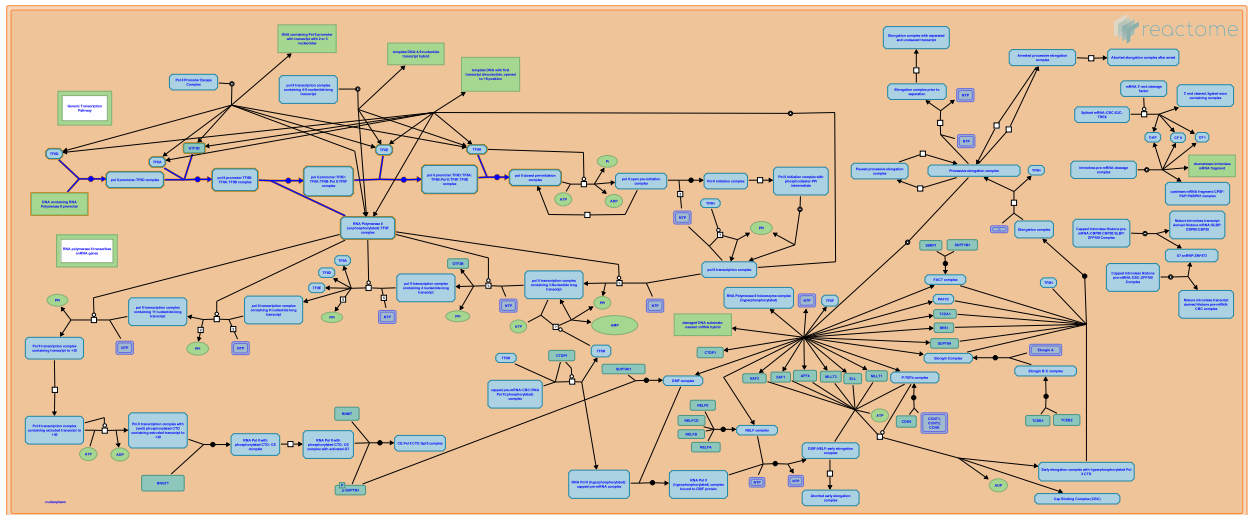


RNA Polymerase II Transcription Pre-Initiation And Promoter Opening



Joshi-Tope, G., Reinberg, D.

European Bioinformatics Institute, New York University Langone Medical Center, Ontario Institute for Cancer Research, Oregon Health and Science University.

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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. [↗](#)
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- 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. [↗](#)

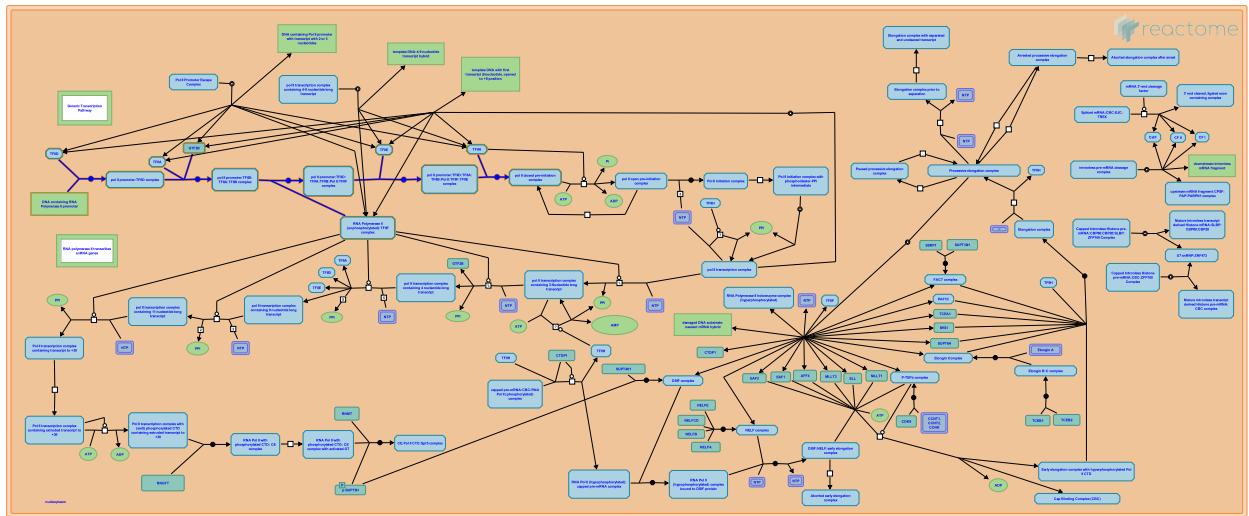
Reactome database release: 75

This document contains 1 pathway and 5 reactions ([see Table of Contents](#))

RNA Polymerase II Transcription Pre-Initiation And Promoter Opening ↗

Stable identifier: R-HSA-73779

Compartments: nucleoplasm



Formation of the pre-initiation complex proceeds in five steps, recognition and binding of core promoter elements by TFIID, binding of TFIIA and TFIIB to the pol II promoter:TFIID complex, recruitment of RNA Polymerase II Holoenzyme by TFIIF to the pol II promoter:TFIID:TFIIA:TFIIB complex, binding of TFIIE to the growing preinitiation complex, and formation of the closed pre-initiation complex (Orphanides et al. 1997).

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

Editions

2003-09-11	Authored	Reinberg, D.
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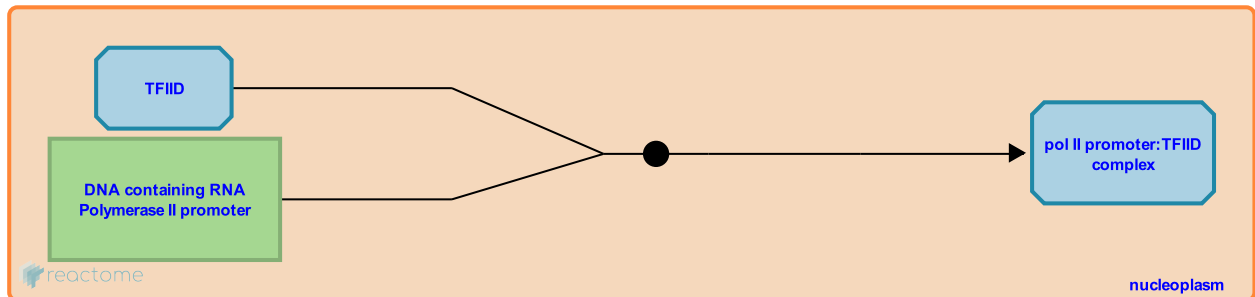
Recognition and Binding of Core Promoter Elements by TFIID ↗

Location: [RNA Polymerase II Transcription Pre-Initiation And Promoter Opening](#)

Stable identifier: R-HSA-109636

Type: binding

Compartments: nucleoplasm



Although TBP (TATA box binding factor) is necessary and sufficient for initiation of basal transcription, the other subunits of the general transcription factor TFIID, the TBP-associated factors, are required for response to transcriptional activators. TBP binds to the TATA box (a core promoter element), and bends the DNA 80 degrees toward the major groove. This conformation of TBP-TATA box provides the proper topology for the binding of the general transcription factor TFIIB.

Transcriptional activators function by affecting the kinetics of binding of TBP to the promoter DNA.

Followed by: [Binding of TFIIA and TFIIB to the pol II promoter:TFIID complex](#)

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

Hernandez, N. (1993). TBP, a universal eukaryotic transcription factor?. *Genes Dev*, 7, 1291-308. ↗

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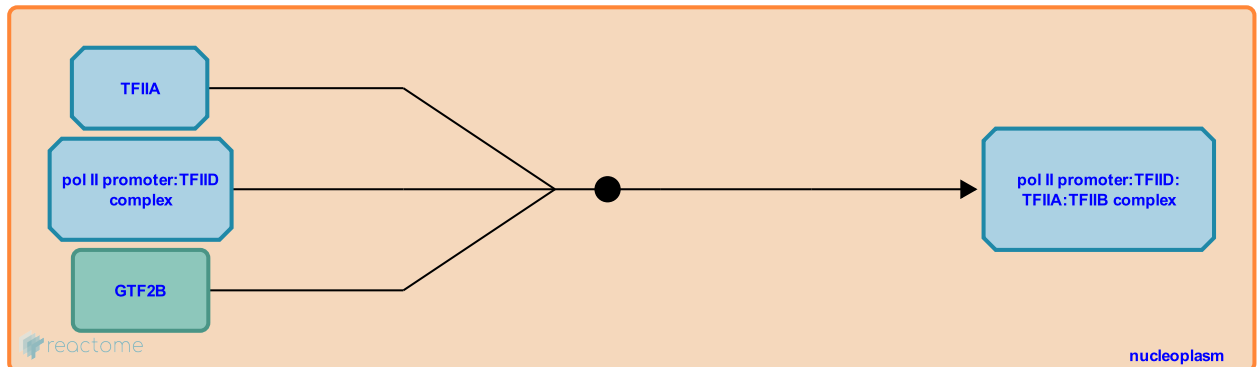
Binding of TFIIA and TFIIB to the pol II promoter:TFIID complex ↗

Location: [RNA Polymerase II Transcription Pre-Initiation And Promoter Opening](#)

Stable identifier: R-HSA-109637

Type: binding

Compartments: nucleoplasm



The general transcription factor TFIIB is a single polypeptide of approximately 35 kDa. There is a Zn-binding domain near the N terminus of TFIIB, and the C-terminal domain encompasses two imperfect repeats; between the N and C termini is a phylogenetically conserved region. The C terminus interacts with TBP and RNA Polymerase II, whereas the N terminus interacts with factor TFIIF and RNA polymerase II. TFIIB is a sequence-specific factor, and it interacts with the BRE element within the promoter.

TFIIB interacts with the Rpb1 subunit of RNA polymerase II to define transcription start sites. Several activators directly bind TFIIB, and stimulate transcription. The N-terminus and the C-terminus can participate in intramolecular interactions, and this can be disrupted by specific activators by causing a conformational change in TFIIB.

TFIIA also binds the preinitiation complex along with TFIIB. However, TFIIA is not required for accurate initiation, but rather functions as a coactivator of transcription.

Preceded by: [Recognition and Binding of Core Promoter Elements by TFIID](#)

Followed by: [Recruitment of RNA Polymerase II Holoenzyme by TFIIF to the pol II promoter:TFIID:TFIIA:TFIIB complex](#)

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

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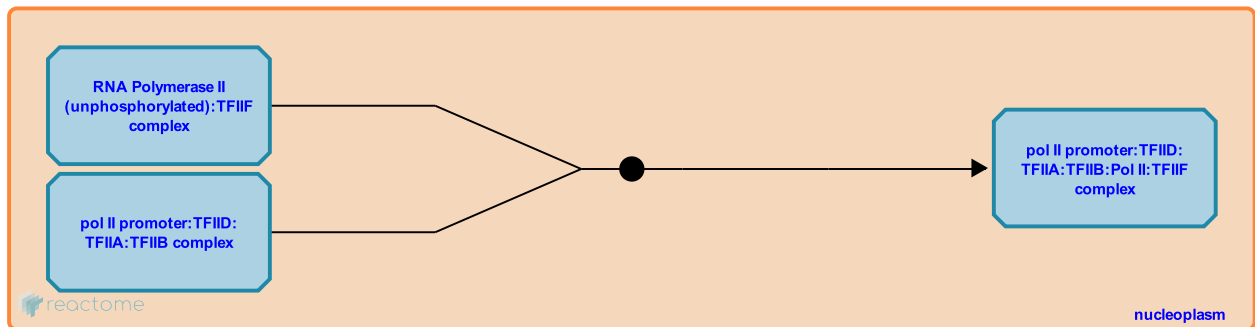
Recruitment of RNA Polymerase II Holoenzyme by TFIIF to the pol II promoter:TFIID:TFIIA:TFIIB complex ↗

Location: [RNA Polymerase II Transcription Pre-Initiation And Promoter Opening](#)

Stable identifier: R-HSA-109638

Type: binding

Compartments: nucleoplasm



The general transcription factor TFIIF has a high affinity for the RNA Polymerase II holoenzyme. TFIIF stabilizes the preinitiation complex, and suppresses non-specific binding of RNA Pol II to DNA, and is thus critical for start site recognition.

Preceded by: [Binding of TFIIA and TFIIB to the pol II promoter:TFIID complex](#)

Followed by: [Binding of TFIIE to the growing preinitiation complex](#)

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

Editions

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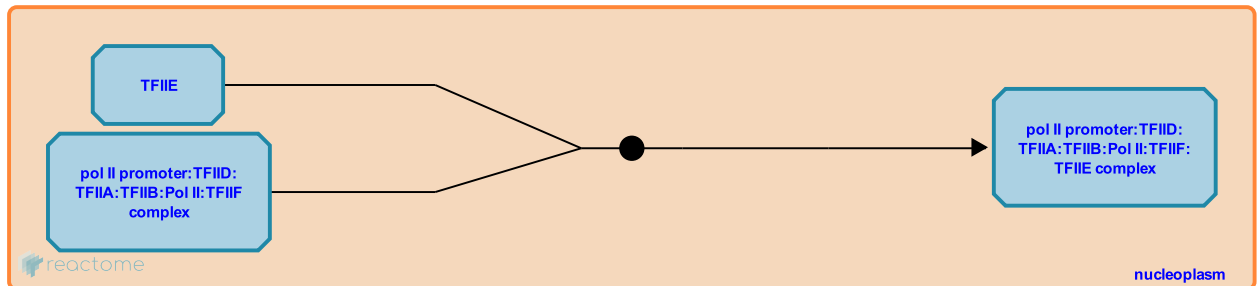
Binding of TFIIE to the growing preinitiation complex ↗

Location: RNA Polymerase II Transcription Pre-Initiation And Promoter Opening

Stable identifier: R-HSA-75095

Type: binding

Compartments: nucleoplasm



Factor TFIIE enters the preinitiation complex after TFIIF recruits RNA Polymerase II. TFIIE is composed of two subunits of 56 kDa and 34 kDa. TFIIE facilitates the recruitment of factor TFIIF to the preinitiation complex, and it also stimulates the phosphorylation of the RNA Polymerase II CTD by TFIIF.

Preceded by: Recruitment of RNA Polymerase II Holoenzyme by TFIIF to the pol II promoter:TFIID:TFIIA:TFIIB complex

Followed by: Formation of the closed pre-initiation complex

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

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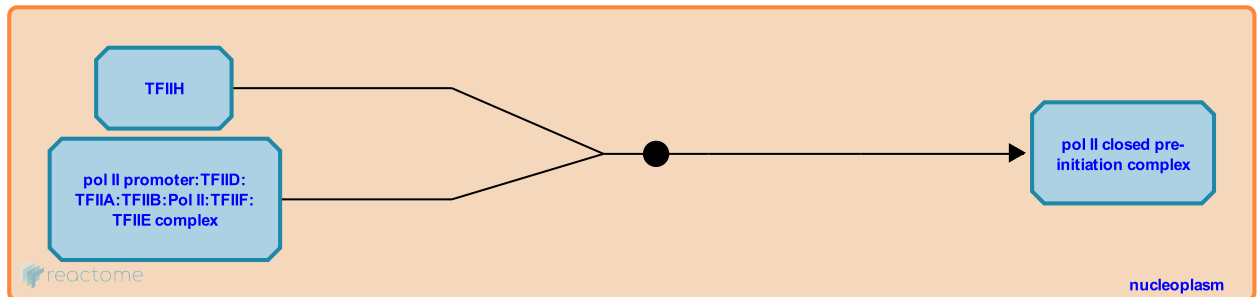
Formation of the closed pre-initiation complex ↗

Location: [RNA Polymerase II Transcription Pre-Initiation And Promoter Opening](#)

Stable identifier: R-HSA-109639

Type: binding

Compartments: nucleoplasm



The binding of TFIH completes the assembly of the preinitiation complex (PIC) for RNA Polymerase II transcription. Although RNA polymerase binds the TATA box on the promoter DNA, no initiation of transcription occurs until TFIH is bound to the PIC. TFIH is the only factor with known enzymatic activities.

Preceded by: [Binding of TFIIE to the growing preinitiation complex](#)

Literature references

Orphanides, G., Lagrange, T., Reinberg, D. (1997). The general transcription factors of RNA polymerase II. *Genes Dev*, 10, 2657-83. ↗

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