Dev Cell, 12*, 17-30. ↗

Okada, M., Cheeseman, IM., Hori, T., Okawa, K., McLeod, IX., Yates, JR 3rd. et al. (2006). The CENP-H-I complex is required for the efficient incorporation of newly synthesized CENP-A into centromeres. *Nat Cell Biol, 8*, 446-57. ↗

Maddox, PS., Hyndman, F., Monen, J., Oegema, K., Desai, A. (2007). Functional genomics identifies a Myb domain-containing protein family required for assembly of CENP-A chromatin. *J Cell Biol, 176*, 757-63. ↗

Hayashi, T., Fujita, Y., Iwasaki, O., Adachi, Y., Takahashi, K., Yanagida, M. (2004). Mis16 and Mis18 are required for CENP-A loading and histone deacetylation at centromeres. *Cell, 118*, 715-29. ↗

Editions

2010-04-15	Authored, Edited	May, B.
2010-05-30	Reviewed	Dunleavy, EM., Almouzni-Pettinotti, G.
2010-06-14	Reviewed	Foltz, DR.

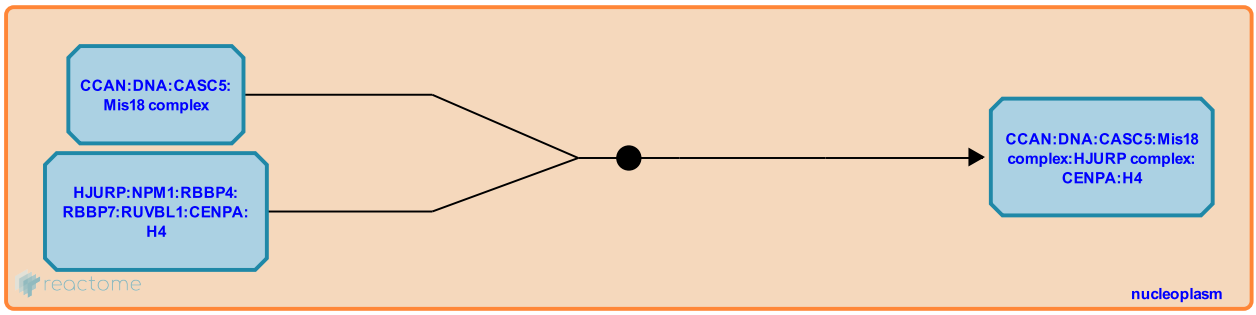
HJURP:CENPA complex localizes to the centromere ↗

Location: Deposition of new CENPA-containing nucleosomes at the centromere

Stable identifier: R-HSA-606326

Type: binding

Compartments: nucleoplasm



The HJURP complex binds free, newly synthesized CENPA-H4 tetramers. A direct interaction occurs between HJURP and CENPA. The CATD domain of CENPA is sufficient for the interaction. The complex then localizes to the centromere in early G1 phase. HJURP is required for deposition of new CENPA-containing nucleosomes.

Preceded by: Mis18 complex binds the centromere

Followed by: New CENPA-containing nucleosomes are deposited at the centromere

Literature references

Foltz, DR., Jansen, LE., Bailey, AO., Yates, JR 3rd., Bassett, EA., Wood, S. et al. (2009). Centromere-specific assembly of CENP-a nucleosomes is mediated by HJURP. *Cell, 137*, 472-84. ↗

Shuaib, M., Ouararhni, K., Dimitrov, S., Hamiche, A. (2010). HJURP binds CENP-A via a highly conserved N-terminal domain and mediates its deposition at centromeres. *Proc Natl Acad Sci U S A, 107*, 1349-54. ↗

Dunleavy, EM., Roche, D., Tagami, H., Lacoste, N., Ray-Gallet, D., Nakamura, Y. et al. (2009). HJURP is a cell-cycle-dependent maintenance and deposition factor of CENP-A at centromeres. *Cell, 137*, 485-97. ↗

Fujita, Y., Hayashi, T., Kiyomitsu, T., Toyoda, Y., Kokubu, A., Obuse, C. et al. (2007). Priming of centromere for CENP-A recruitment by human hMis18alpha, hMis18beta, and M18BP1. *Dev Cell, 12*, 17-30. ↗

Barnhart, MC., Kuich, PH., Stellfox, ME., Ward, JA., Bassett, EA., Black, BE. et al. (2011). HJURP is a CENP-A chromatin assembly factor sufficient to form a functional de novo kinetochore. *J. Cell Biol., 194*, 229-43. ↗

Editions

2010-04-15	Authored, Edited	May, B.
2010-05-30	Reviewed	Dunleavy, EM., Almouzni-Pettinotti, G.
2010-06-14	Reviewed	Foltz, DR.

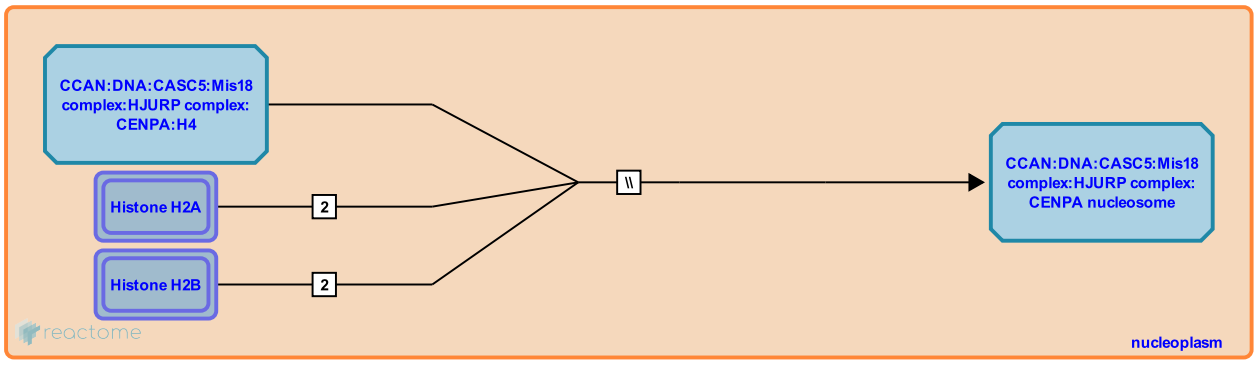
New CENPA-containing nucleosomes are deposited at the centromere ↗

Location: Deposition of new CENPA-containing nucleosomes at the centromere

Stable identifier: R-HSA-606289

Type: omitted

Compartments: nucleoplasm



A new centromeric nucleosome containing histone H2A, histone H2B, histone H4, and CENPA is deposited at the centromere in late telophase/early G1 phase. The exact mechanism by which the new CENPA-containing nucleosome is transferred to DNA is unknown. HJURP directly binds newly synthesized CENPA before deposition. The Mis18 and HJURP complexes are required for deposition of newly synthesized CENPA-containing nucleosomes. The exact stoichiometries and interactions of the complexes are unknown.

Preceded by: HJURP:CENPA complex localizes to the centromere

Followed by: RSF complex binds the centromere

Literature references

Perpelescu, M., Nozaki, N., Obuse, C., Yang, H., Yoda, K. (2009). Active establishment of centromeric CENP-A chromatin by RSF complex. *J Cell Biol, 185*, 397-407. ↗

Foltz, DR., Jansen, LE., Bailey, AO., Yates, JR 3rd., Bassett, EA., Wood, S. et al. (2009). Centromere-specific assembly of CENP-a nucleosomes is mediated by HJURP. *Cell, 137*, 472-84. ↗

Shuaib, M., Ouararhni, K., Dimitrov, S., Hamiche, A. (2010). HJURP binds CENP-A via a highly conserved N-terminal domain and mediates its deposition at centromeres. *Proc Natl Acad Sci U S A, 107*, 1349-54. ↗

Dunleavy, EM., Roche, D., Tagami, H., Lacoste, N., Ray-Gallet, D., Nakamura, Y. et al. (2009). HJURP is a cell-cycle-dependent maintenance and deposition factor of CENP-A at centromeres. *Cell, 137*, 485-97. ↗

Fujita, Y., Hayashi, T., Kiyomitsu, T., Toyoda, Y., Kokubu, A., Obuse, C. et al. (2007). Priming of centromere for CENP-A recruitment by human hMis18alpha, hMis18beta, and M18BP1. *Dev Cell, 12*, 17-30. ↗

Editions

2010-04-15	Authored, Edited	May, B.
2010-05-30	Reviewed	Dunleavy, EM., Almouzni-Pettinotti, G.
2010-06-14	Reviewed	Foltz, DR.

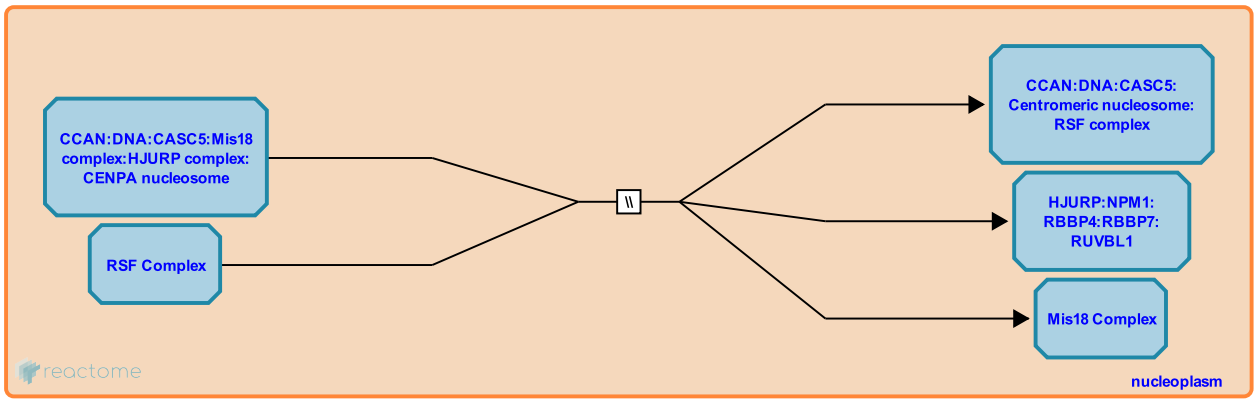
RSF complex binds the centromere ↗

Location: Deposition of new CENPA-containing nucleosomes at the centromere

Stable identifier: R-HSA-606287

Type: omitted

Compartments: nucleoplasm



The RSF complex binds the centromere in mid-G1 phase after deposition of new CENPA-containing nucleosomes has occurred. The RSF complex is required for stable incorporation of the previously deposited CENPA-containing nucleosomes.

Preceded by: New CENPA-containing nucleosomes are deposited at the centromere

Literature references

Perpelescu, M., Nozaki, N., Obuse, C., Yang, H., Yoda, K. (2009). Active establishment of centromeric CENP-A chromatin by RSF complex. *J Cell Biol, 185*, 397-407. ↗

Editions

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2010-05-30	Reviewed	Dunleavy, EM., Almouzni-Pettinotti, G.
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